PROLINE-CE

WORKPACKAGE T1, ACTIVITY T1.1

PEER REVIEW OF LAND USE AND WATER MANAGEMENT PRACTICES

D.T1.1.1 Country Reports About the Implementation of Sustainable Land Use in Drinking Water Recharge Areas

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

Hungary is a lowland country, situated in the Carpathian Basin in the heart of Europe. Its terrain is relatively unvaried, 68 % of its area is below 200 m altitude, 30 % is covered by hills (200-400 m), and only 2 % exceeds 400 m. The highest peak of Hungary is the Kékes (1014 m). The entire area of the country (93 000 km^2) belongs to the Danube catchment.

The climate of Hungary – determined mainly by its geographic location – is continental, with Atlantic and Mediterranean influences. The mean temperature is 8-11 °C, with large yearly variation (20-25 °C). The yearly precipitation is 500-900 mm, the lowest values are measured in the Great Plains, while the highest in Western Hungary. Primary wet periods are in early summer (May-June) and in the autumn (October-November). Snow coverage is 30-80 days, depending on the altitude. The natural water balance of Hungary is positive, the total precipitation is 55707 million m^3, while the evapotranspiration is 48 174 million m^3. As a result of climate change, yearly mean temperature is expected to rise, the yearly precipitation pattern to change (and the total yearly amount to decrease) and the frequency of extreme weather events is likely to increase. This might lead to increased frequency of floods and inland water accumulation. The trend of a more variable precipitation pattern is already visible, 2010 was the most humid and 2011 the driest year since 1901, and 2011, 2012 and 2013 were all significantly hotter than average. Climate change is likely to affect the availability and quality of water in Hungary, and the climate is expected to shift towards a Mediterranean climate. Droughts are already prevalent, especially in the Great Plains area.

Majority of the land, 5.3 million hectares (from the overall 7.4 million hectares of agricultural areas) were permanently used for agricultural production, mostly as cropland (58.7 %) or pastures (7.4 %). The overall proportion of vegetable gardens, fruit trees and vineyards is approximately 3.5 %. Forests account for 26 % of cultivated lands, reed and fishfarms 1.4 %. For the period 2000-2012, the overall area of arable lands, fruit trees, vineyards, forests and wetlands shows a decreasing trend, while the overall area of meadows, pastures, complex agricultural cultivations is increasing. The ratio of developed (communal, industrial) lands is 6 % nationally, and increasing, especially in Central-Hungary (the Danube sub-catchment).

Pollution of groundwater (and also surface water) through nitrate loads and excesses of pesticides occur mainly within intensively used agricultural areas and regions with less precipitation. Further impacts to groundwater bodies can come from industrial activites and mining.

Forests are key elements of hydrology, influencing precipitation runoff and drainage. Potential problems within Drinking Water Protections Zones (DWPZ) can occur through protection of the DWPAs as nature protection area: some of the tree species are not acceptable for the point of view of nature reservation (e.g. invasive species) but they are convenient as protective forest regarding to water protection.

2. Water supply resources, protection and management policy on national and regional level

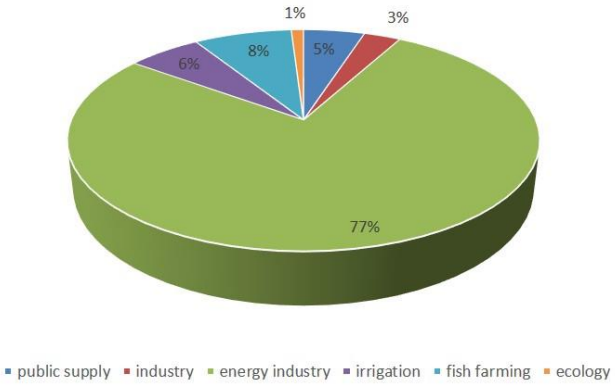
2.1 Water management

- Which water resources (groundwater, surface water-lakes, reservoirs…) are used for water supply and in which rate?

Hungary is located on the Danube watershed in the Carpathian basin, which is one of the most closed basins of the world. This geographical feature has especially important effects on surface waters and our groundwater resources.

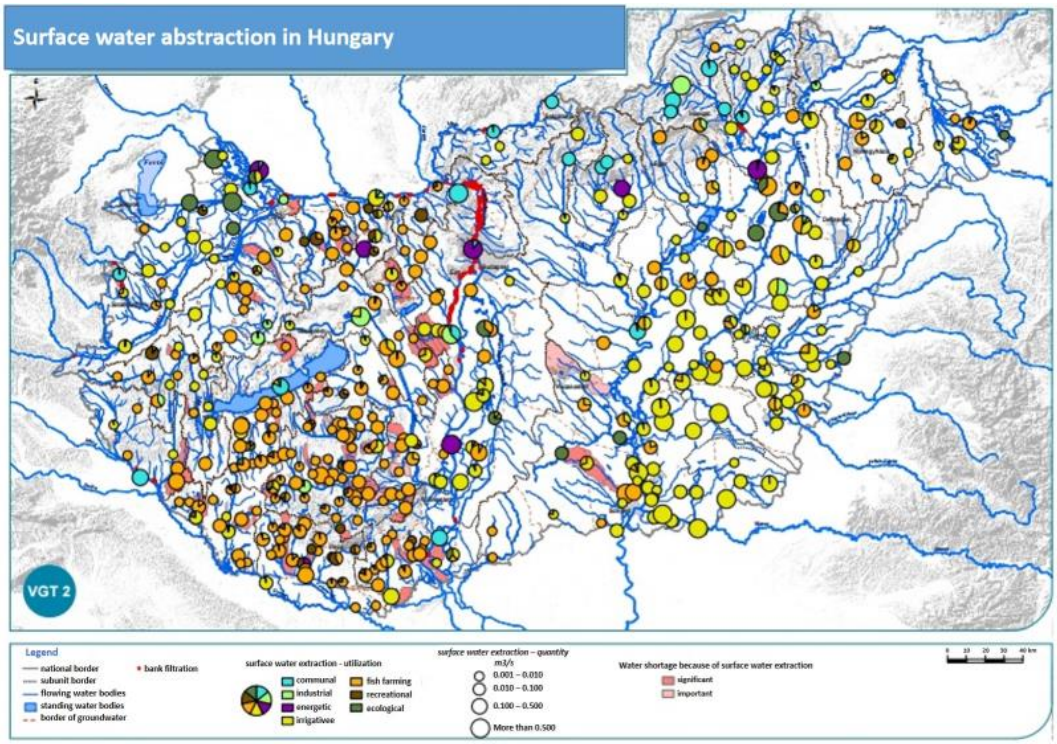
The major user of surface water is energy industry (77%), and especially the atomic power industry, though only for cooling purposes. Water demand of public use, irrigation and fish farming is also significant. Water usage for irrigation is the most demanding because plants completely use or evaporate the received water.

Distribution of surface water use among the different sectors (2013)



Amount of abstracted surface water of the main users in 2013:

Water abstraction	Annual quantity [million m^3]
Communal	247
Industrial	124
Energy	3535
Irrigation	242
Fishery	308
Recreational	3
Ecological	38
Total:	**4636**



Hungary – due to its location and unique geology – is rich in groundwater. The average depth of shallow groundwater is 2-5 m (extremes 0-16 m) depending on the precipitation. Shallow groundwater is vulnerable to surface contamination and usually not suitable for consumption. Bank filtration, on the other hand, is one of the main sources of drinking water. Deep groundwater is less vulnerable to contamination, but its recharge is much slower. Abstraction is mainly used for drinking water, though in several areas naturally occurring chemicals (e.g. arsenic, iron or manganese) hinder the use without treatment. Karstic waters also contribute significantly to drinking water production.

Overall, approximately 95 % of drinking water in Hungary is from groundwater source (including bank filtration). However, almost 2/3 of the sources is vulnerable. The geothermic gradient in Hungary is higher than average, resulting in the abundance of thermal (often 70-90 °C) waters. Thermal waters are used for recreational and therapeutic purposes.

Direct groundwater abstractions (2008-2013, annual average in 1000 m^3/a), source: VGT2:

Type of water body	communal	industrial	energetics	mining	irrigation	other agricultural	spa, medicinal	other	without permission	**total**
bank filtration (surface water)	223473	5805	290	0	88	1	350	618	0	**230626**
springs (surface water)	40202	0	0	0	0	0	0	0	0	**40202**

Type of water body	communal	industrial	energetics	mining	irrigation	other agricultural	spa, medicinal	other	without permission	total
karst	55740	4232	63	5946	134	353	1215	391	0	**68074**
thermal karst	4695	178	1058	0	37	51	15701	576	0	**22295**
shallow mountainous (mixed)	6719	1430	47	15	175	300	222	413	7314	**16636**
mountainous (mixed)	10550	937	0	3376	198	391	1273	411	14	**17150**
shallow porous	52853	4921	290	5411	7788	2448	1080	4240	68223	**147255**
porous	312236	26219	1013	15970	5901	23904	8935	9944	22113	**426233**
porous thermal	10770	408	11733	0	47	1153	25578	602	0	**50292**
Water extraction without bank filtration and springs	453563	38324	14204	30718	14281	28600	54004	16576	97664	**747935**
Total water extraction	**717238**	**44130**	**14494**	**30718**	**14369**	**28601**	**54354**	**17194**	**97664**	**1018763**

In Hungary, 19 surface water resources and nearly 2.000 groundwater resources service drinking water; 95 per cent of Hungary's drinking water is gained from groundwater resources. All surface water resources and the half of the groundwater resources are vulnerable. 5 of the 19 drinking water resources supply from rivers directly, 5 established for the purpose of drinking water supply dam reservoir, and further 7 supply from the Lake Balaton.

In Hungary, there are more than 70 perspective drinking water resources, which are all groundwater resources.

Bank-filtered drinking water resources: 51 waterworks and 41 perspective water resources, 28% and 25% of all drinking water resources; Karstic drinking water resources: 155 waterworks, 8% of all drinking water resources; Groundwater resources: 1453 waterworks and 14 perspective water resources, 21% and 4% of all drinking water resources; Shallow groundwater resources: 200 waterworks and 19 perspective water resources, 5% and 9% of all drinking water resources.

In terms of total groundwater absraction from GWBs: bank-filtered 26%, karst: 8%, karst thermal: 3%, shallow mountainous: 1%, mountainous: 2%, shallow porous: 9%, porous: 45%, porous thermal: 45%.

- For which purpose is this water used?

Groundwater: drinking water, industry, energy , mining, irrigation, other agriculture, bath, other, illegal , reinjection

Surface water: energy, fisheries, drinking water, irrigation, agriculture, industry, recreation, ecology

- Who control and manage water policy?

Water policy is the responsibility of the Ministry of Interior. General Directorate of Water Management and 12 water management directorates are responsible for water management.

- Who control and manage drinking water policy?

See above

- The legal and administrative organization of water policy?

The Ministry of Interior is responsible for the legal and administrative organization of water policy.

- The legal and administrative organization of drinking water policy?

See above

- Who manage and coordinate implementation of state policy in scope of water?

Ministry of Interior, Ministry of National Resources, Ministry of National Development

- Please provide a list of legislation related to water management, their protection and management of floods/droughts (land use legislation/polices, Water management legislation/policies, groundwater and surface water management plans and other legislation)

Acts:
- Act LVII of 1995 on water management
- Act LIII of 1995 on protection of environment
- Act LIII of 1996 on protection of nature
- Act CCIX of 2011 on water utility supply

Government Regulations:
- Government Regulation 221/2004. (VII.21.) on regulations of river basin management
- Government Regulation 220/2004. (VII.21.) on protection of the quality of surface water
- Government Regulation 219/2004. (VII.21.) on protection of groundwaters
- Government Regulation 178/1998. (XI.6.) on base data related to water management tasks
- Government Regulation 123/1997. (VII.18.) on the protection of the actual and potential sources, and the engineering structures of drinking water supply
- Government Regulation 201/2001. (X.25.) on drinking water quality and controlling
- Government Regulation 78/2008. (IV.3.) on requirements of quality, designation and operation of the natural bathing waters
- Government Regulation 27/2006. (II.7.) on protection of water against agricultural nitrate pollution
- Government Regulation 58/2013. (II.27.) on the implementation of Act CCIX of 2011 on water utility services
- Government Regulation 541/2013. (XII.30.) on designation and protection of critical water management systems and infrastructure
- Government Regulation 240/2000. (XII.23.) on identification of catchment areas of nutrient sensitive areas under urban waste water treatment directive
- Government Regulation 147/2010. (IV.29.) on general regulations according to activities and facilities of use, protection and elimination of damages of water
- Government Regulation 232/1996. (XII.26.) on protection against damages caused by water

- Government Regulation 83/2014 (III.24.) on the preparation and the issues of the Flood Riverbed Management Plans
- Government Decision 2052/2002. (II.27.) on Action Programme of Drinking Water Protection
- Government Decision 1155/2016. (III.31.) on acception of the updated, 2015. River Basin Management Plan of Hungary
- Government Decision 1146/2016. (III.25.) on acception of the Flood Risk Management Plan of Hungary

Ministry Regulations:
KvVM Ministry Regulation 31/2004. (XII.30.) on monitoring and status assessment of surface waters
KvVM Ministry Regulation 30/2004. (XII.30.) on the inspection (designation of water bodies, status assessment and monitoring) of groundwaters
KvVM Ministry Regulation 6/2002. (XI.5.) on the quality required of surface freshwater to abstract for drinking water purposes and to support fish life and their monitoring
KvVM Ministry Regulation 18/2007. (V.10.) on the data service of the environmental registration system (FAVI) of the groundwater and geological formation
KvVM Ministry Regulation 28/2004. (XII.25.) on the emission limits of water pollutants
KHVM Ministry Regulation 23/1998. (XI.6.) on water management registration of the water administrative institutions
KvVM-EüM-FVM Ministry Regulation 6/2009. (IV.14.) on limits necessary to protect the geological formation and groundwater against pollution, measuring the pollutions
VM Ministry Regulation 10/2010. (VIII.18.) on contamination limits of surface water
BM Ministry Regulation 45/2014. (IX.23.) on tasks of hydrography
KHVM Ministry Regulation 47/1999. (XII.28.) on the charges of the state-owned water utility services
BM Ministry Regulation 8/2014. (I.31.) on the subsidisation of public users fees of water utilities and compensation of temporary solutions for healthy drinking water supply
KvVM Ministry Regulation 30/2008. (XII.31.) on technical regulations according to activities and facilities of use, protection and elimination of damages of water
BM Ministry Regulation 16/2016. (V. 12.) on the public water works and the public wastewater treatment plants during the operation about the water management and water protection requirements, types of analyses and the data services

2.2 Drinking water protection zones

- Which are criteria for determining water protection zones?

Government Regulation 123/1997. (VII.18.) on the protection of the actual and potential sources, and the engineering structures of drinking water supply defines the criteria of water protection zones.

The scope of this regulation extends to the sources of water serving the supply of drinking water, mineral- and medicinal water development, regardless whether actually exploited, committed or designated for future use, further to the facilities which serve the treatment, storage and distribution of water for such uses, and which supply water to at least 50 persons on a daily average.
Protection is understood to mean the determination, designation, establishment and maintenance of a protective block or area or zone. Protection is realised by the implementation of part, or all of the safety measures. The boundaries of the protective zones shall be determined by observing the particular hydrological and hydrogeological conditions considering the permitted rate of abstraction or in the case of future sources of supply the full capacity of the aquifer(s).
The protective measures set forth in the regulation serve the following purposes:
a) The inner protective block, zone: protection of the abstraction works and the water supplies from direct pollution and damage,
b) The outer protective block, zone: protection against refractory, further bacterial and other decomposable pollutants,
c) The hydrology or hydrogeological block, zone: Protection against refractory pollutants by measures prescribed for the entire, or part of the catchment (recharge) area of the abstraction.
The hydrogeological protective block or area is subdivided to "A", "B" and "C" protective zones.
The delineation of the protection zones is based on the estimation of the travel time, assuming steady seepage flow.

Dimensioning the protective blocks, protective areas of groundwater sources of supply in terms of the travel:

Type of protection	Design yield		Travel time	Delineation on the surface of the protective area
	Operated source	Future source		
Inner zone	Daily peak	-	20 days	Surface projection of block, minimum 10 m from the abstractions
Outer zone	Monthly peak	-	6 months	Surface projection of block, minimum 100 m from the abstractions (No protective area in the absence of surface projection)
Hydrogeological zone "A"	Annual mean	Annual mean	5 years	Surface projection of block
Hydrogeological zone "B"	Annual mean	Annual mean	50 years	Surface projection of block
Hydrogeological zone "C"	Annual mean	Annual mean	catchment	Surface projection of recharge block

Dimensioning the protective area of surface sources of supply:

Protective area	Lakes and reservoirs		Rivers and other streams	
	Smaller than 10 ha, or less than 60 days retention time	Larger than 10 ha, or over 60 days retention time	$Q^{95} < 50\ m^3/s$	$Q^{95} \geq 50\ m^3/s$
Inner zone - on water surface	Full water surface	Circle of 100 m radius about the intake	200 m upstream and 20 m downstream of the intake (the downstream distance is 50 m on sections with flow velocity less than 0.5 m/s, disturbed, or backflow) 50 m on each side of the intake	
Inner zone - on bank side	50 m wide strip on full HHW along bank	If the intake is farther than 100 m from the LLW along bank: none If the intake is closer: a 20 m wide strip along the bank section intersected by the circle	For intakes less than 50 m from the LLW along bank: 20 m wide strip beyond the HHW along bank	
Outer zone - on water surface	-	For less than 120 days retention time the entire water surface, otherwise the part beyond the inner zone of a 200 m radius circle about the intake	5 km upstream of the intake	2 km upstream of the intake
Outer zone - on land	50 m wide strip on full along bank beyond the inner zone	For less than 120 days retention time as for less than 10 ha size, otherwise a 50 m wide strip along the HHW along bank section intersected by the 200 m radius circle, or a 100 m wide strip beyond the inner zone	From the HHW along bank 200 m wide up to 1 km, 100 m wide up to 2 km upstream of the intake.	From the HHW along bank 200 m wide up to 0.5 km.
Hydrologic	For less than 120 days retention time the entire catchment		Not covered by the present order	Not covered by the present order

➢ What limitations and restrictions have been declared within the water protection zones?

The most stringent restrictions are in the inner zone, for example: The inner zone shall be fenced or guarded in another effective manner. The owner of the inner zone shall be the same as that of the water facilities. Regular access shall be permitted to the personnel of the operator of the water facility, who perform work there and who possess a "health book" demonstrating the regular medical checks provided for in another act of legislation. Entry shall be authorised further to superiors of the personnel and representatives of the supervisory authority, further to persons authorised specifically (e.g. for the period of performing work) by the owner of the protective area. The person authorising entry shall be responsible for preventing those staying temporarily in the protective area from causing pollution.

In the protection zones depending on in which zone, several activities are prohibited, or prohibited for new facilities and activities, or may be allowed pending on the outcome of an environmental audit or environmental impact assessment. Other activities are allowed if they

operates without pollution or new facilities and activities can let pending on the outcome of an EIA, or environmental audit, or an equivalent investigation. Some activities are not restricted at all or in the hydrological or hydrogeological zones.

	Surface and subsurface supplies		Subsurface supplies, hydrogeological	
	inner	outer	A	B
	protective zones			
Residential, recreation development				
Housing colony, real-estate development for recreation	-	-	-	o
Residential- or office building with sewerage	-	x	+	+
Residential buildings without sewerage	-	-	x	o
Sewer crossing the area	-	x	o	o
Sewage treatment plant	-	-	o	+
Domestic sewage seepage pit	-	-	o	o
Construction and operation of communal liquid wastes disposal facility	-	-	-	o
Communal solid (non-hazardous) wastes landfill	-	-	-	o
Building rubble deposit	-	-	o	x
Cemetery	-	-	x	+
Hobby gardens	-	-	o	o
Camping, bathing	-	x	+	+
Sports ground	-	x	+	+
Industry				
Production, processing of highly toxic or radioactive materials, storage, disposal thereof	-	-	-	-
Production, processing, storage of toxic materials	-	-	-	o
Plants using no toxic materials, with appropriate sewerage	-	x	o	+
Production, transport in pipelines, processing and storage of petroleum and such products	-	-	x	o
Hazardous wastes disposal facility	-	-	-	x
Hazardous wastes landfill	-	-	-	-
On-site collection of hazardous wastes	-	-	x	o
Seepage disposal and storage of food industry effluents	-	-	-	o
Seepage disposal of other industrial waste waters	-	-	-	-
Landfilling with slag and ash	-	-	o	o
Agriculture				
Forest planting and management without chemicals	-	+	+	+
Crop farming[1]	-	o	o	o
Composting facility	-	-	x	o
Animal farming beyond the home demand level	-	-	x	o
Grazing, keeping domestic animals	-	o	o	+
Manure application[1]	-	o	o	+
Fertiliser application[1]	-	o	o	o
Application of dissolved fertiliser and liquid manure	-	-	-	o
Release of liquid manure	-	-	-	-

[1] In particular investigations the provisions of the directive 91/676 EEC on pollution control against nitrate from agriculture should be applied

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	Surface and subsurface supplies		Subsurface supplies, hydrogeological	
	inner	outer	A	B
	protective zones			
Sewage irrigation[1]	-	-	-	o
Irrigation with sewage treatment plant effluent[1]	-	-	o	+
Pesticide application[1]	-	o	o	o
Pesticide application from aircraft[1]	-	-	-	o
Pesticide storage and residues disposal	-	-	-	x
Washing pesticide equipment, effluent disposal	-	-	-	o
Manure- and fertiliser storage	-	-	x	o
Sewage sludge storage	-	-	x	o
Farmland disposal of sewage sludge[1]	-	-	x	o
Burying carcasses, construction and operation of carcass wells	-	-	-	o
Fish farming, feeding	-	-	o	o
Transportation				
Motorway, highway, sealed storm drain	-	x	o	+
Other road with sealed storm drain	-	x	+	+
other road	-	-	x	+
Railway	-	-	o	+
Vehicle parking area	-	-	o	+
Fuel filling station	-	-	x	o
Washing, repair shop, de-icing salt storage	-	-	o	+
Other activities				
Mining	-	-	x	o
Drilling, sinking new well	-	o	o	o
Other activities affecting the cover, or the aquifer	-	-	o	o

- Who control and manage legal acts for determination of drinking water protection zones?

Water Authorities of Government Offices. Compliance with the provisions, obligations and use restrictions on designated and established protective blocks, protective areas and zones set forth in the present order and in the authority decision shall be monitored regularly by the water authority, the special authorities involved in the procedure and the operator (permit holder) of the water works.

- What is the procedure of drinking water protection zones implementation?

Government Regulation 123/1997. (VII.18.) on the protection of the actual and potential sources, and the engineering structures of drinking water supply defines the procedure of implementation of water protection zones.

The dimensions of the protective block, zone of a particular subsurface source of supply shall be estimated in terms of the travel time, assuming steady seepage flow, starting from the point of abstraction. The period of seepage flow between the terrain and the surface as the saturated zone shall be neglected in the computations.

The protective block, area determined by computation or an engineering guess shall be delineated as follows:

a) In the case of a protective block the horizontal projection of the three dimensional blocks, the distance (in metre units) of the points closest to, and farthest from, the surface shall be specified.
b) The boundaries of a protective area shall be traced relative to topographic contours, natural and/or artificial terrain features, or relative to data (lines) shown on the land register maps - on the enlargements thereof if necessary - so that these shall include the block, area determined by computation.
c) The area including the protective areas of several water facilities (intake works) shall be delineated as the common protective area thereof as a possibly simple shape.

The protective block, area or zone around the source of supply, or water facility protected, or to be protected is designated in compliance with the provisions of the present order by the water authority empowered to permit the execution of the particular water use, observing the general rules of state administration and the procedure laid down in a separate act of legislation.

In the course of the water authority procedure on designation, establishment and maintenance related to an operating abstraction (exploited source of supply), the documents submitted in compliance with a separate act of legislation2 are used to lay down
a) the identification of the source of supply, water facility, abstraction, further the creation of protective blocks, areas,
b) the identification of the abstraction works placed under protection, indicating their water management purpose, location, number of the establishment and operation permits, the screen section depths and the water volume(s) permitted,
c) the water resources placed under protection, identification of the geological formations containing them, listing and describing concisely the parameters relevant to protection,
d) the boundaries of the protective blocks, areas, indicating also the projections on the surface of not outcropping protective blocks larger than the protective area, cartographic illustration of the properties involved in the protective area, showing and indicating the land use classification and actual use of the various properties, the sources of pollution and any interference affecting the water resources,
e) the land use restrictions imposed in the protective areas, the list of the measures prescribed together with the dates set for compliance and references to the professional grounds stated by the competent authorities, the list of activities for each protective block, area that are

ea.) prohibited or

eb) allowed under certain conditions, with restrictions, inspections, specifying the particular provisions on restriction, inspection in the official permit, or

ec) allowed under certain conditions (restrictions, inspection) without an official permit,

f) the introduction of any other administration procedure related to the establishment and maintenance of protective areas (e.g. prohibition of building, property development, etc.), stating the grounds of the procedure,
g) the prescriptions on the layout and operation of the observation network to be established (operated) in the protective area by the permit holder and around the sources of pollution by the

user of the environment, further the obligations on the easements needed to performing these functions,
h) the list of measurement, data collection, data reporting and state assessment obligations relating to the water facilities in the protective areas,
i) the prescriptions on fencing, signposting, guarding the protective areas,
j) the list of the obligations of the permit holder on the care and maintenance of the protective area,
k) the list of obligations on the printing and dissemination of public information material, further on the relations with the land users serving the safety of the protected areas,
l) the date of the next revision of the protective blocks, areas, listing also the events upon the occurrence of which a revision of the statement must be initiated.

As provided for in paragraph (4), item d), detailed lists shall be drawn up by protective areas of the inner, outer and hydrogeological "A" protective zones and zones, showing the classification of the various properties by land use, the actual land use, all facilities and activities relevant to the protective measures which may have a bearing on the state of the water resources, the level of protection of the supplies, further the name and postal address of the owners, or persons using the property under another title.

In the hydrogeological "B" zones the provisions set forth in paragraph (5(shall apply to the properties, on which an actual engineering measure, or change of land use is necessary.

Up to the definite designation of a protective block, protective area, the water authorities shall observe the provisions set forth in Articles 10-14 of the present order concerning the provisionally delineated protective blocks, areas. The provisionally delineated protective blocks, areas shall be registered in the "water book".

The documents on which the ruling is based shall be revised by the permit holder in the light of the information, data gained in the course of establishment and the conditions set forth in the permit of operation, but not later than five years after receipt of the permit of operation, and the results of such revision shall be forwarded to the water authority.

Depending on the results of the revision, the designated protective area, block, zone may be modified on request, or upon the authority's own motion.

The owner of the property affected by the designation of a protective block, protective area or zone, or the person using the property under another title shall be obliged by the decision of the water authority on the designation and maintenance of a protective area to tolerate access to the property of the operator of the water facility and of the persons authorised to carry out official inspections, further the use of the property to the extent required for performing their professional functions. These, however, must not prevent, or hinder appreciably the normal use of the property.

- DWPZ are designed based on the field investigations and desk studies. How DPWZ are transferred to the space and how DWPZ are considered in the spatial planning procedures?

Spatial planning has to take into consideration all the vulnerable DWPAs and DWPZs (including those areas which are have not designated by authority yet, only are determinated or estimated). DWPZs are part of the national water quality protection zone on the National Spatial Management Plan.

- Who are parties with whom DPWZ are discussed (e.g. local communities, water managers, land owners, any other party)?

Water authorities of government offices, water management directorates, waterworks, operators, municipalities, local owners, other competent authorities

- Are borders of DWPZ negotiated and agreed?

Yes.

- Are interdictions, limitations and measures negotiated?

Yes.

- Is there any coordination during this process?

Yes.

- In what extend opinions from the possible procedure must be accepted and how they are accepted?

Acceptance very much depend on the situation. Usually, land users are not happy on restrictions but overriding public interest persuade them to accept DWPZ delineation and limitations.

- How DWPZ borders are considered in the space and in the spatial planning process?

See above.

- Are borders of DWPZ drawn so that they are following land plot (cadastral / parcel) borders?

Yes.

- Are borders of DWP drawn so that only design criteria are considered, no matter what are the ownership relationships in space?

DWPZs are determinated only by expert determination, but after the hydrogeological modelling, the borders of the DWPZs are snapped to the land plot border, so the decision of authority of the DWPAs contains the actions and measures for that snapped areas.

- Is the list of plots (cadastral parcels) positioned on the DWPZ prepared and it is publicly available or even published in the official documents?

Yes. It is avaliable on the proprerty documents (title-deed) of the land administration, also the decision of the water authority contains these information as like the diagnostic investigation of the DWPA.

- Who and how is exercising control over the surface of DWPZ?

Compliance with the provisions, obligations and use restrictions on designated and established protective blocks, protective areas and zones set forth in the present order and in the authority decision shall be monitored regularly by the water authority, the special authorities involved in the procedure and the operator (permit holder) of the water works.

- How the breaches of the requirements defined on DWPZ are penalized?

Fines, suspension of licences of authorities.

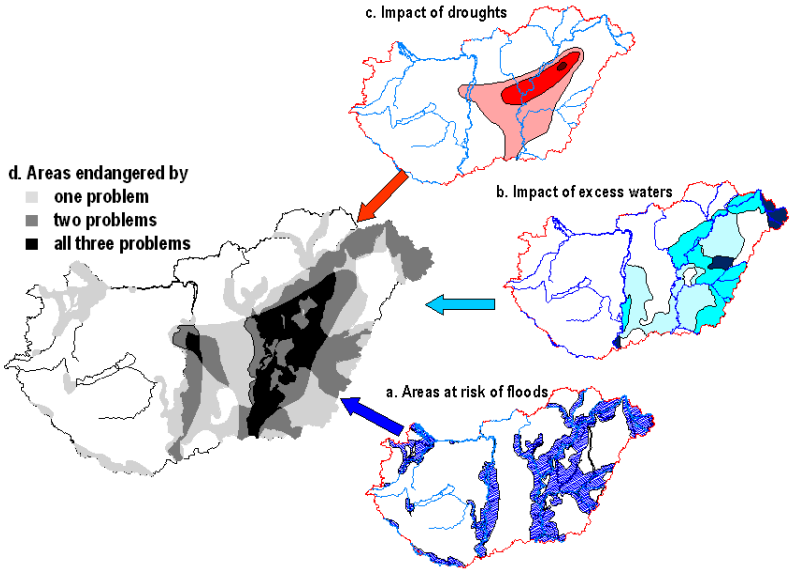
2.3 Floods/droughts management

In respect of floods and inland inundation, Hungary is a significantly threatened area. The temporal and spatial distribution of our water resources is very extreme. Generally there are two main periods of floods on rivers in Hungary. Floods in early spring are caused by runoff from snowmelt, while floods in early summer are the consequences of maximum precipitation at the beginning of summer. Nearly the half of Hungary is plain area (44,500 km^2), with endorheic lowlands having a significant share. More than 20,000 km^2 are exposed to floods, of which 5,610 km2 belong to the river basin of River Danube, and 15,641 km2 to the river basin of River Tisza.

Due to the unequal distribution of precipitation in time and space 28 years from 100 years is expected to be droughty in Hungary. The drought can occur in 90 % of the country, primarily affects the centre of the Great Plain, where the evapotranspiration usually exceeds the precipitation amount (climatic water scarcity). The climatic water scarcity/excess is ranging from 100 mm/a excess to 350 mm/a scarcity, with the peaks in the southern Tisza catchment. This periodically occurring phenomena – causing long-term water scarcity for the flora and the fauna, the agriculture and for the society – will be worsen by the climate change. Due to the interventions after the mid of the XIX. century, the reduction of floodplains and the changing land use the area and duration of drought also increased.

The major challenge of the climate change in Hungary is the struggle with extremes, and based on the national water strategy (Kvassay Jenő National Water Strategy, https://www.vizugy.hu/index.php?module=content&programelemid=142) the adaptation to the climatic (or other natural) circumstances will be much more important. The fight against the extreme water management circumstances is major driving force in Hungary. The flood protection, inland excess water protection, the protection against drought damages are all on a national scale, but are especially important on the Great Plain and the Tisza catchment.

Areas of flood (a), inland excess water (b) and drought (c) (LÁNG ET AL., 2006)



- In which way management of floods and droughts is regulated in your country?

Flood management of Hungary has been based on the DIRECTIVE 2007/60/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the assessment and management of flood risks, yet. This is the revision of the Hungarian flood prevention startegy, considering the modern and remarkably changed social- economical demands on strategic and national level.

The negative process taking place in riverbed and floodplain 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 riverbed management plans 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 riverbed management plans are reducing flood levels, keeping or repairing capacity of riverbed and ensure the flood protection safety. The hight of the damage protection ifrastructures based on the Minisztatial Regulation 74/2014. (XII. 23.) on design water level.

Government Regulation 232/1996. (XII.26.) on protection against damages caused by water regulates the flood protection tasks and competencies including the governance of activities and responsibilities of institutions.

There is no specific regulations on droughts management but according to the Act LVII of 1995 on water management there is priority order of sectors in water supply. In case of water sortage the drinking water utility supply has the priority .

The water directorates operate pumping stations and canal system to supply water for agricultural users. This agricultural water service and pricing of water is regulated by a new Government Regulation 115/2014. (IV.3.).

Hungary adopted the United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa. Our obligation is to report regularly to the UNCCD on the activities supporting the implementaton of the Convention. The LDN (Land Degradation Neutrality) Target Setting Program is the UNCCD's new initiative contributing to the SDG (Sustainable Develeopment Goal) target 15.3 which aims to 'sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss'. Hungary is currently considering to join the programme.

- Do you have flood/drought risk assessment done on national level?

Yes, both in case of flood risk according to the EU 2007/60/EC Floods Directive while drought risk assessment based on a national methodology called "Pálfai Index" (PAI).

- If yes, have you designated areas for which significant risk of flooding/droughts is estimated?

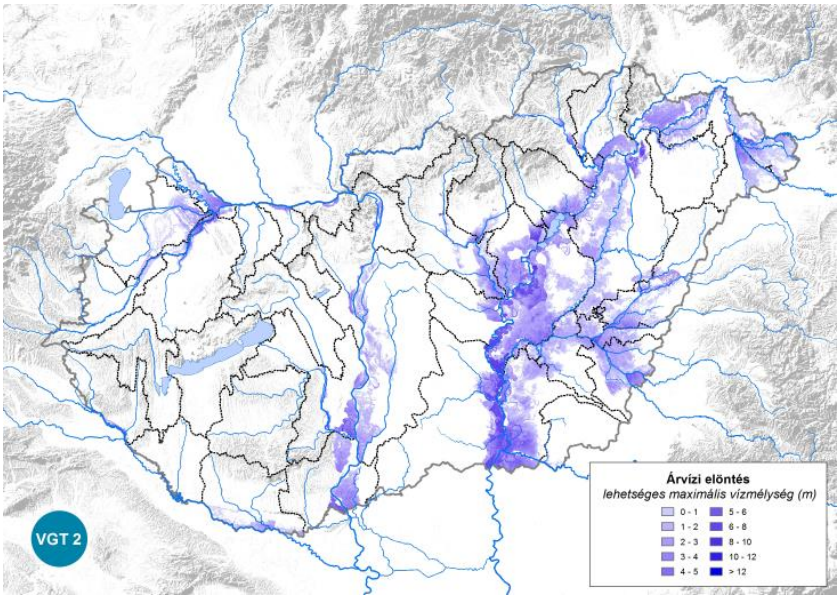
Yes. There are 8 areas with potential significant flood risk identified for Hungary. (Felső-Duna, Balaton, Dráva, Alsó-Duna, Közép-Duna, Felső-Tisza, Középső-Tisza, Alsó-Tisza)

In Hungary the preliminary flood risk assessment has been done based on the readily available information within the Hungarian water management. In Hungary, three flood groups are created for an examination of inundation hazards:

- Floods of river sections protected by dykes (riverine floods);
- Floods of river and stream sections not protected by dykes (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 defence potential (the human and material resources of the defence organization).

Map: Flood hazard - the depth of inundation in meters

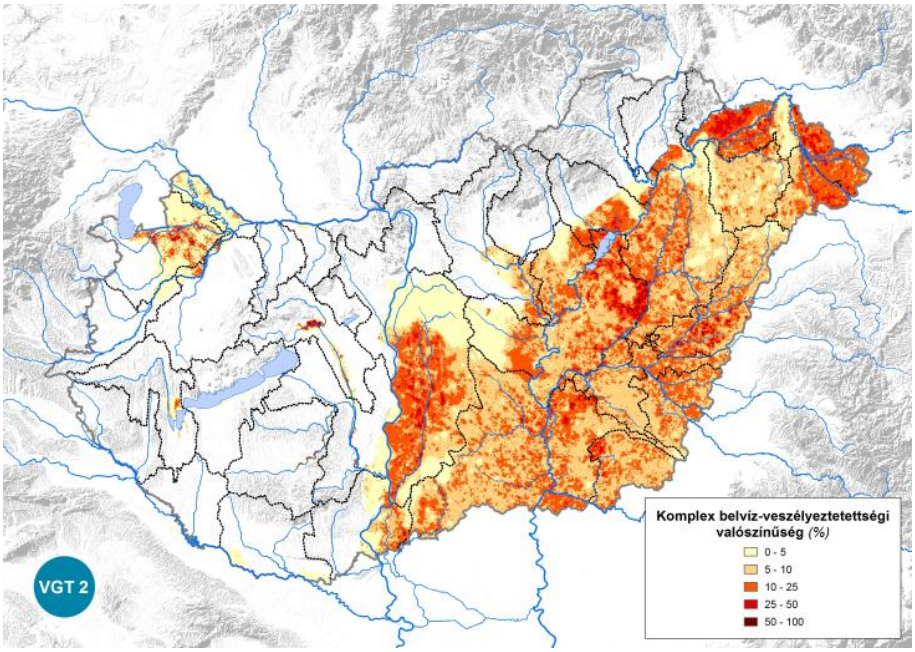


Flash floods on the small streams in mountainous and hilly areas. Here, due to the typically narrow valleys, 1D hydraulic simulations are usually sufficient. The risk calculation, next to the inundation depth is defined by the water velocity.

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.

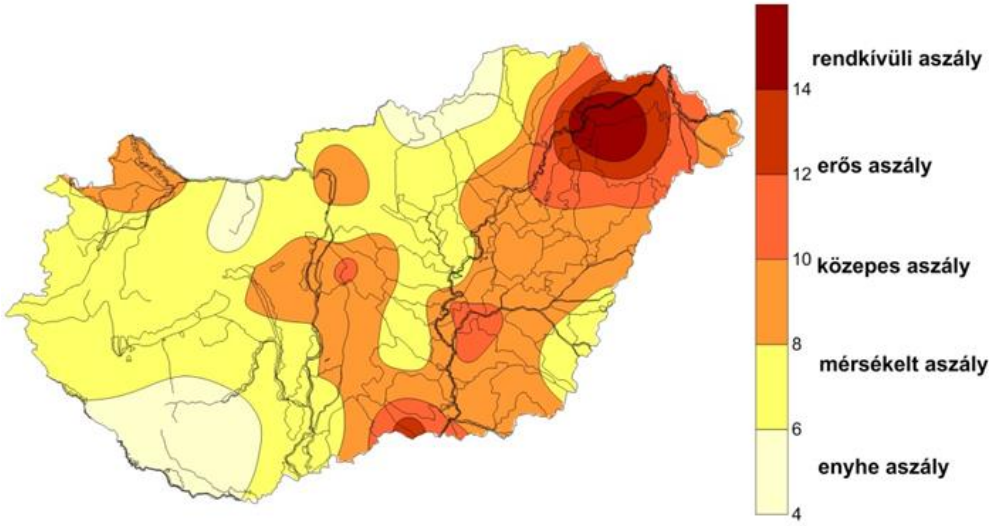
One-quarter of the area of Hungary is plain lowlands, from where water does not flow away in a natural way. Some 10%–15% of the regularly used, nearly 5 million hectares of arable land area is often covered annually by inland inundation, about 130 thousand hectares of area for 2–4 months per year on average.

Map: Excess water inundation potential



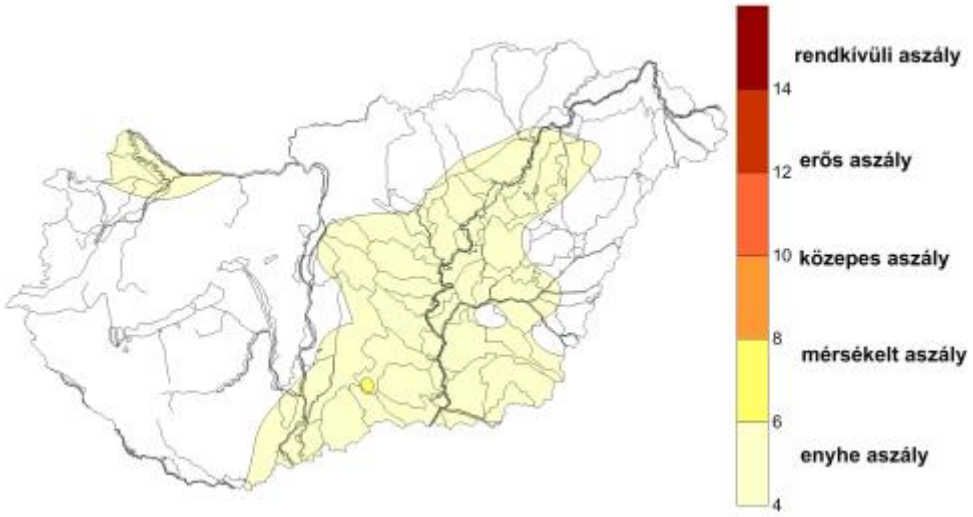
In 2015 Hungary experienced a moderate drought according to the PAI drought index. PAI is a commonly used index in Hungary to mark the drought severity for a whole year. The average value of Pálfai Drought Index (PAI) for the whole country was 8.42 °C/100 mm in 2015. Drought is considered minor between 4 and 6 PAI values, mild 6 to 8, moderate 8 to 10, severe 10 to 12, exceptional 12 to 14 and extreme above 14.

Map: Drought zones in 2015 according to the PAI



According to the PAI drought index in 2016 Hungary did not hit by drought at national level. Only some peaks were experienced locally in the values of the index.

Map: Drought zones in 2016 according to the PAI



The extreme weather conditions in the last decades (floods and droughts) have made it necessary to change the former water management practices (rapid channelling of water in the river bed). During floods a substantial part of water should be led into reservoirs, and this reserved water should be used for irrigation during droughts.

- Is there a map of floods/droughts risk?

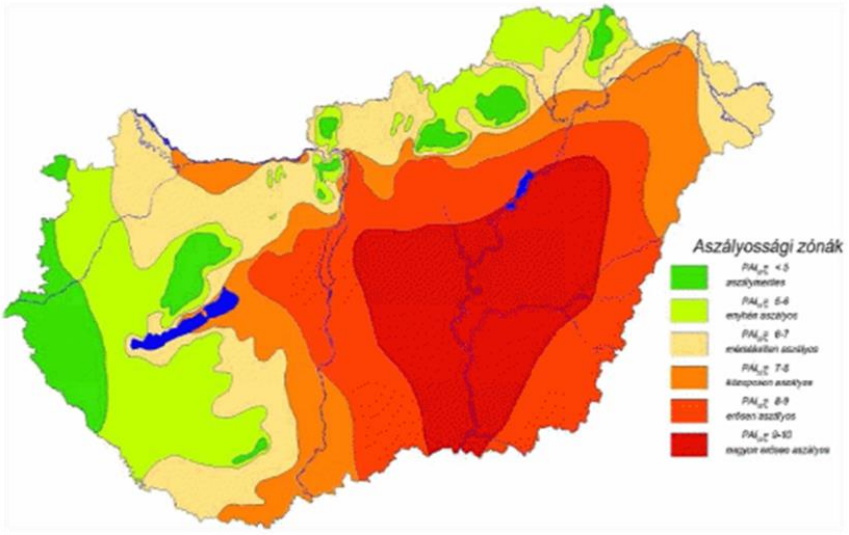
Yes.

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 (1000 yr return time period) , in a medium probability scenario (with a return period of 100 years) and if appropriate a high probability scenario (with a return period of 33 years).

Flood risk maps, also were 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.

Long term average of PAI drought index shows that drought can occur in 90 % of the country, especially in the Great Hungarian Plain, eastern and southern Hungary. Homokhátság, between Rivers Danube and Tisza, is in the wort condition in this regard.

Map: Drought zones (long term average – PAI)



From the results of long-term predictions it is expected that the PAI drought index for the period of 2021-2050 will increase by 1,2 °C/mm (compared to 1961-1990) for the whole country. On the eastern side of the country the expected changes will even exceed this.

➢ Whether an estimation of potential flood damage has been done?

Yes, according to the EU 2007/60/EC Floods Directive.

In Hungary the preliminary flood risk assessment has been done based on the readily available information within the Hungarian water management. In Hungary, three flood groups are created for an examination of inundation hazards:

- Floods of river sections protected by dykes (riverine floods);- fluvial floods:
- Floods of river and stream sections not protected by dykes (flash floods);- pluvial floods: on the small streams in mountainous and hilly areas. Here, due to the typically narrow valleys, 1D hydraulic simulations are usually sufficient. The risk calculation, next to the inundation depth is defined by the water velocity.
- Inland inundations (excess water), see above.

2.4 Water quality state, trends and monitoring

➢ Who performs monitoring of drinking water quality, which parameters are routinely observed and how frequent?

Operators of waterworks performs monitoring of drinking water quality. The water supplier performs analysis in his accredited laboratory, or in the health departments laboratory, or in an other accredited laboratory to perform the drinking water quality analysis. The monitoring of drinking water is carried out after the sampling plan, which is aproved annualy by the

competent authority. The monitoring of drinking water quality is regulated in Government Regulation 201/2001. (X.25.) on drinking water quality and controlling
If the water supply is more than 10 m^3/day annual average, or it performs more than 50 capital permanent population, operator's safety management system has to record in drinking water safety plan. The competent public health authority approves in decision the water safety plan.
Waterworks which performs more settlements, must perform at least annually control testing for one sample.
The sampling frequency and observed parameters are specified in above government regulation, see above.
The legislation seperates a ***control analysis*** from a ***detailed analysis***.
The number of both analyses varies depending on the mean amount of water supplied a day (in m^3).

The amount of water produced (supplied) in the supply area m^3/d	Number of samples for **control analysis** samples/year	Number of samples for **detailed analysis** samples/year
<10	deteminated by the competent authority	deteminated by the competent authority
10-100	4	
100-1000	4	1
1000-10 000	4 samples+ 3 samples for every started 1 000 m^3/d the quantity	1 sample + 1 sample for every started 3 300 m^3/d the quantity
10 000-100 000		3 samples + 1 sample for every started 10 000 m^3/d the quantity
>100 000		10 samples, + 1 sample for every started 25 000 m^3/d the quantity

The following parameters are part of the ***control analysis:*** colour, odour, taste, turbidity, pH, conductivity, ammonium, nitrite (0,5 mg/l and [nitrate/50]+[nitrite/3]≤1), permanganate index (KOIps), iron, Escherichia coli (E. coli), Coliforms, number of colonies at 22°C. In addition in statutory cases are added the following parameters: manganese (where the presence is expected, or in water treatment used manganese compound), aluminium (where as a flocculant is used aluminium compound), Clostridium perfringens (including spores) (from water has been under the influence of surface water and from water obtained from surface water), Pseudomonas aeruginosa (when the tempetarature of water supplied supplying network exceed 20°C), chlorite (in case of disinfecting with chlorine dioxide), free and bond active chlorine (in case of chlorinated water).

In case of carstic, ground-water and bank-filtred drinking water supplied without treatment in each water extraction point separately, and in case of drinking water from surface water resource, produced in water treatment plant the following requirements applies:

Parameter	Parametric value	Unit
Permanganate index (KOIps)	3,5	mg/l
Ammonium	0,20	mg/l
Nitrite	0,10	mg/l
Chlorid	100	mg/l

In 25% of samples the following control parameters examined: hardness, sulphate, chlorid, nitrate, total organic carbon (TOC), Enterococci.

Every two years, in 5% of samples, but at least twice examined the microscopic biological parameters.
In statutory cases in 25% reduced frequency examined the following parameters: arsenic, boron, fluoride, Trihalomethanes – sum (total) (in case of chlorinated water), bromate (ozone water treatment).

The following parameters are part of the ***detailed analysis***:

Microbiological parameters for drinking water

Parameter	Limit value (number/100 ml)
Escherichia coli (E. coli)	0
Enterococci	0

Chemical parameters of drinking water

Parameter	Limit value	Unit
Akrilamid	0,10	µg/l
Antimony	5,0	µg/l
Arsenic	10	µg/l
Benzene	1,0	µg/l
Benzo(a)pyrene	0,010	µg/l
Boron	1,0	mg/l

Bromate	10	µg/l
Cadmium	5,0	µg/l
Chromium	50	µg/l
Cooper	2,0	mg/l
Cyanide	50	µg/l
1,2-dichloroethane	3,0	µg/l
Epichlorohydrin	0,10	µg/l
Fluoride	1,5	mg/l
Lead	10	µg/l
Mercury	1,0	µg/l
Nickel	20	µg/l
Nitrate	50	mg/l
Nitrite	0,50	mg/l
Pesticides	0,10	µg/l
Pesticides - sum (total)	0,50	µg/l
Polycyclic aromatic hydrocarbons	0,10	µg/l
Selenium	10	µg/l
Tetrachlorethylene and Trichlorethylene	10	µg/l
Trihalomethanes - sum (total)	50	µg/l
Vinyl chloride	0,50	µg/l
Cis-1,2-dichloroethylene	50	µg/l
Chlorite	0,20	mg/l
Bond active chlorine	3,0	mg/l

Indicator parameters of drinking water

Parameter	Parametric value*	Unit
Aluminium	200	µg/l
Ammonium	0,50	mg/l
Chloride	250	mg/l
Clostridium perfringens (including spores)	0	number/100 ml
Colour	Acceptable to consumers and no abnormal change	
Conductivity	2500	µS cm^{-1} at 20 °C
pH	≥6,5 and ≤9,5	
Iron	200	µg/l
Manganese	50	µg/l
Odour	Acceptable to consumers and no abnormal change	
Permanganate index (KOIps)	5,0	mg/l O_2
Sulphate	250	mg/l
Sodium	200	mg/l
Taste	Acceptable to consumers and no abnormal change	
Number of colonies at 22 °C and 37 °C	No abnormal change	number/ml
Coliforms	0	number/100 ml
Pseudomonas aeruginosa	0	number/100 ml
Total organic carbon (TOC)	No abnormal change	
Turbidity	Acceptable to consumers and no abnormal change	
Hardness	Min. 50, max. 350	mg/l CaO
Radon	100	Bq/l
Tritium	100	Bq/l
Indicative dose	0,10	mSv

- value of chemical, biological and radioactive substances in drinking water, as well as physical characteristics, above which must be examined that poses a risk to human health, and if necessary corrective measures must be taken.

➢ Who performs monitoring of drinking water resources (surface water, groundwater…) quality, which parameters are routinely observed and how frequent?

The water supplier performs monitoring of surface and groundwater drinking water resources. The monitoring of potential drinking water resources performs the competent water directorates. The water permit of operation, and the decision about the designation of drinking water protection zones includes the procedure of monitoring of drinking water resources.

Conform the regulation it must be permorm ***a firt base state analysis*** (***Regular base chemical analysis*** and ***Additional chemical analysis***), and then at lest every 6 years ***repeated base analysis***. It must be perform annualy ***regular base state analysis***. ***Control analysis*** must be performed daily min. one in case of river water abstraction, from the Lake Balaton two in every weeks, from the reservoirs one analysis per week. For unprotected groundwater resources under a half year after the regular base analysis once, in case of water treatment (excluding degasing and desinfection) and drinking waterworks with capacity higher than 5000 m^3/d at the network entry points one analysis per month is required. In the period between control analyses bacteriological tests must be perform.

Control chemical analyses	
Conductivity	µS/cm
Ammonium	mg/l
Nitrate	mg/l
Nitrite	mg/l
KOIps	mg/l
Chloride	mg/l
Control radiological examination *(must be carried out with chemical tests)*	
Tritium	Bq/l / TU

Bacteriological tests
Escherichia coli
Number of colonies at 22 °C
Coliforms

Regular base chemical analyses	
Conductivity	µS/cm
pH	

Sodium	mg/l
Potassium	mg/l
Calcium	mg/l
Magnesium	mg/l
Iron	mg/l
Manganese	mg/l
Ammonium	mg/l
Chloride	mg/l
Sulphate	mg/l
Bicarbonate	mg/l
Carbonate	mg/l
Nitrate	mg/l
Nitrite	mg/l
Total hardness	CaO/mgl
Alcalinity (m)	mmol/1
Alcalinity (p)	mmol/1
chemical oxygen demand (COD)	mg/l
Cyanide total	µg/l
Arsenic	µg/l
Total organic carbon (TOC) – for surface water extraction	mg/l

Additional chemical analyses	
Fluoride	mg/l
Dissolved oxygen	mg/l
Total phosphorus	mg/l
Orthophosphate (dissolved)	mg/l
Detergents (anionic, cationic, non ionic)	mg/l
Phenol index	µg/l
AOX	µg/l
TPH (Total Aliphatic Hydrocarbons)	µg/l
Antimony	µg/l
Arsenic	µg/l
Boron	µg/l
Mercury	µg/l
Cadmium	µg/l
Chromium	µg/l
Nickel	µg/l

Lead	µg/l
Copper	µg/l
Selenium	µg/l
Aluminium	µg/l
Additional radiological examination *(Must be carried out with Additional chemical analyses)*	
Radon	Bq/l
Tritium	Bq/l
Indicative dose	mSv

The procedure of monitoring of surface drinking water recources is specified in KvVM Ministry Regulation 6/2002. (XI.5.) on the quality required of surface freshwater to abstract for drinking water purposes and to support fish life and their monitoring.

The classification of surface drinking water resources (after an official health check) is according of the necessary treatment methods:

A1 - Simple physical treatment and disinfection.
A2 - Normal physical treatment, chemical treatment and disinfection.
A3 - Intensive physical and chemical treatment, and further treatment and disinfection.

The list of surface drinking water resources and their classification are incuded in above Ministry Regulation.

The competent public authority must verify the compliance with water quality limit values at least frequently:

The minimum annual frequency of the sampling and testing of the surface drinking water resources in accordance with the quality characteristics groups

	Treatment category	A1			A2			A3		
	Quality characteristics group	I	II	III	I	II	III	I	II	III
Number of inhabitants on the supply area	▫ 10 000	2	2	2	2	2	2	2	2	2
	▫ 10 000 ▫ 30 000	2	2	2	2	2	2	3	2	2
	▫ 30 000 ▫ 100 000	2	2	2	4	2	2	6	2	2
	▫ 100 000	3	2	2	8	4	2	12	4	2

Quality characteristics groups by the sampling and testing frequency

I		II		III	
Quality characteristics		Quality characteristics		Quality characteristics	
1	pH	10	Dissolved iron	8	Fluorid
2	Colour	11	Dissolved manganese	14	Boron
3	Total suspended solids	12	Cooper	15	Arsenic
4	Temperature	13	Zink	16	Cadmium
5	Conductivity	23	Sulphate	17	Total chrome
6	Odour	25	Surfactants	18	Lead
7	Nitrate	27	Phenols	19	Selenium
24	Chloride	34	Nitrogen with Kjeldahl-method	20	Mercury
26	Phosphate	37	Total coliforms	21	Barium
31	Chemical oxygen demand (COD)	38	Faecal coliforms	22	Cyanide
32	Dissolved oxygen saturation			28	Dissolved or emulsified hydrocarbons
33	Biochemical Oxygen Demand (BOD)				
35	Ammonium			29	Polyaromatic hydrocarbons
				30	Total pesticides
				36	Extractables
				39	Faecal streptococci
				40	Salmonella

Pollution limits values of surface resources in accordance with the treatment categories

Nr.	Quality characteristics	Unit	Treatment categories		
			A1	A2	A3
1.	pH		6.5-8.5	5.5-9.5	5.5-9.5
2.	Colour (After a simple filtration)	mg/l scale Pt	20(**)	100(**)	200(**)
3.	Total suspended solids	mg/l suspended solids	25		
4.	Temperature	°C	25(**)	25(**)	25(**)
5.	Conductivity	¤Scm^{-1} 20 °C-on	2500	2500	2500
6.	Odour	(dilution factor on 25 °C)	3	10	20
7.*	Nitrate	mg/l NO_3	50(**)	50(**)	50(**)
8.	Fluorid	mg/l F	1.5	2	2

10.*	Dissolved iron	mg/l Fe	0.3	2	2
11.*	Dissolved manganese	mg/l Mn	0.05	0.3	1
12.	Cooper	mg/l Cu	0.05(**)	2	2
13.	Zink	mg/l Zn	3	5	5
14.	Boron	mg/l B	1	1	1
15.	Arsenic	mg/l As	0.01	0.01	0.1
16.	Cadmium	mg/l Cd	0.005	0.005	0.005
17.	Total chrome	mg/l Cr	0.01	0.01	0.01
18.	Lead	mg/l Pb	0.01	0.05	0.05
19.	Selenium	mg/l Se	0.01	0.01	0.01
20.	Mercury	mg/l Hg	0.001	0.001	0.001
21.	Barium	mg/l Ba	0.1	1	1
22.	Cyanid	mg/l CN	0.05	0.05	0.05
23.	Sulphate	mg/l SO_4	250	250(**)	250(**)
24.	Chloride	mg/l Cl	250	250	250
25.	Surfactants (methylene blue responders)	mg/l (lauril-sulphate)	0.2	0.2	0.5
26. *	Phosphate	mg/l P_2O_5	1	1	1
27.	Phenols (fenol-index)	mg/l C_6H_5OH	0.001	0.005	0.1
28.	szénhidrogének Dissolved or emulsified hydrocarbons (after petroleum ether extraction)	mg/l	0.05	0.2	1
29.	Polycyclic aromatic hydrocarbons (PAH)	mg/l	0.0002	0.0002	0.001
30.	Total pesticides	mg/l	0.001	0.0025	0.005
31.*	Chemical oxygen demand (COD)	mg/l O_2	30	70	100
32.*	Dissolved oxygen saturation	% O_2	>70	>50	>30
33.*	Biochemical Oxygen Demand (BOD) (on 20 °C without nitrification)	mg/l BOI_5	<3	<7	<10
34.	Nitrogen with Kjeldahl-method (without NO3)	mg/l N	2	4	6
35.	Ammoium	mg/l NH_4	0.5	1,5	4 (X)
36.	Extrahálható anyagok Extractables	mg/l e.a.	0.2	1	2
37.	Total coliforms 37 °C	/100 ml	100	50 000	200 000
38.	Fecal coliforms	/100 ml	40	20 000	80 000
39.	Faecal streptococci	/100 ml	40	10 000	50 000
40.	Salmonella	/1000 ml	Not present in (undetectable) 5000 ml	5	20

- Is there systematic monitoring of quality parameter trends for drinking water and for their resources? Who performs this monitoring?

The water supplier and the public health departament regulary monitors the untreated water, the drinking water and the recharge areas (the wells monitoring located on drinking water protection areas). The test data are registered by operators, they annually send to the competent regional water authority.

- Who is the user of this data?

Authorities, water management directorates, operators, consumers, environmental and water public enterprises, universities, research institutes.

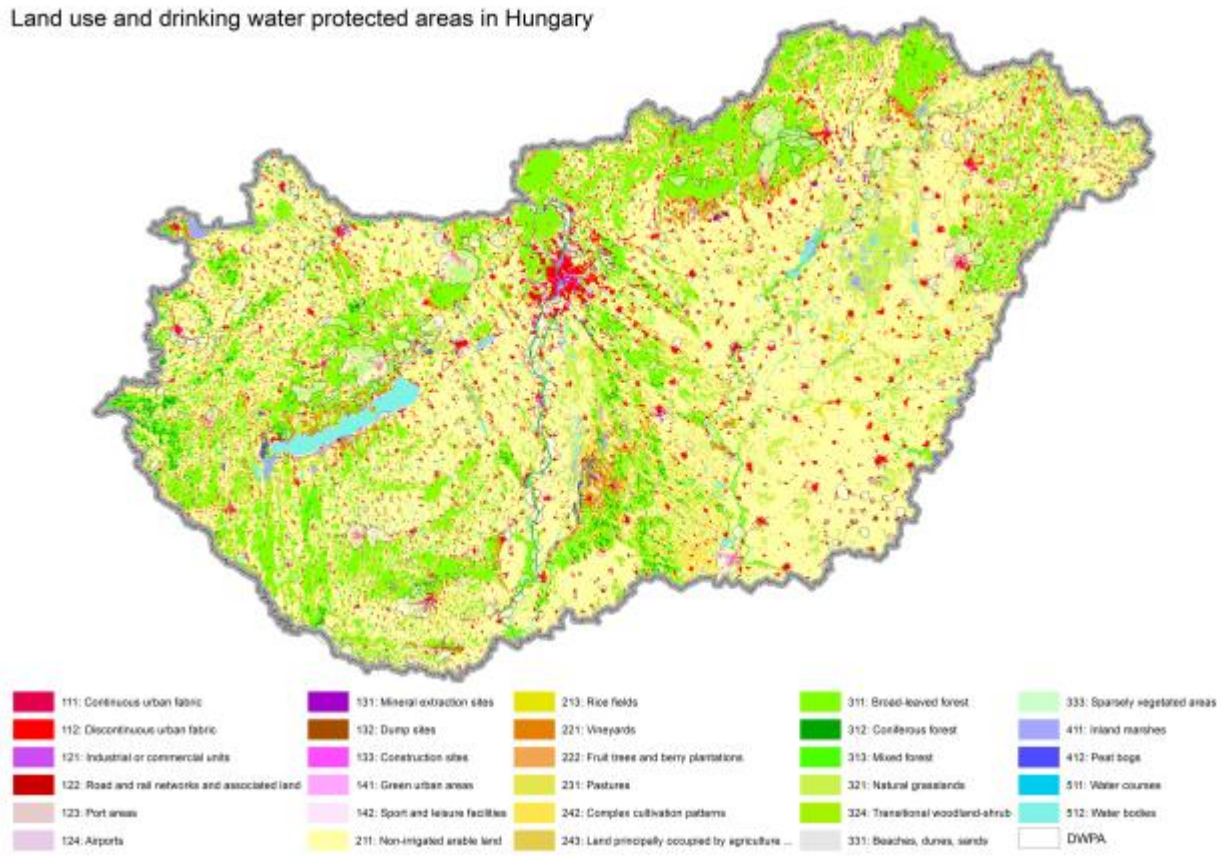
- Which is the procedure in the case of negative quality trends?

If the operator notified, or the authority perceives an extraordinary event about the quality of drinking water, any of the test results exceed the limit and parametric values set out in the legislation, and in case of a pollution risk, the competent public health departement will investigate the cause of the overrun and the required water quality improvement measures will order.

3. Actual land use activities

3.1. Land use map

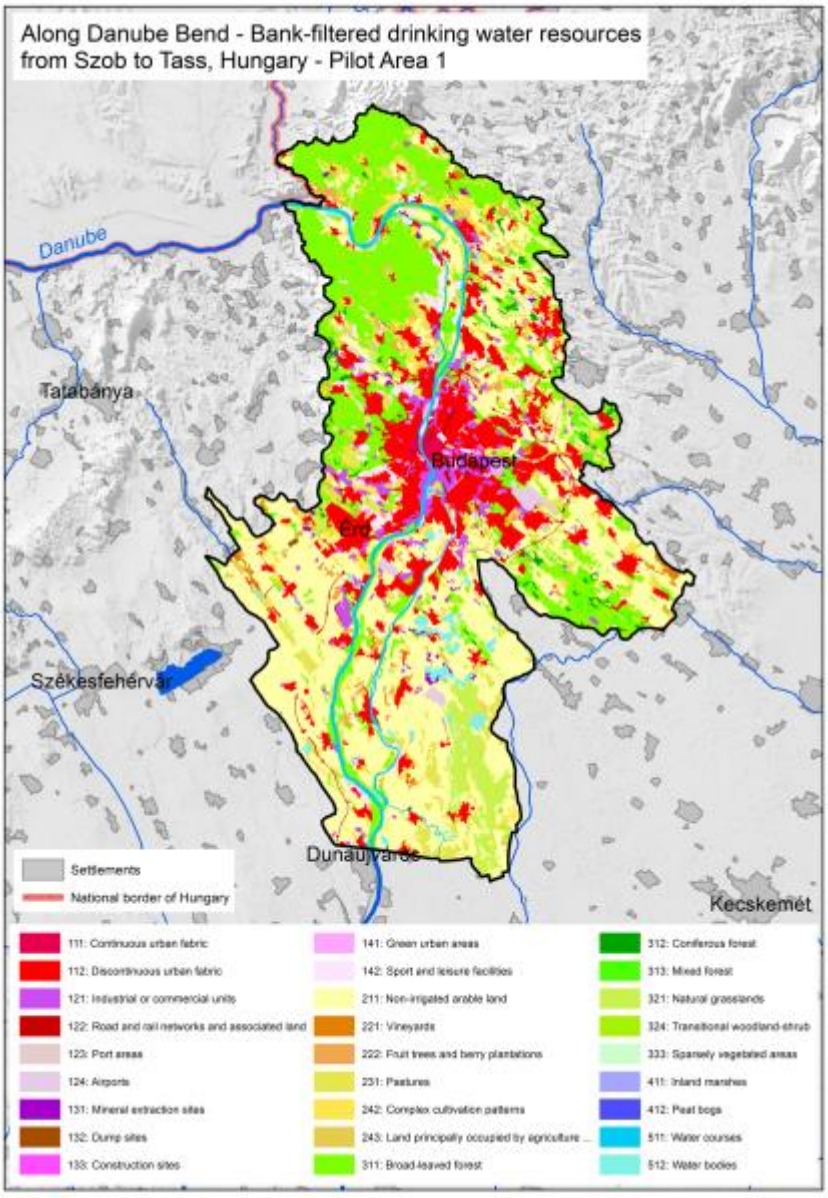
Land use map of Hungary based on Corine land cover 2012



CLC code	LABEL 3	Surface area (%)	Surface area (km^2)
111	Continuous urban fabric	0,02	17,42
112	Discontinuous urban fabric	4,70	4373,03
121	Industrial or commercial units	0,66	610,94
122	Road and rail networks and associated land	0,10	93,58
123	Port areas	0,00	2,86
124	Airports	0,08	70,05
131	Mineral extraction sites	0,10	95,30
132	Dump sites	0,06	52,69
133	Construction sites	0,03	26,21
141	Green urban areas	0,06	53,21
142	Sport and leisure facilities	0,37	345,02

CLC code	LABEL 3	Surface area (%)	Surface area (km²)
211	Non-irrigated arable land	51,58	47971,80
213	Rice fields	0,09	82,54
221	Vineyards	1,20	1116,97
222	Fruit trees and berry plantations	0,75	700,21
231	Pastures	7,40	6882,97
242	Complex cultivation	3,09	2870,85
243	Land principally occupied by agriculture, with significant areas of natural vegetation	1,78	1652,98
311	Broad-leaved forest	15,90	14786,86
312	Coniferous forest	0,98	915,54
313	Mixed forest	1,64	1523,38
321	Natural grassland	2,46	2285,48
324	Transitional woodland shrub	4,12	3829,60
331	Beaches, dunes, and sand plains	0,00	0,28
333	Sparsely vegetated areas	0,03	27,10
411	Inland marshes	0,82	766,63
412	Peat bogs	0,10	94,28
511	Water courses	0,50	463,04
512	Water bodies	1,40	1300,31

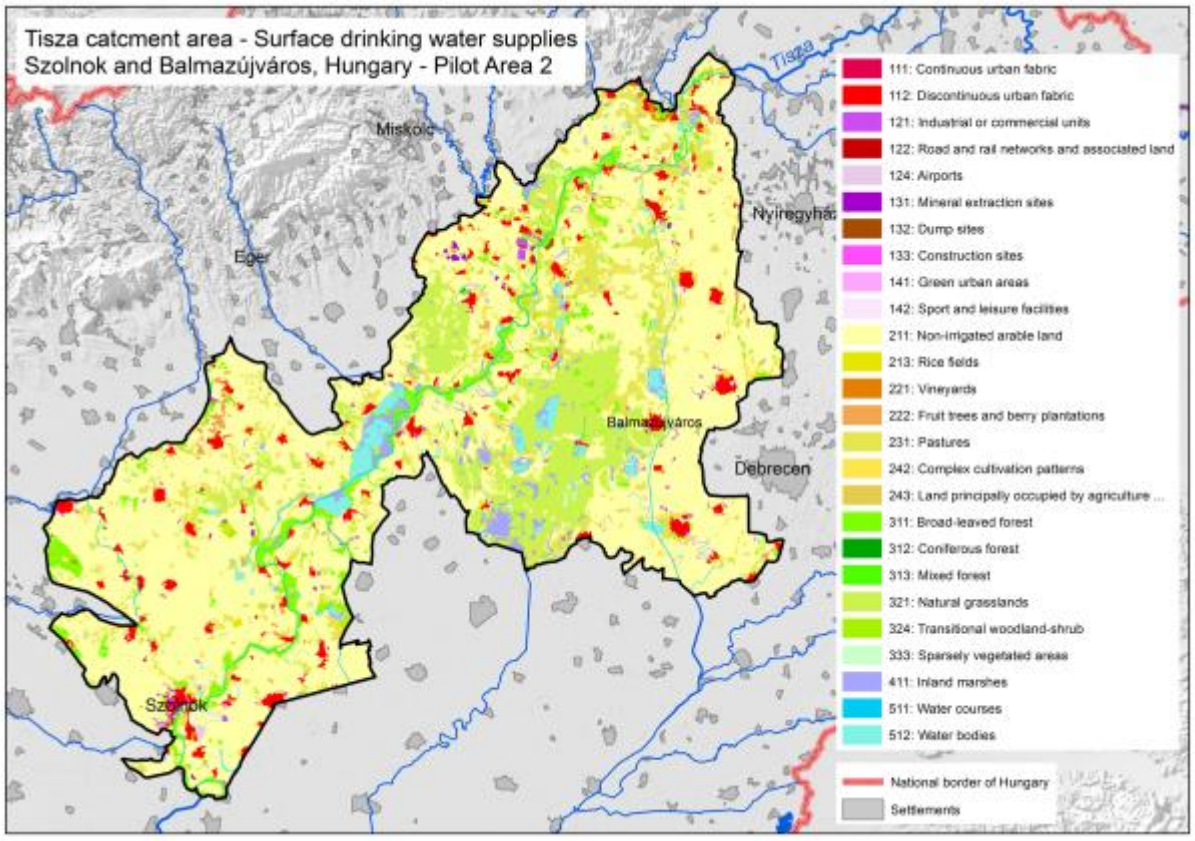
Pilot area 1 – Danube Bend



CLC code	LABEL 3	Surface area (%)	Surface area (km^2)
111	Continuous urban fabric	0,34	13,71
112	Discontinuous urban fabric	14,06	559,85
121	Industrial or commercial units	3,27	130,39
122	Road and rail networks and associated land	0,75	29,84
123	Port areas	0,07	2,86
124	Airports	0,55	21,92
131	Mineral extraction sites	0,32	12,64
132	Dump sites	0,08	3,33

CLC code	LABEL 3	Surface area (%)	Surface area (km²)
133	Construction sites	0,14	5,47
141	Green urban areas	0,38	15,19
142	Sport and leisure facilities	2,51	99,99
211	Non-irrigated arable land	35,42	1 410,24
213	Rice fields	0,0	0,0
221	Vineyards	0,58	23,06
222	Fruit trees and berry plantations	1,04	41,55
231	Pastures	6,44	256,57
242	Complex cultivation	3,03	120,48
243	Land principally occupied by agriculture, with significant areas of natural vegetation	1,71	68,04
311	Broad-leaved forest	17,36	691,31
312	Coniferous forest	0,71	28,25
313	Mixed forest	1,08	42,99
321	Natural grassland	2,81	111,98
324	Transitional woodland shrub	3,39	135,16
331	Beaches, dunes, and sand plains	0,0	0,0
333	Sparsely vegetated areas	0,10	3,81
411	Inland marshes	0,25	10,02
412	Peat bogs	0,00	0,18
511	Water courses	2,43	96,57
512	Water bodies	1,17	46,54

Pilot area 2 – Tisza catchment



CLC code	LABEL 3	Surface area (%)	Surface area (km²)
111	Continuous urban fabric	0,01	0,45
112	Discontinuous urban fabric	3,62	275,59
121	Industrial or commercial units	0,55	41,53
122	Road and rail networks and associated land	0,02	1,78
123	Port areas	0,0	0,0
124	Airports	0,05	3,56
131	Mineral extraction sites	0,13	9,55
132	Dump sites	0,06	4,38
133	Construction sites	0,01	0,97
141	Green urban areas	0,02	1,29
142	Sport and leisure facilities	0,21	16,34
211	Non-irrigated arable land	61,93	4 715,16
213	Rice fields	0,10	7,74
221	Vineyards	0,13	9,56
222	Fruit trees and berry plantations	0,52	39,88

CLC code	LABEL 3	Surface area (%)	Surface area (km²)
231	Pastures	9,66	735,58
242	Complex cultivation	1,19	90,70
243	Land principally occupied by agriculture, with significant areas of natural vegetation	0,56	42,72
311	Broad-leaved forest	4,26	324,12
312	Coniferous forest	0,00	0,34
313	Mixed forest	0,01	0,78
321	Natural grassland	9,85	749,96
324	Transitional woodland shrub	1,51	114,62
331	Beaches, dunes, and sand plains	0,0	0,0
333	Sparsely vegetated areas	0,13	10,06
411	Inland marshes	2,23	169,73
412	Peat bogs	0,0	0,0
511	Water courses	0,88	67,22
512	Water bodies	2,37	180,53

3.2. Overview of the particular land use activities

3.2.1 Urban areas

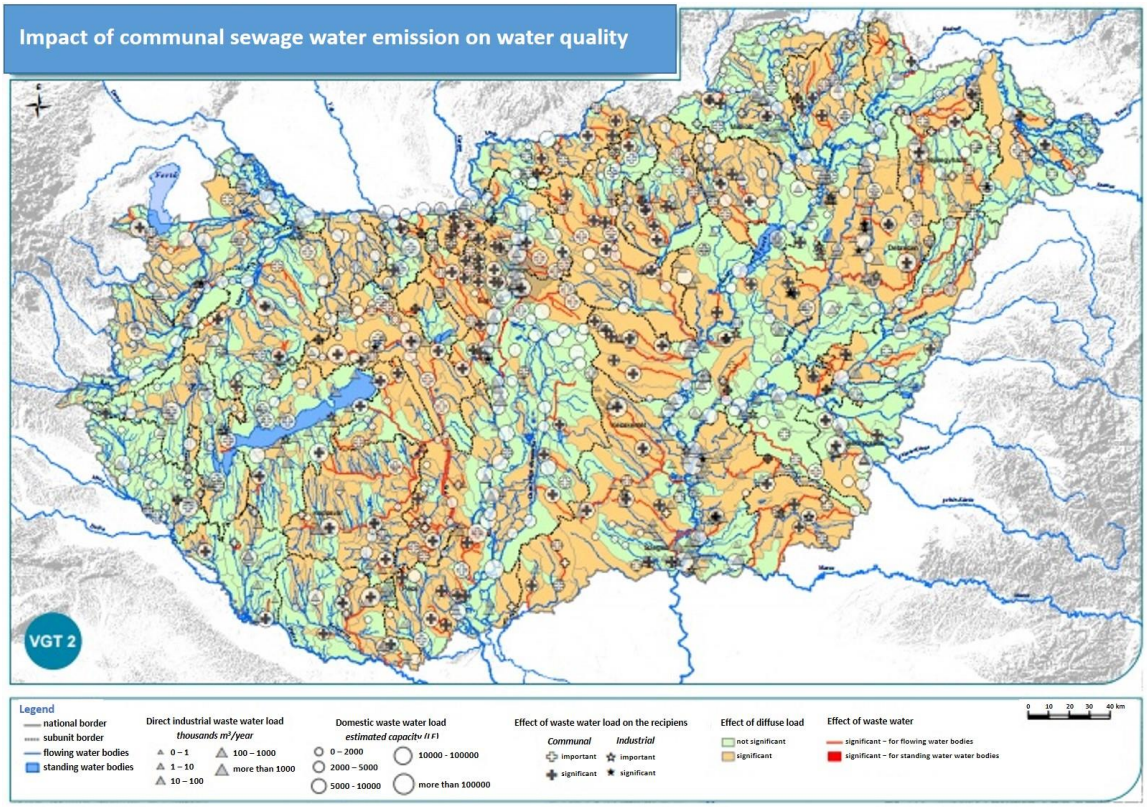
The estimated population number of Hungary calculated from the 2011 census data was 9 million 823 thousand on 31st December 2015 (source: Hungarian Central Statistical Office).

Since 2007 the rate of settlements supplied with safe drinking water is constantly 100%. The same rate for dwellings is 94.7%. Between 2000 and 2013, the amount of water produced and supplied, within this the amount of water supplied to households decreased as a result of rising water rates and the proliferation of private wells. This represents a more than 17% decline in case of produced water. *The weather had a significant influence on annual household water consumption, e.g. there were water consumption spikes in the droughty years (2000, 2003, 2007, 2012).*

The rate of settlements connecting to utility sewage system is continuously increasing, and was 60.2% in 2014 (there is no data available for 2015 yet). The same rate for dwellings is 77.0%. Between 2000 and 2013, the number of settlements connected to the sewage system increased from 854 to 1860. Along with this, the number of dwellings connected to the sewage system increased by more than 1.2 million to 3.3 million resulting in 75% coverage. Between 2000 and 2013, the average output of the sewage system was 527 million m^3, which was more than 80% of the drinking water abstraction of public water works (661 cubic meters) (source: Hungarian Central Statistical Office).

Municipal wastewater plays an important role in the pollution of surface waters. Individual desiccation-type sewage disposal in residential areas with no sewage system put a heavy load on groundwaters. Due to developments of colletion and sewage treatment pressure on groundwater decreased while on surface waters increased in the last decade.

One of the highest priority point sources (due to the volume of emission) is communal sewage, mainly as a source of nutrient and organic matter load, but may also contribute to hazardous chemical contamination (e.g. metals, salts, antibiotics and other pharmaceuticals, household chemicals and personal care products). Nutrient emission from communal sewage treatment is monitored and reported (BOD, COD, total N, total P, salt and particulate matter) by treatment plant. However, data on hazardous substance emission is scarce. Next Figure indicates the overall estimated impact of treated sewage emission on surface water quality (including hazardous



substances), and next Table lists the emissions from communal wastewater in Hungary.

Table: *Hazardous substance emission of communal wastewater treatment plants, 2010*

Category	Number of records	Pressure on surface water kg/year	Pressure on soil kg/year	Measured components
Cyanides	1	0,6	n.a.	All cyanides (1)
Other non	3	3118	125	Ethyl-mercaptan (1), surfactants (reacting with

Category	Number of records	Pressure on surface water kg/year	Pressure on soil kg/year	Measured components
categorized substances				methylen blue) (2)
Semi-metals and metals	116	16311	200	Chromium (VI) (1), total aluminium (1), total barium (1), total silver (3), total mercury (compounds as Hg) (21), total cadmium (compounds as Cd) (18), total cobalt (1), total nickel (30), total lead (24), total iron
Phenols	8	3729	n.a.	Phenol (3), phenols (phenol index) (5)
Fluorids	3	498	n.a.	Fluorids (3)
Oils, greases	383	1008380	18476	Total aliphatic hydrocarbons (TPH) C5-C40, aliphatic hydrocarbons used as a fuel C10-C32 (1), organic solvent extract (oils)

Urban precipitation runoff is an additional, though not well characterized contamination source in Hungary. In addition in combined sewage systems, heavy precipitation may also lead to sewage overflow, increasing the release of contaminants significantly.

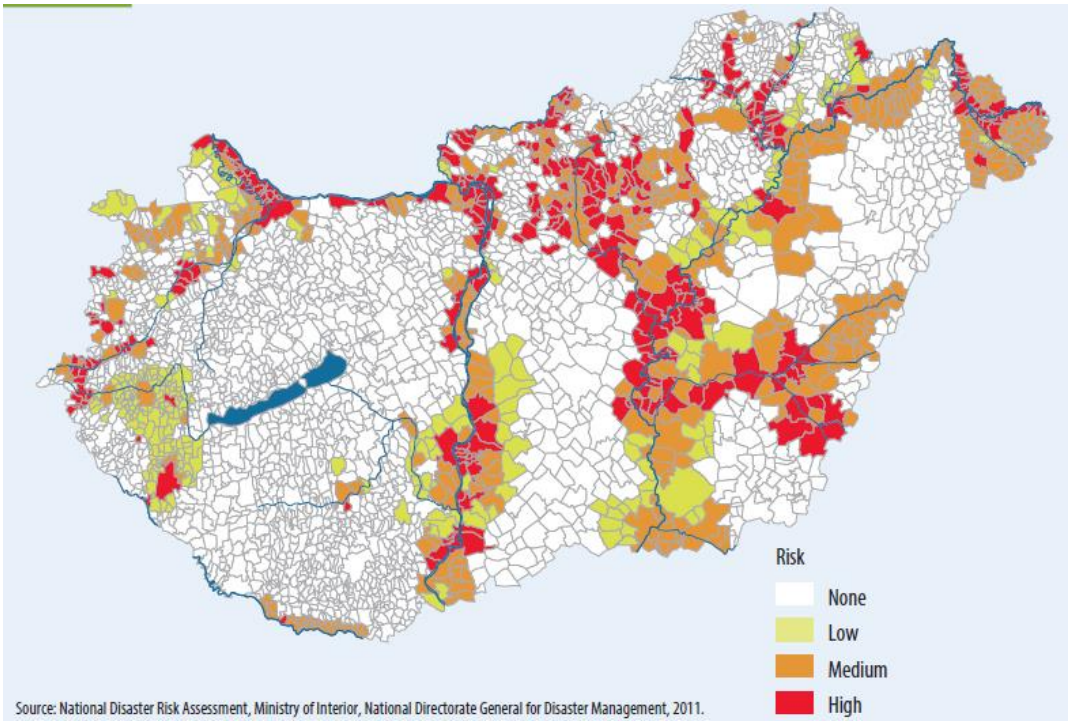
Table: Contaminants from urban precipitation runoff

Pollutant	Source
Rubbish, solid materials	Construction works, erosion from unpaved surfaces, air deposition (of transportation and industrial emission), built environment deterioration, stormwater outlets
Oxigen demanding (organic, degradable) substances	Plant debris (leaves, grass), animal feces, street waste and other organics
Microbial contaminants, pathogens	Animal feces, combined sewage outlets
Nutrients (N, P)	Air deposition, erosion of unpaved surfaces, combined sewage, fertilizer used in gardens or parks
Heavy metals (Zn, Cu, Cd, Ni, Cr, Pb)	Air deposition (of transportation and industrial emission), outdoor metal objects (e.g. gutters), drainage of waste dumps
Oil, grease	Transportation (vehicles), pumping stations, car-wash
Other organic micropollutants (pesticides, phenols, PAHs)	Air deposition (of transportation and industrial emission), pesticides used in gardens
Salts	De-icing of pavements

In Hungary, household waste is mixed, separately collected as well as bulky waste generated in households including waste generated in homes, residential properties and premises used for the purpose of recreation and leisure. The proportion of recycled and composted municipal waste has risen since 2005. This is mainly due to the expansion of separate collection, since separate collection is available to an increasing number of people with the establishment of civic amenity sites and the location of waste collection points, and separately collected waste can be removed directly from houses in more and more settlements. The average proportion of incinerated municipal waste steadily increased since 2004. However, the proportion of landfilling has declined for years. Comparing the distribution of the three forms of treatment, it is apparent that landfill, which is the least environment friendly form of waste treatment, is the most common

process of treatment in Hungary, mainly because it is cheaper than incineration or recycling. The ratio of hazardous wastes (3.4%) to all generated wastes was near the EU average (source: Hungarian Central Statistical Office).

Map: Flood risk classification of settlements

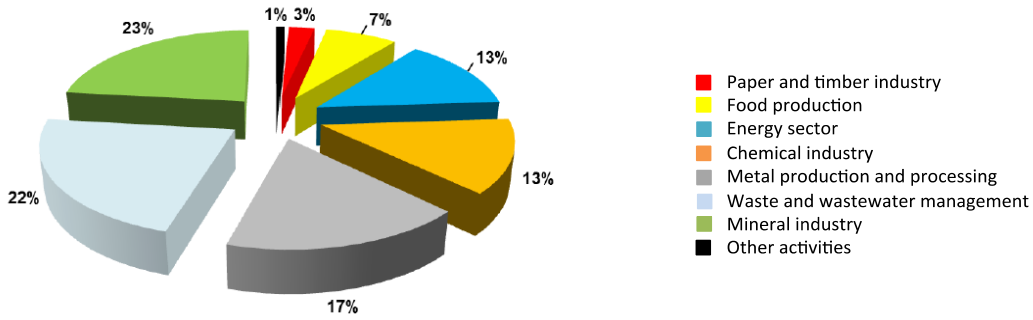


In Hungary, the protection from floods and inland inundation has an over 150-year-old tradition. An about 4200-km-long flood protection system was built along the rivers.

3.2.2 Industrial areas

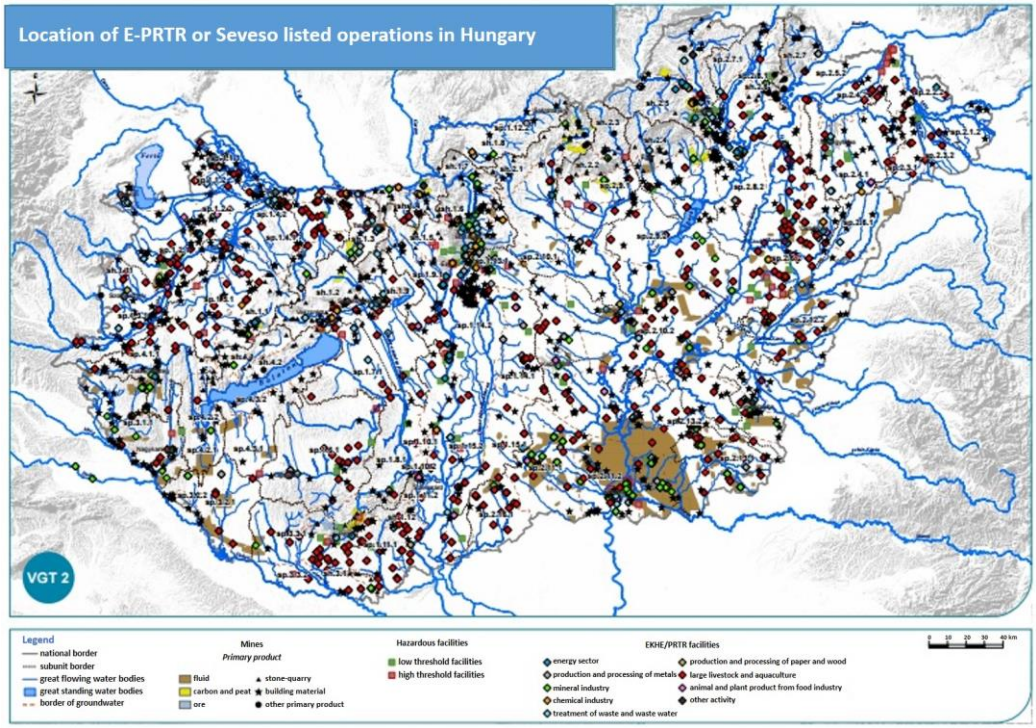
Industrial sewage from industrial or commercial activities is either directly impacts the receiving water, or if the facility is located within a municipality, its sewage is generally combined with communal sewage after pre-treatment or storage if necessary. The emissions from industrial and communal sewage in the latter case cannot be separated at the emission point but are estimated based on the scope of the industrial activity. Operations qualifying as significant sources of pollution are listed in the European Pollution Release and Transport Register (E-PRTR) and report yearly on their emission. The proportion of various activities among the facilities listed in E-PRTR is shown in the next Figure.

Figure: Proportion of various industrial activities in the E-PRTR



Industry using hazardous substances (registered in Seveso) does not necessarily has continuous emission, but it is a risk of pollution in case of industrial accidents, and should be therefore considered. The location of E-PRTR and Seveso facilities is shown on Map below.

Map: Location of E-PRTR or Seveso listed operations in Hungary, with the indication of activity.



All industrial or commercial activity (import, manufacturing, storage, transport, distribution or retailing) related to hazardous substances is to be reported to national authorities. The lists of CLP, REACH, PIC and biocide related activities was used to identify substances which may contribute to water pollution during regular or accidental release (see next Table)

Table: Hazardous substances linked to commercial activities, on national and sub-catchment scale

Compound	Number of activities	Danube	Tisza	Drava	Balaton
1,2,5,6,9,10-hexabromocyclododecane (1,2,5,6,9,10-cyclodecane)	1	1			
1,2- dichloroethane	1	1			

Compound	Number of activities	Danube	Tisza	Drava	Balaton
alachlor (technical)	1		1		
Anthracene	1	1			
Benzo(a)pyrene	2	2			
Benzo(b)fluoranthene (benz[e]acephenanthrylen) Benzo(k)fluoranthene (PAH_c)	2	2			
Benzo(g,h,i)perylene, indeno[1,2,3-cd] pyrene	3	3			
Benzol	10	3	5	1	1
cybutryne (N'-terc-Butyl-N-cyclopropyl-6-(methylthio)-1,3,5-triazine-2,4-diamine)	1	1			
Cyclodiene pesticides (aldrin, dieldrin, endrin, isodrin)	4	3	1		
Cypermethrin	14	14			
dichlorvos 2,2- Dichloroethenylphosphoric-dimethyl-ester; 2,2- Dichlorovinyl-dimethyl-phosphate	1	1			
Diuron	6	3	3		
hexachloro-cyclohexane	1	1			
Isoproturon	14		14		
Naftalin	37	23	9	1	4
Heavy metals: cadmium (1), nickel(49), lead (41), mercury (20)	111	92	11	4	4
nonylphenol (4-nonyphenol)	19	4	15		
octyphenol (4-(1,1,3,3 -tetra-me hyl-butyl) phenol)	4	4			
Pentachlorophenol	2	2			
Tetrachloromethane	4	2	2		
terbutryn (2 tert-butylamino-4-etylamino-6-methyltio-1,3,5-triazine)	5	4	1		
tetrachloroethylene (tetrachloroethene)	2		2		
Trifluralin	1	1			
trichloroethylene (trichloroethene)	4	4			
trichloromethane (chloroform)	13	4	6	2	1
Total	264	176	70	80	10

The list of activities clearly shows the location of large industrial zones, and the predominance of Budapest. Other potential point sources include previously contaminated sites and active or recultivated waste dumping sites. Mining is a considered a diffuse source of heavy metals.

Industrial or other accidents may also heavily impact water quality. Next Tables list the water pollution incidents and recurring pollution incidents between 2010-2012.

Table: Water pollution incidents by pollution and water type, 2010-2012

Pollution	Affected water course	Affected water bodies	Affected groundwaters	Total
Oil pollution	111	6	10	124
Other	89	3	3	95
Fish die-off	33	7		40
Discharge of wastewater	48	3		51
Solid pollution	36	1	3	40
Other chemical pollution	10		10	20
Oxygen deficiency	12			12
Animal carcasses	13			13
Excessive vegetation	5			5
Pesticide leaching	1			1
Total	358	20	26	404

Table: Recurrant water pollution incidents, 2010-2012

Recurring water pollution	Potential or known reasons
Danube at Budapest: oil pollution	navigation, ports, urban rainwater
lowland streams (canals), deadlegs: fish and shellfish die off, oxygen deficiency, excessive vegetation	nutrient stress, insufficient current or flow of the water
Upper-Tisza: floating waste	landfill on the floodplain

3.2.3 Agricultural land

In total 84% of the for-profit agricultural organisations used land and 31% of them was involved in husbandry. 68% of those organisations can be considered professional as a professional plant grower and another 17% professional animal rearer. In case of 5% the two types of farming had equal share in their economic activities.

In Hungary, the agricultural land (about 7,4 million ha) can be categorized as follows: plough field 58,5%, forest 26,2%, grassland 10,6%, orchard 1,2%, vineyard 1,1%, kaleyard 1,1%, reedbed 0,9% and fish pond 0,5%. About 75% of the potential agricultural land is used actively and half of that is managed by individual farms. They cultivate 58% of all agricultural land and 56% of plough fields within. The production area of corns and root plants decreased by 16% between 2013 and 2016,

and they were replaced by vegetables, fodder and leguminous plants. Corns made up 60% of the plough fields. The main crops in 2016 were: wheat (1,05 m ha), maize (1,03 m ha), winter barley (0,2 m ha), triticale (0,1 m ha). Other important crops were: sunflower (0,64 m ha), oil rape seed (0,25 m ha), alfalfa (0,13 m ha), corn silage (77 thousand ha), soy bean (63 thousand ha), potato (16,5 thousand ha), sugar beet(16,2 thousand ha). Hay was produced on 0,2 m ha and the area of fellow land was 0,135 m ha.

Land by type of cultivation - 2015

Cultivation	area (1000 ha)	share (%)
Arable land	4 332	46.6
Garden	80	0.9
Orchard	92	1.0
Vine	81	0.9
Grassland	761	8.2
Agricultural land	5 346	57.5
Forest	1 940	20.8
Reed	65	0.7
Fishpond	36	0.4
Production area	7 388	79.4
Non-agricultural land	1 916	20.6
Total land	9 303	100.0

Source: Hungarian Central Statistical Office

More than half of the Hungarian arable land is occupied by wheat and maize based on 2015 data, sunflower and rape represented 19.2 %.
Reduction in area with regards to wheat harvesting is often the result of excess water like in 2015 compared to 2014. However average yield was nearly a record in 2015 exceeded the average of the last 5 years with 20.2 %. Corn yield was worsen by the extremely hot and rainless summer weather. 2015 was also not a good year for oil plant and potatoe production, especially for the rape yields. Sunflower – grown in the third largest growing area among arable crops after maize and wheat – shows an increasing trend in harvested area.
Among the main arable crops rape had the greatest area of growth in the last ten years. Looking at a longer time horizon beet harvested area shows a decreasing trend.

Main arable crops production in 2015

Crop type	Harvested area (1000 ha)	Total yield (1000 tons)	Average production (kg/ha)
Wheat	1 029	5 331	5 180
Rye	38	104	2 760
Barley	296	1 409	4760
Oat	45	129	2830
Maize	1 146	6 633	5790
Sugar beet	16	911	58 720
Sunflower	612	1 557	2550
Rape (Swede rape and turnip rape)	221	590	2680
Alfalfa	134	596	4430
Potato	19	452	22 530

Source: Hungarian Central Statistical Office

Thanks to the favorable natural conditions Hungary has a great tradition of vegetable and fruit cultivation making Hungarian products very popular in the European market. Through the sector's very labor-intensive nature it plays an important role in agricultural employment. Amount of yields highly depend on the climatic situation and extremities (drought, frost, low precipitation) and agricultural trade.

Traditionally, sweet corn, green peas, and watermelon occupies the biggest production area among all produced vegetable, nearly two-thirds (65.5 %) of the whole area for vegetable production in 2015. Hungary has a leading role in sweet corn production in the EU for years.

The fruit production is concentrated by variety of the fruits, apple made up 40.1 %, sour cherry 15.9 % of the production area in 2015.

Viticulture, fruit cultivation and vegetable production in 2015

	Viticulture	Fruit cultivation	Vegetable production
Total area (1000 ha)	**81**	**91**	**84**
Production area (1000 ha)	**72**	**82**	
Average production -for production area (kg/ha)	**6 540**		
Amount of yield (1000 t)	**472**	**778**	**1 601**
- Table grapes	13		
- First racking of wine (million litre)	301		
- Apple		511	
- Peat		37	
- Sour cherry		77	
- Plum		46	
- Apricot		20	
- Peach		37	
- Sweet corn			479
- Tomato			200
- Paprika			116
- Pepper			22
- Watermelon			196
- Melon			16
- Onion			60
- Cucumber			32
- Garlic			7
- Lettuce			12
- White cabbage			65

Source: Hungarian Central Statistical Office

Drought is a serious risk for the Hungarian agriculture, which will probably increase with global warming. In Hungary, 223,000 ha of agricultural land can be irrigated potentially, however only 99,000 ha was irrigated in 2014. The main plants targeted by irrigation were maize, vegetable (e.g. peas) and orchards. It is important that 90% of the water used for irrigation comes from surface water and only 10% from ground water.

Most of farming in Hungary is based on the usage of rainwater; therefore production is highly depending on the climate and climatic variations. Uncertainties in agricultural production can be compensated with irrigation thus in the next years irrigated area is planned to double. Water

supply of large areas can be accomplished using irrigation systems, as well as integrated, connected water distribution systems. In irrigated areas, 72% of irrigation water comes through the state-owned irrigation systems. 83% of the irrigation water used nationally is ensured by lowland irrigation systems.

In 2014, with 115/2014. (IV.3.) Government Decree irrigation water became free for farmers. To meet ex-ante conditions related to EU Water Framework Directive this legislation is being withdrawn stepwise.
The size of area declared for irrigation is nearly unchanged compared to previous years, the water actually used is a question of the given year's hydrometeorological situation and water pricing policy in place. There is also a very good coherency between the size of irrigated area and the evolution of droughts.

Irrigation in 2015

Licensed area for irrigation (ha)	Irrigated area (ha)	Irrigated area (%)	Water amount utilized for irrigation (1000 m^3)	Irrigation water used for 1 ha (m^3)
172 703	105 852	61.3	156 474	1 478

Source: General Directorate of Water Management

To use more effectively the capacity of the irrigation infrastructure, the General Directorate of Water Management has made crucial steps placing great emphasis on the maintenance and upgrading of water supply systems. Promotion of water saving technologies is also a priority in irrigation bearing in mind sustainable water management. The Irrigation Department recently assessed possible irrigation plots and conducted a survey on the irrigation water demand in 2014. The irrigation water demand survey's evaluation was based on the water resources and service and showed that approximately 30 % of the demand could be provided to the farmers with or without any restrictions. It is essential that irrigation investment and support is to be given only for those who clearly need it underpinned by the also this survey. The design of an Irrigation Information System is also under development. There are projects under the Environment and Energy Efficiency Operative Programme which are connected to irrigation improvement for 2014-2020. A study/project is currently under compilation targeting to explore the possibilities of water reuse. Supporting also irrigation development, a drought monitoring and early warning system is under development. The monitoring system is introduced in more details among Best Practices.

The use of pesticides in the agriculture has been steadily growing since 2000. In 2014, 29092 tons of pesticides were sold in Hungary out of which 31% was herbicide, 22% insecticide, 20% fungicide and 27% was other type of pesticide. That amount of pesticides contained a total of 8971 tons of active substance. The largest areas treated with pesticides were fields of maize (981,000 ha), wheat (854,000 ha), sunflower (486,000 ha), oil rape seed (203,000 ha) and grape (60,000 ha). The most used substances were gliphosate, sulfur, S-metolachlore, pendimetalin, copper-oxichloride, chlorpyrifos, paraffine, terbutilazine, mancozeb, tebuconazole.

Based on the available data, the total amount of fertilizers used in Hungary has been growing steadily in the past years, especially those containing nitrogen. Considering the substances in fertilizers, in total 358,000 tons of nitrogen, 81,000 tons of phosphorus and 80,000 tons of potassium were sold to farmers in 2015. Those values were 327,000 tons, 82, 000 tons and 78,000 tons, respectively. In natural weight, it means 1,489,000 tons of fertilizers in total. The ratio of simple (one substance) and complex (more substances) fertilizers were 77% / 23% in 2015 (75% / 25% in 2014).

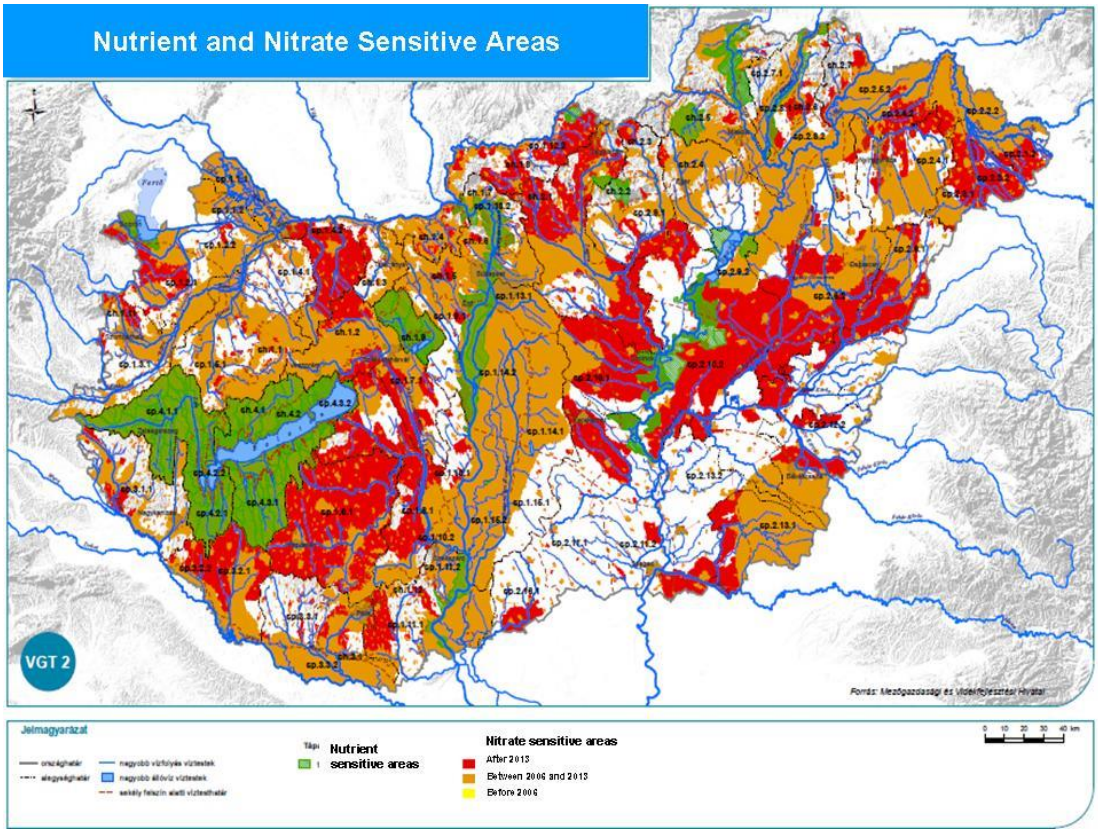
Fertilizer usage in 2015

Nitrogen-	Phosphorous-	Potassium-	TOTAL
fertilizer, in active substances			
Amount sold (1000 tons)			
358	81	80	520
For 1 ha agricultural area (kg)			
67	15	15	97

Source: Hungarian Central Statistical Office, Research Institute of Agricultural Economics

The nitrate-sensitive areas in Hungary total 6,526,800 ha, most of them in agricultural use. In respect of surface waters, the "highly nitrate-sensitive" designation was reserved for nutrient sensitive areas subject to Government Decree 240/2000 (23 December) "on the designation of surface waters and their catchment areas that are sensitive to settlement waste water treatment." (watershed areas of larger lakes and watershed areas of drinking water reservoirs.)

Map of nitrate sensitive areas in Hungary



Hungary's Government Decree 27/2006 (7 February) lists nitrate-sensitive areas specifying the settlements (1779 settlements) and makes reference to "Good Agricultural Practices" whereby

farmers will be able to meet the criteria articulated in Directive 91/676/EC, known as the Nitrate Directive. The rules of these "Good Agricultural Practices" are set in Ministerial Decree 59/2008 (29 April). The action programme includes the pursuit and enforcement of "Good Agricultural Practices," with aid and funding allocated for this purpose in the National Rural Development Plan and under the ARDOP.
Organizations and self-employed farmers cultivating nitrate-sensitive lands number 450,700. According to the General Agricultural Census (2000) data by the Hungarian Central Statistical Office, the farmers breeding livestock in nitrate-sensitive lands number 320,700. From the point of view of protecting water supplies, the greatest problems are presented by the liquid manure and waste water discharges of large, industrialized livestock farms raising pigs, cattle, and poultry. The most urgent task is to reduce harmful nitrate discharge. Harmful nitrate discharge in this country comes partly from inadequate manure storage methods at livestock farms as noted above and partly from the disposal of untreated sewage from settlements, neighbourhoods, and buildings without drain canals.

Pesticide pollution is derived from agriculture either from current use, drainage water, or from previous soil contamination. Relevant pesticide list (included in the nex Table) was compiled based on current use, presence in surface and groundwater and environmental persistence.

Table: Use of pesticides relevant for water resource protection (2013-2014)

Name of plant protection products	Area treated (ha)	Application cases
2, 4-D (dichlorophenoxy acetic acid)	8599	1302
acetochlor	133	40
atrazine	45	15
dicamba	16530	2999
Dimethenamid-P	7644	1145
captan	7944	3011
sulphur	42331	24930
chlorpyrifos	18536	2799
mancozeb	13013	8144
metazachlor	6023	709
Copper-hidroxide	6586	3817
S-metholachlor	14519	2531
Tebuconazole	50345	10179
terbutilazine	16386	3006

3.2.4 Forest

Forests covers 2,56 million ha in Hungary and they can be found predominantly in the hills and mountains and less in the lowland, which latter makes 2/3 of the area of Hungary (central and eastern parts). The area of forests has been growing steadily in the last decades. The two major type of the forest ownership are state forests and private forests. The forest management is determined by the function of a given forest. In that respect, the most widespread type is the for-profit "economic" forests that makes 59% of the forest area. It was followed by the "protection" forest with 34%. That type includes all forests that are designated for nature and landscape conservation, preventing soil erosion, game reserves, forests serving water management functions or protecting artificial objects (roads, railways, buildings, etc.). Forests designated for nature conservation gives 42% of all forest areas. Invasive black locust is also considered as a forest-making species in the forestry statistics.

Forest land, forest cover in 2015

Category	area (1000 ha)
TOTAL land	**9 303**
Total land under forest management	2 061
from which: - Area covered with forest stands	1 941
- State-owned forests	1 067
- Public-owned forests	20
- Private forests	854
Forest cover (%)	**20.9**

Source: National Food Chain Safety Office

Afforestation in 2015

Type	Reforestation (ha)	Forestation, forest establishment (ha)
State forest holders	7 241	135
Other forest holders (private and public)	9 452	183
TOTAL	**16 693**	**318**

Source: National Food Chain Safety Office

The climatic and geographic features of a given area determine the species for the given area. As for the type of dominant tree species 89% of the forests is deciduous and 11% is coniferous forest. Most widespread forest species in Hungary are Oaks (Quercus spp.) covers 387,000 ha, European Turkey oak (Quercus cerris) follows with 208,000 ha, beech (Fagus sylvatica) can be found on 110,300 ha, common hornbeam (Carpinus betulus) gives 96,300 ha. He invasive black locust (Robinia pseudoacacia) also forms "forests" in Hungary that covers 447,900 ha. Other hardood species (maple, elm, ash species) covers 110,000 ha.

Softwood forests that can be found mostly along rivers and in floodplains cover 294,500 ha, out of which 40% is poplar clones for industrial use.

Finally, conifers cover 207,600 ha, out of which 58% is Scots pine (Pinus sylvestris), 31% is the black pine (Pinus nigra) that is alien to Hungary and 11% other coniferous species.

According to the following table there are some differencies in the share of species whether we consider the categories of occupied land, standing tree stocks or wood production.

Distribution of forest species in Hungary

Species	Occupied land (%)	Standing tree (%)	Wood production (%)
Oak	20.8	23.3	13.7
Acacia	24.0	13.5	23.0
Pine	11.3	15.0	12.6
Turkey oak	11.1	12.6	11.7
Other deciduous	11.1	12.0	7.4
Aspen	10.5	8.0	18.0
Beech	6.0	10.8	9.7
Hornbeam	5.2	4.8	4.0

As an improvement the wastewater treatment plant in Nagykálló was renewed in 2014 under the National Wastewater Program. The plant treats Nagykálló's and Biri's urban waste water. Previously it was operated as a water treatment plant using aspen plantations. After the renewal the treated and purified wastewater flow into an overflow reservoir system now by gravity, from where it is possible to irrigate the surrounding area.

The General Directorate of Water Management recently initiated a project proposal on the practical feasibility of wastewater reuse. The project would be implemented in dry pilot areas such as the 'Kecskemét-Tiszaalpár' plot. Within the framework of the project such possibilities as energy production, agricultural use, irrigation etc. would be examined aiming to reuse wastewater of Kecskemét and Kiskunfélegyháza.

Floodplain forests play a crucial role in flood management having the capacity to slow down the flow of waters. 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 in Hungary. One of the cheaper solution is to remove of the vegetation which caused run-off barriers. This implemention helps to provide better run-off conditions. In some zones clearcut is planned while in other places undergrowth of the forests on floodplain will be taken away.

River Basin Management Plan for Hungary, developed in 2009 and 2015, refers to improve not just ecological status of waters but improve management of water supply. One of the solutions that satisfy both demands is 'giving more space to the rivers', developing their hydromorphology and improve water retention capacity on rivers' floodplains.

Drinking water resources especially that are results of infiltration of surface water are often covered by softwood forests. Such area can be found e.g. in the Szentendre island that is the drinking water source protection area for wells that serve potable water to Budapest. The potable water comes from the surface water as infiltrated mainly from Danube through the bank.

The establishment of agro-forestry systems is considered a new potential development area in terms of diversification. 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. This new 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. In agro-forestry system tree plantation in a broad network or tree lines, keeping animals, provide for the multi-purpose use of the given land. The selection of species that fit the needs and the conditions of the area, and, to secure the continuation of agricultural land use, the planting of arboreal plants and herbs for the *creation of wooded grazing areas, grassland protecting shrubbery and tree lines and groups of trees, extensive grazing, broad network of trees for wood production for industrial purposes, forest fruit (apple, cherry, walnut, mulberry, apricot, pear, almond, sour cherry, chesnut, plum), medicinal herb and honey production*.

3.2.5 Pastures

Animals stock increased by 0,8% since 2013. About 90% of the livestock is concentrated in large farms with more than 500 animal units – that ration has not changed since 2010. The main breeds are cattle, sheep, pig and poultry. The numbers of livestock in the end of 2015 were as follows: 821,000 cattle, 1,2 million sheep, 3,1 million pig and the number of poultry (all breeds combined) was 37 million. The major types of livestock breeding are extensive and non-extensive breeding. Sheep, horses and partly cattle are kept extensively using pastures for grazing. It is almost exlusively the cattle that is bred also non-extensively in stables. Pigs are not relevant respecting pastures. ***Also recently, according to Hungarian legislation, grazing of any livestock breed is forbidden in forests. According to a new scheme (agro-forestry systems) amendment of this rules will be change in floodplain forests***.

Pastures make 7,4% of the area of Hungary that is 688,200 ha. As follows from the number of livestock, pastures are grazed predominantly by sheep and cattle, and less by horse and other livestock. Livestock grazing has an important role in the conservation management of Natura 2000 grasslnad areas. Those areas are semi-natural habitats transformed from natural steppes through hundreds of years by livestock grazing. Due to the geographical position, Hungarian grasslands can be considered the westernmost Eurasian steppe or steppe-like areas hosting a diverse flora and fauna with significant populations of steppe species that cannot be found more

to the west. Thus agri-environmental support schemes was – and probably will be – available for nature friendly grazing to conserve those wild flora and fauna. Of course, such management has positive impact also on water quality.

In addition, there are legal obligations on grazing and livestock breeding on drinking water basis regulating the number of animals, treatment of manure, etc. in line with WFD.

3.2.6 Transport units

Hungary has one of the highest motorway densities in all of Europe and the third highest road density, after Belgium and Holland. Highways reach the borders of the country and the different regions of Hungary. Hungary has a central location in Europe, at the crossroads of four main European transportation corridors. Major Hungarian towns are connected to the capital city, Budapest, by motorways.

Due to its central location, Hungary has an extensive railway network. Rail transport carries more than 20% of total freight, which is well above the EU average. Several main train lines connect Hungary with the main ports of Western Europe and the Adriatic with regular services. The total length of the Hungarian railway system is 7,729 km, of which double-track is 1,335 km (17.3%) and the electrified railway network is 2,628 km (34%). Záhony and its region is the junction and reloading centre for European standard-gauge railways and the wide-gauge system of the CIS states.

Hungary has excellent waterway connections, as the Danube crosses through the whole country from north to south. The Danube-Rhine-Main canal in Europe links the North Sea and the Black Sea: several scheduled block train lines connect Hungary with the seaports on the North Sea, and on the Adriatic.

Runoff from transport areas may carry rubbish, petroleum compounds, salts, and contaminants from air deposition (e.g. heavy metals) including greenhouse gases as well. The contaminants from transportation can be detected in surface and groundwater as well. Eco-friendly de-icing alternatives are more and more used in the last decades like Calcium Chloride or Magnesium Chloride (both in liquid form), just sand or zeolite granulates on pavement. Also the anti-icing technology instead of de-icing is spreading. Anti-icer brine solutions are applied prior to snowfall to prevent snow and ice from bonding to the pavement.

3.3 Impact of land use activities on water quality and quantity floods/droughts - DPSIR approach for the present/past state - prioritize national issues in DPSIR

Impact on water resources quality an quantity				
URBAN AREAS				
Driving forces	**Pressures**	**State (ECOSYSTEM SERVICES)**	**Impacts**	**Responses (MEASURES)**
areas without sewage system	Emission of microbiological pollutants, nutrient N&P compounds	High values of N&P compounds in groundwaters	Deterioration of groundwater quality	construction of the sewage system and devices for wastewater treatment KTM 1
sealed artificial surfaces and pollution deposition from air	discharge of surface pollutants (e.g. from traffic, construction sector)	increased amount of pollutants contained in water	deterioration of water quality (both surface and ground water)	increase the amount of green surfaces KTM 21
sealed surfaces	decreased infiltration capacity	decreased water recharge	decreased water quantity	implementation of decentralized infiltration measures KTM 21
areas without waste water treatment plants	emission of microbiological pollutants, nutrients and priority substances	microbiological pollution, N & P compounds, farmaceuticals, heavy metals	deterioration of groundwater quality – impact on human health	Set up of waste water treatment plan for sewage system Set up of individual treatment plants for individual houses KTM 1
centralized rainwater infiltration	limited drainage capacity	increased amounts of polluted sewer waters in combined sewers	contamination of surface waters in case of overflowing sewers	implementation of decentralized rainwater infiltration KTM 21
centralized rainwater infiltration	decreased infiltration capacity	decreased water recharge	decreased water quantity	implementation of decentralized infiltration

				measures KTM 21
Climate Change	flash floods risk increased	Flood peaks increased and urban runoff quality worsen: turbidity, nutrient, priority substances	Erosion processes Surface water quality deteriorate Less infiltration to groundwater	Integrated urban planning; Urban flood risk management; KTM 24 Natural water retention measures; KTM 23
High leakage of water supply systems	Overabstraction	quantity status deterioration	ecological flow cannot be garantied	establishemnet of reconstruction programme and financing strategy for depreciation KTM 8, KTM 9
AGRICULTURE				
Driving forces	**Pressures**	**State**	**Impacts**	**Responses**
use of fertilisers (N consumption)	Diffuse N contribution (runoff and percolation)	growing nitrates concentration	Deterioration of groundwater quality, impact on human health	precision agriculture and/or ecological agriculture KTM 2
innappropriate collection or use of manure	soil and groundwater pollution caused by nitrates and pathogens	values of nitrates and pathogens above legally permitted limit values in some areas	deterioration of groundwater quality, impact on human health	training of farmers; KTM 12 investments into manure storage KTM 2
conventional soil tillage	soil compaction and increased interflow and surface runoff	decreased groundwater recharge	decreased water availability and provision for supplying purposes	fostering conservation tillage, non-turning techniques KTM 23
use of pesticides	diffuse load of pesticides	some pesticides (especially persistent ones like Triazine) exceed the thresholds	deterioration of groundwater and surface water quality	Precision agriculture; Control of pesticide usage; Prohibition of pesticide application in DWPAs KTM 3
agricultural areas in floodplain	diffuse pollution to surface waters	Eutrophic surface waters or not good	Deterioration of surface waters	Land use change Organic farming

		chemical status	quality	Riparian buffer strip KTM 2, KTM 3
INDUSTRIAL UNITS				
Driving forces	**Pressures**	**State**	**Impacts**	**Responses**
Industrial waste waters	emissions of pollutants to ground and surface waters	pollutants in ground and surface waters (e.g. heavy metals, organic pollutants)	deterioration of ground and surface water quality, impact on human health	implementation of appropriate measures, better monitoring KTM 15
Old industrial locations	soils contaminated with industrial sector-specific pollutants	contamination of groundwater	deterioration of groundwater quality, impact on human health	more stringent persecution of contaminated site remediation KTM 4
sealed surfaces	decreased infiltration capacity	decreased water recharge	decreased water availability and provision for supplying purposes	implementation of decentralized infiltration measures, e.g. desealing KTM 21
accidental pollution from industry	Emission to surface and/or groundwater	Point source pollution plumes in surface and groundwater, contaminated sites	deterioration of groundwater or surface water quality	Remediation of contaminated sites KTM 4
TRANSPORT UNITS				
Driving forces	**Pressures**	**State**	**Impacts**	**Responses**
road accidental spills	emission of fuel, oil and other dangerous substances	contaminated soil, possible infiltration of fuel, oil or other dangerous supstances into groundwater	deterioration of soil and water quality	effective action plan in case of spills, low reaction time and fast intervention KTM 21
FORESTS				
Driving forces	**Pressures**	**State**	**Impacts**	**Responses**
clear cuting	increased runoff, humus degradation, soil erosion	Low water protection capacity	Increased soil erosion, increased solid and nutrient content in source	continuous forest cover KTM 13

			waters	
Agro-forestry scheme	Agricultural activity in the forest (e.g. grazing)	Pollution from agricultiral activities	Higher nutrient content of the waters	Control on agricultiral activities to keep extensive usage KTM 2, KTM 3
Plantations (monoculture)	Decreased water retention	Less water protection capacity	Fewer ecosystem services	Promotion of mixed plantation KTM 13
removal of deadwood	reduced formation of humus	decreased water purification	increased leaching of free nutrients and air pollutants	fostering an adequate deadwood management KTM 6
spreading of invasive species	Plantation of alien species	Less water protection capacity purification	Fewer ecosystem services	Promotion of plantation of native species KTM 18
Use of heavy machineries	destroyed soil structure	induce bad land formation	increased linear erosion	controlling of working and transport in the forests KTM 22
Climate change – ice damage in forest	clear cutting of damaged areas	Low water protection capacity	Increased soil erosion, increased solid and nutrient content in source waters	afforeastation KTM 22
PASTURES				
Intensive grazing	manure droppings	values of nitrates and pathogens above legally permitted limit values in some areas	deterioration of groundwater or surface water quality	Control of grazing Prohibition in DWPAs KTM 2
Intensive manuring of grasslands	diffuse N contribution	values of nitrates and pathogens above legally permitted limit values in some areas	deterioration of groundwater or surface water quality	Control on manure management Prohibition in DWPAs KTM 2
plowing up of grassland	diffuse N contribution (runoff and percolation)	growing trends of nitrate concentrations	deterioration of groundwater quality, impact on human health	implementation of measures for advisory and financial support to avoid conversion of

				grassland KTM 12, KTM 11
Impact on floods/drouhts				
URBAN AREAS				
Driving forces	**Pressures**	**State**	**Impacts**	**Responses**
sealed surfaces	decreased infiltration capacity	decreased water retention	deterioration of non-structural flood protection	implementation of retention measures KTM 23 & other
insufficient dimensioning of sewer systems	limited drainage capacity	decreased water retention	increased risk for flash floods (overflow through exceeded drainage capacity) and river floods (backflow through increased river water level and impounded sewer water)	reassessment of sewer systems, fostering implementation of seperated sewers
urban development	Development of urban zones in flood prone areas - vulnerable structures in the flood hazard zones	Vulnerable structures and activities in the flood hazard zones	Vulnerable structures and activities in the flood hazard zones	Protection of vulnerable structures (constructive measures) - retention basins, dykes, diversion canals...
river regulation in urban areas	longitudinal hydromorfological modification of surface water bodies faster runoff	deteriorating ecological status flood risk managed at urban area but higher risk below	deterioration of ecosystem service capacity	rehabilitation, restoration of natural conditions or usage of environmental friendly solution in river regulation KTM 6
AGRICULTURE				
Driving forces	**Pressures**	**State**	**Impacts**	**Responses**
conventional soil tillage	soil compaction	decreased infiltration capacity and water retention	enhanced overland flow contribution to direct runoff	fostering conservation tillage, non-turning techniques KTM 23
understanding of	Reduced	Clogged and	Increased runoff	Improved practice

role of drainage in agriculture	maintenance of agricultural drainage systems	inefficient Reduced retention capacity of agricultural land	and related flooding	of agricultural drainage KTM 23
Drainage of agricultural areas (especially excess water inundated areas)	diffuse pollution to surface waters indirect discharge from groundwater	Eutrophic surface waters or not good chemical status of surface water, deterioration of groundwater quantity	Deterioration of surface waters quality Groundwater level decrease	Greening of frequently inundated areas (land use change to grassland, wetland, agro-forestry) Natural water retention measure KTM 23
Water waster irrigation systems (existing)	Overabstraction	quantity status deterioration	ecological flow cannot be garantied	Technical development for water saving; Metering and controlling KTM 8
development of irrigation	increasing water abstraction	quantity status deterioration	ecological flow cannot be garantied	Control on development to ensure water savings and metering KTM 8
climate change	prolongated drought	quantity status deterioration	ecological flow cannot be garantied	Drought Mitigation measures KTM 7
INDUSTRIAL AREAS				
Driving forces	**Pressures**	**State**	**Impact**	**Response**
development of industrial areas	Sealed land (buildings, parking lots etc.) and urbanized watercourses	Increased runoff due to the sealed surfaces	Flooding more serious	Development of retention capacities - urban agriculture, dispersed development of retention basins

existing industrial areas in flood prone zones	Investments/ measures in the protection of existing industrial facilities	Industrial facilities exposed to flooding	Inducing reduction of flood retention volumes without compensation	Self-protection for industrial areas
FORESTS				
Driving forces	**Pressures**	**State**	**Impacts**	**Responses**
clear cuting on floodplain	increased runoff, humus degradation, soil erosion	Lower flood risk	Flow capacity increase	continuous forest cover with undergrowth management KTM 13
clear cuting on catchment	increased runoff, humus degradation, soil erosion	Higher flood risk	Increased runoff	continuous forest cover KTM 13
removal of deadwood on floodplain	increased runoff, decreased humus formation,	decreased water retention	Flow capacity increase	promoting an adequate deadwood management
missing or cutting undergrowth vegetation on floodplain	increased runoff, decreased humus formation,	decreased water retention capacity	Flow capacity increase	adequate control on undergrowth vegetation with focus on invasive species

4. SWOT analysis and evaluation of gaps

STRENGTHS	WEAKNESSES
- implementation of DWPZ for drinking water sources with limitations of spatial planning and activities in those areas - Hungary has well established system for regulation of groundwater and surface water abstraction (water permits) - considering the protective function of aquifer protection layers in the planning process of DWPZ - Flood Risk Management Plan and flood risk management maps of Hungary accepted by Government - River Basin Management Plan of Hungary accepted by Government - methodology for designation of DWPAs - development of supplying networks from different drinking water production areas to ensure a continuous water supply with clean drinking water - advisory system and support of EARDP for farmers to implementation agro-environmental measures - acceptance of river basin management plan and flood risk management plan - UN Sustainable Development Goals approved by several governments/politicians	- conflicts of interests in DWPZ areas (agricultural lobby, industry) - insufficient inspections of good legislation implementation - unstable public administrative structure with several organizational changes in last decades especially on water sector - data quality and water databases are not reliable in all aspects - Despite of the designation of DWPZs, not all DWPZs get decision by water authority - No compensation for the owner of the area of the designated DWPAs - Insufficient education or disinterest of local population and farmers in some regions - low percentage of wastewater reused - developing needs in rainwater management - losses from water utilities - lack of the individual sewage treatment - low willingness to cooperate between farmers, other stakeholders and water suppliers to ensure water protection - financial commitments are not enough to implement completely the Program of Measures of RBMP/FRMP - single area payment scheme (SAPS) and primarily direct payments to farmers weakly support environmental protection, implementation of “greening” not really effective
OPPORTUNITIES	**THREATS**
- use of ecosystem services - combined approach addressing droughts and floods with multiuse reservoirs	- lack of investments into sewage and waste water treatment - climate change with more intensive

- to use of EU funds, particularly agricultural, structural and cohesion funds for co-financing projects to manage groundwater and surface water resources - The upgrading of the requirements of water management in urban planning - increase the number of co-operations between stakeholders - intensification of the cooperation between farmers and water suppliers to enhance the drinking water protection in and beyond the borders of DWPA - ensuring minimum ecological flow in drought-endangered river basins - fostering awareness of humans to flood risks to increase the individual protection of humans and belongings - synchronized water protection and flood risk management measures - realization of "greening" scheme to enhance water protection - promotion of precision agriculture - research on ecosystem services	precipitation and dry periods - No effective control of groundwater and surface water abstraction by water authorities - Lack of the authority decisions of the DWPAs - climate change impact on water resources - alien and invasive species deteriorate ecosystem services - complicated and unsettled ownership of agricultural lands, forests, watercourses, etc. - unknown impact of priority substances (e.g. biocides, drugs) on ecosystem

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Notes:

Abbrevations and references according to the 2000/60/EC Water Framework Directive (WFD)

WFD Article 11.3.a basic measures

BWD	Bathing Water Directive (76/160/EEC)
BD	Birds Directive (79/409/EEC)
DWD	Drinking Water Directive (80/778/EEC) as amended by Directive (98/83/EC)
Seveso	Major Accidents (Seveso) Directive (96/82/EC)
EIA	Environmental Impact Assessment Directive (85/337/EEC)
SSD	Sewage Sludge Directive (86/278/EEC)
UWWTD	Urban Wastewater Treatment Directive (91/271/EEC)
PPPD	Plant Protection Products Directive (91/414/EEC)
ND	Nitrates Directive (91/676/EEC)
HD	Habitats Directive (92/43/EEC)
IPPCD	Integrated Pollution Prevention Control Directive (96/61/EC)

WFD ARTICLE 11.3.B-L OTHER BASIC MEASURES

Article	Short name
11.3.b	Measures for the recovery of cost of water services (Article 9)
11.3.c	Measures to promote efficient and sustainable water use
11.3.d	Measures for the protection of water abstracted for drinking water (Article 7)
11.3.e	Controls over the abstraction of fresh surface water and groundwater and impoundment of fresh surface waters
11.3.f	Controls, including a requirement for prior authorisation of artificial recharge or augmentation of groundwater bodies
11.3.g	Requirement for prior regulation of point source discharges liable to cause pollution
11.3.h	Measures to prevent or control the input of pollutants from diffuse sources liable to cause pollution
11.3.i	Measures to control any other significant adverse impact on the status of water, and in particular hydromorphological impacts
11.3.j	Prohibition of direct discharge of pollutants into groundwater
11.3.k	Measures to eliminate pollution of surface waters by priority substances
11.3.l	Any measures required to prevent significant losses of pollutants from technical installations and to prevent and/or reduce the impact of accidental pollution incidents

25 defined Key Type Measures (KTM)

Selection regarding drinking water and floods (for PROLINE-CE project):

red-relevant, orange-partly relevant, black-not relevant

KTM1. Construction or upgrades of wastewater treatment plants

KTM2. Reduce nutrient pollution from agriculture

KTM3. Reduce pesticides pollution from agriculture.

KTM4. Remediation of contaminated sites (historical pollution including sediments, groundwater, soil).

KTM5. Improving longitudinal continuity (e.g. establishing fish passes, demolishing old dams).

KTM6. Improving hydromorphological conditions of water bodies other than longitudinal continuity

KTM7. Improvements in flow regime and/or establishment of ecological flows.

KTM8. Water efficiency technical measures for irrigation, industry, energy and households

KTM9. Water pricing policy measures for the implementation of the recovery of cost of water services from households

KTM10. Water pricing policy measures for the implementation of the recovery of cost of water services from industry

KTM11. Water pricing policy measures for the implementation of the recovery of cost of water services from agriculture

KTM12. Advisory services for agriculture

KTM13. Drinking water protection measures (e.g. establishment of safeguard zones, buffer zones etc)

KTM14. Research, improvement of knowledge base reducing uncertainty.

KTM15. Measures for the phasing-out of emissions, discharges and losses of priority hazardous substances or for the reduction of emissions, discharges and losses of priority substances.

KTM16. Upgrades or improvements of industrial wastewater treatment plants (including farms)

KTM17. Measures to reduce sediment from soil erosion and surface run-off

KTM18. Measures to prevent or control the adverse impacts of invasive alien species and introduced diseases

KTM19. Measures to prevent or control the adverse impacts of recreation including angling

KTM20. Measures to prevent or control the adverse impacts of fishing and other exploitation/removal of animal and plants

KTM21. Measures to prevent or control the input of pollution from urban areas, transport and built infrastructure

KTM22. Measures to prevent or control the input of pollution from forestry

KTM23. Natural water retention measures

KTM24. Adaptation to climate change

KTM25. Measures to counteract acidification