Integrated Tisza River Basin Management Plan

List of Acronyms

AEWS	Accident Emergency Warning System
ARS	Accidental Risk Spots
BAT	Best Available Techniques
BAP	Best Agricultural Practice
BEP	Best Environmental Practices
BLS	Baseline Scenario
CAP	Common Agricultural Policy
COD	Chemical Oxygen Demand
DBA	Danube Basin Analysis 2004
DRB	Danube River Basin
DRBD	Danube River Basin District
DRBM Plan	Danube River Basin District Management Plan
DRPC	Danube River Protection Convention
EG	Expert Group
EIA	Environmental Impact Assessment
EPER	European Pollutant Emission Register
EU MS	EU Member State(s)
FD	EU Flood Directive (2007/60/EC)
FIP	Future Infrastructure Projects
Non EU MS	Non EU Member State(s)
EU WFD	European Water Framework Directive
GDP	Gross Domestic Product
GEP	Good Ecological Potential
GES	Good Ecological Status
GVA	Gross Added Value
GW	Groundwater
GWBs	Groundwater bodies
HMWB	Heavily Modified Water Bodies
ICPDR	International Commission for the Protection of the Danube River
ITRBM Plan	Integrated Tisza River Basin Management Plan
JAP	Joint Action Programme
JPM	Joint Programme of Measures
MONERIS	MOdelling Nutrient Emissions in RIver Systems
MS	Member State(s)
PRTR	Pollutant Release and Transfer Register
RBM	River Basin Management
SEA	Strategic Environmental Assessment
SWMI	Significant Water Management Issue
TAR	Tisza Analysis Report - 2007
TNMN	Transnational Monitoring Network
TOC	Total Oxygen Demand
TN	Total Nitrogen
TP	Total Phosphorus
TRB	Tisza River Basin
UNDP/GEF	United Nations Development Program / Global Environment Facility
UNEP CC	United Nations Environment Programme - Carpathian Convention Interim Secretariat

UWWTP	Urban Wastewater Treatment Plant
UWWTD	Urban Waste Water Treatment Directive
WFD	Water Framework Directive (2000/60/EC)
WWTP	Wastewater Treatment Plant

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The overall coordination of ICPDR Tisza activities was done by **Ms Diana Heilmann.**

The final editing of the report done by **Ms Kirstie Shepherd.**

Disclaimer

This Integrated Tisza River Basin Management Plan (ITRBM Plan) is based on data provided by September 2010 (reference year 2007) and contributions from the Tisza countries. Data introduced in this document are based on DanubeGIS information, delivered by Ukraine, Romania, Slovakia, Hungary and Serbia.

This document has been prepared for the ICPDR Heads of Delegation, ‚policy makers, experts related to water management issues to outline pressures and measures relevant for the Tisza River Basin. The ITRBM Plan was introduced to the interested parties and stakeholders of the Tisza River Basin with the intention that the final plan will be presented to the ICPDR Heads of Delegation for their endorsement by the end of 2010. This documents should also serve as a basis to initiate further discussions with relevant sectors specified under the integration chapter.

In comparison with the DRBDM Plan, the ITRBM Plan took into account rivers with catchment size larger than 1,000 km^2 instead of 4,000 km^2; natural lakes >10 km^2 instead of 100 km^2; main canals; groundwater bodies >1,000 km^2 and of basin-wide importance. This means that in comparison to the 11 identified transboundary groundwater bodies or groups of Danube Basin-wide importance, the Tisza countries have collected and evaluated information related to 85 groundwater bodies – all the national and transboundary groundwater bodies of importance to the Tisza River Basin.

The following issues are the overall pillars of this document and important to take note of before reading the draft ITRBM Plan:

- The ITRBM Plan follows the structure of the Danube River Basin Management Plan, with information at a higher resolution for the Tisza River Basin. Besides the significant water management issues (organic, nutrient, hazardous substances pollution, hydromorphological alteration), emphasis is placed on water quantity issues (floods, drought and climate change) and particularly integration of these issues with water quality.
- The ITRBM Plan is supported by the UNDP/GEF Tisza MSP project (*Integrating multiple benefits of wetlands and floodplains into improved transboundary management for the Tisza River Basin*) via the preparation of national strategies on pollution reduction, and flood and drought mitigation as well as via the implemented pilot projects in the Tisza River Basin.

The ITRBM Plan is based on Tisza countries' national plans and is harmonised with the outcomes of the Danube River Basin Management Plan. Hence, the ITRBM Plan should be read and interpreted in conjunction with the national river basin management plans. Where inconsistencies may have occurred, the national river basin management plans and WISE (Water Information System for Europe) reporting are likely to provide more accurate information.

Some specific issues to consider when reading the text of the ITRBM Plan:

- The number of river water bodies does contain double-counts, as countries designated a different number of water bodies for some transboundary sections. In the current count, all relevant country designations were taken into account. For the Tisza River, 11 river water bodies were identified as state boundary river water bodies. Reference will be made whether status assessment is harmonised for the transboundary sections.
- SWMIs and related assessments are relevant for both surface and groundwater, problem related to the groundwater issues, however, should be further detailed in the next RBM cycle.
- Floods and flood management related information are introduced in details in the Tisza Analysis Report – 2007 (TAR) and was not the intention to repeat those information already included in the TAR.
- Available information (introduced in the DRBDM Plan) related to sediment and invasive species are relevant for the whole Danube River Basin District and do not discussed separately in the current document.

List of Annexes

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Introduction

1.1 The Tisza River Basin

The Tisza River Basin (**Map 1**) is an important European resource, boasting a high diversity of landscapes which provide habitats for unique animal and plant life species, with a significant number of protected areas and national parks. The Tisza River Basin is blessed with rich biodiversity, including many species no longer found in Western Europe. The region has outstanding natural ecological assets such as unique freshwater wetland ecosystems of 167 larger oxbow-lakes and more than 300 riparian wetlands.

The total area of protected areas in the Tisza River Basin is 38,223 km^2, corresponding to about a quarter of the total area for the protected areas of the Danube River Basin District.

The Tisza River is the longest tributary to the Danube River, and flows through five countries. It drains 157,186 km^2 and its basin is the largest sub-basin of the Danube Basin (**Table I.1** and **Table I.2**). It is home to 14 million people from Ukraine, Romania, the Slovakia, Hungary and Serbia.

The Tisza River Basin can be divided into two main parts:

- the mountainous Upper Tisza and the tributaries in Ukraine, Romania and the eastern part of the Slovakia and
- the lowland parts mainly in Hungary and in Serbia surrounded by the East-Slovak Plain, the Transcarpathian lowland (Ukraine), and the plains on the western fringes of Romania.

The Tisza itself can be divided into three parts:

- the Upper Tisza upstream from the confluence of the Somes/Szamos River,
- the Middle Tisza in Hungary which receives the largest right hand tributaries: the Bodrog and Slaná/Sajó Rivers together with the Hornád/Hernád River collect water from the Carpathian Mountains in the Slovakia and Ukraine, and the Zagyva River drains the Mátra and Bükk, as well as the largest left hand tributaries: the Someş/Szamos River, the Criş/Körös River System and Mureş/Maros River draining Transylvania in Romania and
- the Lower Tisza (downstream from the mouth of the Mureş/Maros River where it receives the Bega /Begej River and other tributaries indirectly through the Danube – Tisza – Danube Canal System.

Table I.1: Coverage of the states in the Tisza River Basin and status within the European Union

Country	ISO-Code	Tisza River Basin area in the country (km^2)	Share of the Tisza River Basin (%) Per country	Share of the Tisza River Basin (%) In the whole country	Status in the European Union
Ukraine	UA	12,732	8.1	2.1	Non EU Member State
Romania	RO	72,620	46.2	30.5	EU Member State
Slovakia	SK	15,247	9.7	31.1	EU Member State
Hungary	HU	46,213	29.4	49.7	EU Member State
Serbia	RS	10,374	6.6	11.7	Potential Candidate EU Member State

Compared to the Sava River Basin, which has the largest discharge of water to the Danube and is the second largest by catchment area, the Tisza River Basin has nearly double the catchment size but only half the average discharge of the Sava River (see **Table I.2**). The population is higher in the Tisza River Basin (14 Million) than in the Sava River Basin (8.5 Million), resulting in a higher demand in water, which raises concerns about the need to ensure a harmonised and sustainable water resource management in the Tisza River Basin.

The Tisza River Basin provides livelihoods for many through agriculture, forestry, pastures, mining, navigation and energy production. The last 150 years of human influence, however, have caused serious problems for the basin's waters. The waters of the Tisza Basin are under the threat of pollution from organic substances from municipalities and urban settlements, nutrients from wastewater and farming and hazardous substances from industry and mining. In some cases, changes in land use and river engineering have reduced the length of the rivers (especially for the Tisza River) and modified the natural structure of the river and resulted in the loss of natural floodplains and wetlands. These changes have led to an increase in extreme events, such as severe floods (the most recent in the period from 1998 to 2006), periods of drought (particularly in Hungary and Serbia) as well as landslides and erosion in the uplands (in Ukraine and Romania).

In the Tisza River Basin Analysis 2007 (analysis report), waters of the Tisza River Basin were characterised by ecoregions (see **Map 2**), by river typology and by defining reference conditions for biological quality elements of the EU Water Framework Directive (WFD). In the analysis report as well as in the current plan the following water bodies were assessed[1]:

- Tisza River and its tributaries with a catchment size of >1,000 km^2;
- main canals;
- natural lakes >10 km^2;
- groundwater bodies >1,000 km^2 and of basin wide importance. This means that in comparison to the 11 identified transboundary groundwater bodies or groups of groundwater bodies of Danube Basin-wide importance, the Tisza countries have collected and evaluated information related to 85 national and transboundary groundwater bodies important to the Tisza River Basin..

Tables I.2 – I.6, **Figures I.1-I.2** as well as **Map 3** and **Map 4** introduce the updated results of the analysis report.

Table I.2: Basic information about the Danube River Basin District and largest sub-basins of the Danube, Tisza and Sava River Basins

River basin	Length (km)	Size of catchment (km^2)	Inhabitants (million)	Average discharge at the mouth (m3/s)	Time series for discharge values
Danube River Basin District	2,857	807,827	80.5	6,500	(1914-2003)
Tisza River Basin	966	157,186	14	825	(1946-2006)
Sava River Basin	945	97,713	8.5[2]	1,559	(1946-2006)

[1] The DRBMP focuses on rivers with a catchment size of >4,000 km^2, all lakes with an area >100 km^2, the main canals, transitional and coastal waters, all transboundary groundwater bodies >4,000 km^2, transboundary groundwater bodies < 4,000 km^2 if they are very important.

[2] Approximate data

Table I.3: General socio-economic indicators (data source: Competent authorities in the Tisza River Basin unless marked otherwise)

Country	Number of inhabitants in the Tisza River Basin	Employees total	GDP (million EUR)	GDP per capita (EUR per capita)
Ukraine	1,248,000	247,400	70,381	857[3]
Romania	5,208,000	2,499,840	21,132	4,058
Slovakia	1,670,000	689,238	8,000	4,790
Hungary	4,048,562	1,382,764	22,095	5,459
Serbia	964,574	392,751	2,170	2,250

Table I.4: Number and lengths of water bodies at the Tisza River

Country	Number	Mean length [km]	Min [km]	Max [km]
Ukraine	7	43.1	14.2	107.4
Romania	1	61.0	-	-
Hungary	8	68.9	21.1	161.0
Slovakia	1	5.4	-	-
Serbia	2	84.5	67.2	101.8
	Σ 19[4]			

Table I.5: Number and lengths of water bodies at tributaries of the Tisza River Basin

Country	Number	Mean length [km]	Min [km]	Max [km]
Ukraine	16	34.1	4.8	76.6
Romania	101	35.7	1.0	214.0
Hungary	43	40.35	4.9	93.7
Slovakia	30	32.7	11.0	86.4
Serbia	14	44.0	13.7	91.4
	Σ 204[5]			

In 2009 Tisza River countries identified 223 water bodies (four more than were initially identified in 2007) – showing that slight changes in identification of water bodies has happened since 2007.

[3] The number shows GDP per capita for the Ukrainian Tisza Basin (Zakarpattia Oblast). The Ukrainian average is 1,494 EUR per capita.

[4] The number does contain double-counts, as for some transboundary sections countries designated a different number of water bodies. In the current count, all relevant country designations were taken into account. In case of the Tisza River, 11 water bodies were identified as state boundary water bodies. Reference will be made as to whether the status assessment is harmonised for the transboundary sections.

Table I.6: Basic characteristics of the Tisza River Basin

Tisza River Basin area	157,186 km^2
Tisza countries	EU Member States (3): Hungary, Slovakia, Romania. Non EU Member States (2): Serbia and Ukraine.
Inhabitants	Approximately 14 million
Length of Tisza River	966 km
Key tributaries of the Tisza River with catchment areas >1,000 km^2	Chorna Tisza, Bila Tisza, Vişeu, Iza, Teresva, Rika, Borzhava, Tur/Túr, Someș/ Szamos, Sieu, Somesul Mic, Lăpuș, Crasna/ Kraszna, Bodrog, Uzh/Uh, Laborec, Latorica,Topla, Ondava, Hornád/Hernád, Torysa, Rimava, Slaná/Sajó, Bodva/Bódva Zagyva , Tarna, Hármas Körös, Crişul Alb/ Fehér-Körös/, Crişul Negru/ Fekete-Körös/, Kettös-Körös, Crişul Repede/ Sebes-Körös/, Barcău/Berettyó, Ier, Kati-ér, Sarkad-Mérges Sáros ér Hortobágy – Berettyó , Dongéri fcs, Kálló-ér Mureș/ Maros , Arieş, Tarnava , Tărnave Mica, Sebeş, Strei , Aranca/Zlatica, Bega/ Plovni Begej,Bega Veche /Stari Begej, Bajski kanal,
Natural lakes >10 km^2	Tisza-tó, Szegedi – Fehér tó, Csaj-tó
Groundwater bodies with catchment areas >1,000 km^2 [5]	85 groundwater bodies (national and transboundary)
Main canals	Danube-Tisza-Danube Canal Hortobágy Main Canal, Eastern Main Canal, Western Main Canals, Vajai III, Ér and Lónyai Main Canal
Important water uses and services	Water abstraction (industry, irrigation, household supply), drinking water supply, wastewater discharge (municipalities, industry), hydropower generation, navigation, dredging and gravel exploitation, recreation, various ecosystem services.

[5] For areas in size less than 1,000 km^2, groundwater bodies were also considered according to their socio-economic importance, uses, impacts, pressures, interaction with aquatic ecosystems, etc.

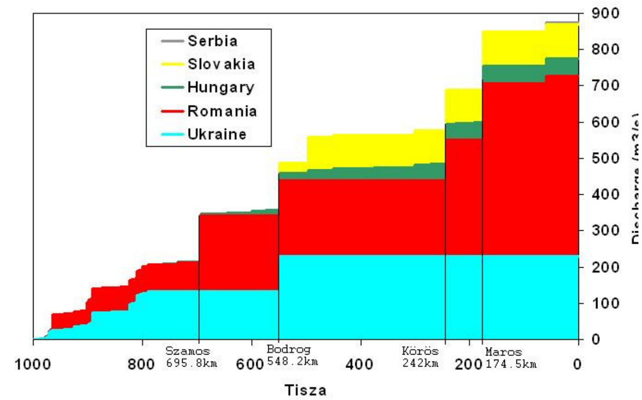

Figure I.1: Longitudinal profile of the Tisza River and contribution of water from each country (in percentage) to the mean discharge of the Tisza (in m3/s)[6]

Figure I.2. is based on the information provided in the completed Risk Assessment Templates[7] and included in the analysis report. Based on the data shown in the figure it was estimated that more than 60% of the Tisza is 'at risk' or 'possibly at risk' due to **organic pollution** and **nutrient pollution**, and approximately 100% of the Tisza River is 'at risk' or 'possibly at risk' due to hazardous substances and hydromorphological alterations.

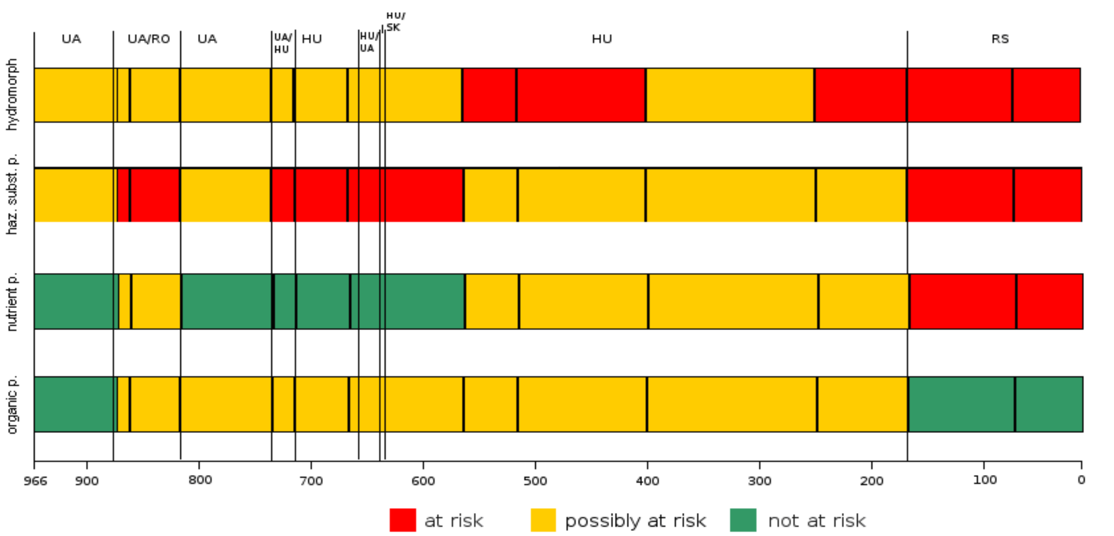

Figure I.2. Results of the risk analysis for the entire Tisza River length (Tisza Analysis Report 2007)

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[6]Information based on data of the JRC-IES dataset (1991-2002) and runs of the VITUKI NFHS flood routing module

[7]To correctly interpret the information, it should be considered that in three transboundary Tisza sections, shared by Ukraine/Romania, Ukraine/Hungary and the SlovakiaSlovakia/Hungary, non-harmonised risk assessment results and river kilometres were reported by the riparian countries. In these cases, only the data of one riparian country could be illustrated in the figure.

In the Tisza River Basin, approximately 70% of the total tributary water bodies were assessed as 'at risk'. The main water bodies 'at risk' lie in Romania (which also has the largest number of water bodies of the Tisza River Basin), the Slovakia, Hungary and Serbia. Tributary water bodies possibly at risk (15% of the total) were reported by all Tisza countries except for Serbia. Tributary water bodies not at risk (14% of the total) are found in Ukraine, the Slovakia and Romania.

The Tisza tributaries are at risk mainly due to **hydromorphological alterations** and **nutrient pollution** followed by organic pollution and hazardous substances. Hazardous substances, however, were the main reason for the classification of tributary water bodies as 'possibly at risk' (especially in Romania, Hungary and the Slovakia).

In 2007, the majority (88%) of the transboundary groundwater bodies was reported as not at risk in terms of **chemical status** (quality). Transboundary groundwater bodies at qualitative risk (12%) were reported by the Slovakia, Romania and Ukraine.

Of the nominated transboundary groundwater bodies, 85% were assessed as 'not at risk' in terms of quantity status. Transboundary groundwater bodies at quantitative risk were reported by Hungary (3%) and groundwater bodies possibly at risk were reported by Serbia and Ukraine (12%).

1.2 Cooperation in the Tisza River Basin

The Tisza Countries have a long history of cooperation including the agreement on the protection of the Tisza and its tributaries in 1986 and the establishment of the Tisza Forum to address flood issues in 2000. The Tisza countries are all parties to the Danube River Protection Convention (signed in Sofia in 1994 and entered into force in 1998), the most comprehensive agreement in force for all Danube countries. In addition, all Tisza countries are parties to the Carpathian Convention, which was signed in Kyiv, Ukraine in 2003 and entered into force in 2006.

At the first ministerial meeting of the ICPDR countries in December 2004, ministers and high-level representatives of the five Tisza countries signed the Memorandum of Understanding - *Towards a River Basin Management Plan for the Tisza River supporting sustainable development of the region.* The ICPDR established the Tisza Group as the platform for strengthening coordination and information exchange related to international, regional and national activities in the Tisza River Basin and to ensure harmonisation and effectiveness of related efforts.

The Tisza countries agreed to prepare a sub-basin management plan (the ITRBM Plan), which integrates issues of water quality and water quantity, land and water management, floods and drought. According to the countries' agreement, the draft Integrated Tisza River Basin Management Plan (ITRBM Plan) was developed in 2010, submitted to public participation process and the final plan was introduced to the ICPDR Tisza Countries Heads of Delegation in December 2010.

The first step towards the objective was the preparation of the analysis report in 2007, which is the first milestone in implementing the Memorandum of Understanding (MoU). This process is the basis for an updated MoU for the further cooperation.

The Tisza Analysis Report – 2007 (TAR) includes the characterisation of surface waters and groundwater, introduces pressures and risks, addresses issues related to mining, gives an inventory of protected areas, includes an economic analysis, elaborates on activities within public participation and provides an outlook on further activities.

The analysis report concluded that this region faces serious threats from pollution and structural changes as well as from floods and droughts. The 150 years of human influence in the region – including activities such as farming, forestry, mining and river engineering, all essential to the livelihoods of the people in the basin – have contributed to problems in the form of pollution and changes to the natural form of the river. The impacts of pollution are significant in the Tisza River Basin and affect human health, the access to healthy fisheries, the safety of settlements and the development of a successful tourism industry.

The analysis report shows that current water reserves are sufficient, but there is concern that increasing demands for agricultural irrigation, together with a fluctuating climate, may require additional efforts to manage resources fairly for all the people living in the basin.

A key conclusion of the analysis report is that water quantity is a relevant water management issue and integration (*integration of water quality and quantity in land and water planning*) is an essential issue for the ITRBM Plan.

1.3 Towards Integrated Tisza River Basin Management

At the Danube River Basin District level, four significant water management issues (SWMI) were identified that impact the water quality of surface and groundwater (organic pollution, nutrient pollution, hazardous substances pollution and hydromorphological alterations).

To bring the approach for the Tisza Sub-basin level in harmony with the Danube Basin level, the Tisza countries adapted the Danube Basin management objectives in line with the four SWMIs for the Tisza River Basin. In addition, visions and management objectives were developed related to water quantity issues. The management objectives for the Danube River Basin and also the Tisza River Sub-basin are:

- describe the measures that need to be taken to reduce/eliminate existing significant pressures on the basin-wide and sub-basin-wide scale for each SWMI and groundwater and
- improve the linkage between measures on the national level and their agreed upon coordination on the basin and sub-basin level to achieve the overall WFD environmental objective.

In addition to the process described above, the Tisza countries defined that management issues related to water quantity needed special attention and are therefore treated as an additional relevant water management issue**.** Water scarcity and droughts, and floods and excess water events are a major challenge in the Tisza River Basin. Climate change is expected to further influence these challenges. An overview of the main impacts of climate change on the Tisza River Basin (based on current knowledge) is important to investigate in order to determine whether the Programme of Measures (PoM) is 'climate-proof' and includes further adaptation measures.

Floods and droughts have negative side-effects on biodiversity and water quality. In addition, previously existing problems related to water quality could be exacerbated by the effects of these water quantity events. This ITRBM Plan therefore also focuses on these issues and on how their management can be integrated.

The Integrated Tisza River Basin Management Plan objectives are therefore twofold:

1. Discuss and manage significant water management issues related to water quality in line with the approach for the Danube River Basin District;
2. Discuss and manage management issues related to water quantity (floods and excess water, drought and water scarcity, climate change) in an integrated way by focusing on measures that are contributing to reaching good water status by 2015.

In summary, according to the principles of Integrated Water Resources Management – *which promote the co-ordinated development and management of water, land and related resources, to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems*[8]– the Tisza countries have developed the Integrated Tisza River Basin Management Plan (ITRBM Plan) accounting for both water quality and water quantity issues, to identify measures which will have positive impacts both on water quality and quantity and on aquatic ecosystems in the Tisza River Basin.

1.4 Specifics of ITRBM Plan compared to Danube River Basin Management Plan

The ITRBM Plan follows the methodology and process of the Danube River Basin level, developed and agreed upon by the Danube River Basin countries. The development of a Plan at sub-basin scale has two generic points of added value:

1. Scale: According to the WFD, the river basin management plans and programmes of measures in the Danube River Basin District have been developed on four scales:
(1) the international level – Part A
(2-3) the national level and internationally coordinated sub-basin level – Part B – for selected sub-basins (Tisza, Sava, Prut, Danube Delta)
(4) the sub-unit level – Part C.

As outlined in the strategic document on the Development of the Danube River Basin Management Plan, the information increases in detail from Part A to Part B and C. The ITRBM Plan represents **Part B** and assesses water management issues at a more detailed scale than the Danube River Basin Management Plan based on the

8 Source: GWP, 2000. Global Water Partnership - Integrated Water Resources Management. Global Water Partnership Technical Advisory Committee. TAC Background Papers No 4

contribution from all the Tisza countries. In the ITRBM Plan, the following water bodies will be assessed (see also in Chapter 1.1):

- Tisza River and its tributaries with a catchment size of >1,000 km^2;
- main canals;
- natural lakes >10 km^2;
- groundwater bodies >1,000 km^2 and of basin-wide importance. This means that in comparison to the 11 identified transboundary groundwater bodies or groups of groundwater bodies of Danube Basin-wide importance, the Tisza countries have collected and evaluated information related to all national and transboundary groundwater bodies (85 groundwater bodies) of importance to the Tisza River Basin.

The work for the ITRBM Plan used previously existing methodologies of the Danube River Basin Management Plan, but with the possibility of filling the missing data and gaps and bringing together the most comprehensive and up-to-date information and statistics, which together make it possible to better analyse some pressures and impacts and the effects of measures to address those needs.

2. Integration of water quality and water quantity issues: In addition to the four SWMIs of the Danube River Basin (organic, nutrient, hazardous substances pollution and hydromorphological alteration), the analysis report identified three issues of concern for the integration of water quality and water quantity: floods and excess water, droughts and water scarcity, and climate change.

The ITRBMP Plan introduces the methodology developed for integration of water quality and quantity issues specified for the Tisza River Basin, which could be applied to the whole Danube Basin or other specific sub-basins in the next river basin management planning cycle.

This approach diversifies the issues investigated compared to the Danube River Basin Management Plan, such as: integration of water quality with quantity, aspects of droughts and flooding treated together and wetlands reconnected as nutrient reduction measures.

1.5 Management issues and structure of the ITRBM Plan

The Tisza Group decided that the Tisza River Basin-related significant water management issues be identified in a similar way as they are introduced in the Danube Basin Analysis. Four Significant Water Management Issues (SWMI) have been identified for the Tisza River Basin, which can directly or indirectly affect the status of both surface water and groundwater[9]:

- **Pollution by organic substances**
- **Pollution by nutrients**
- **Pollution by hazardous substances (special attention to mining and related pollution)**
- **Hydromorphological alterations**

As well as another relevant issue in the Tisza River Basin:

- **water quantity issues (floods and excess water, drought and water scarcity, climate change)**

The Joint Programme of Measures (JPM) has been developed for each SWMI as well as for water quantity based on the defined visions and management objectives. As a consequence, it now includes commonly agreed upon basin-wide measures for the Tisza Basin-side scale. The basin-wide measures of the JPM are firmly based on and were coordinated with the national programmes of measures and with Danube Basin-wide measures.

Regarding the JPM, special attention needs to be paid to the identified measures, their basin-wide importance, to the identification and implementation of priority measures and to measures that lack adequate funding. Any issues related to financing which emerge during the implementation of the JPM need to be followed up (e.g. the ICPDR will serve as the coordination and facilitation platform for informing and supporting the Tisza countries in the use and exploit of appropriate European and international funding mechanisms).

[9] Groundwater quality and quantity of important transboundary and national groundwater bodies.

The ITRBM Plan identifies significant pressures, and the status information and the JPM refer individually to each SWMI. Separate chapters will deal with the issue of the integration of water quality and water quantity. **Figure I.3**. shows the inter-linkages between the water quality and quantity related management issues identified by the ICPDR Tisza Group.

The ITRBM Plan includes steps toward the integration of water quality and water quantity, taking into account flood management and flood protection measures (including in the ICPDR Flood Action Plan developed for the Tisza River Basin in 2009), and measures to achieve the objectives of the WFD to ensure the best possible solutions.

Overall, the visions and management objectives of the ITRBM Plan reflect the joint approach among all Tisza Basin countries and support the achievement of the WFD and FD objectives in this very large, unique and heterogeneous European river basin.

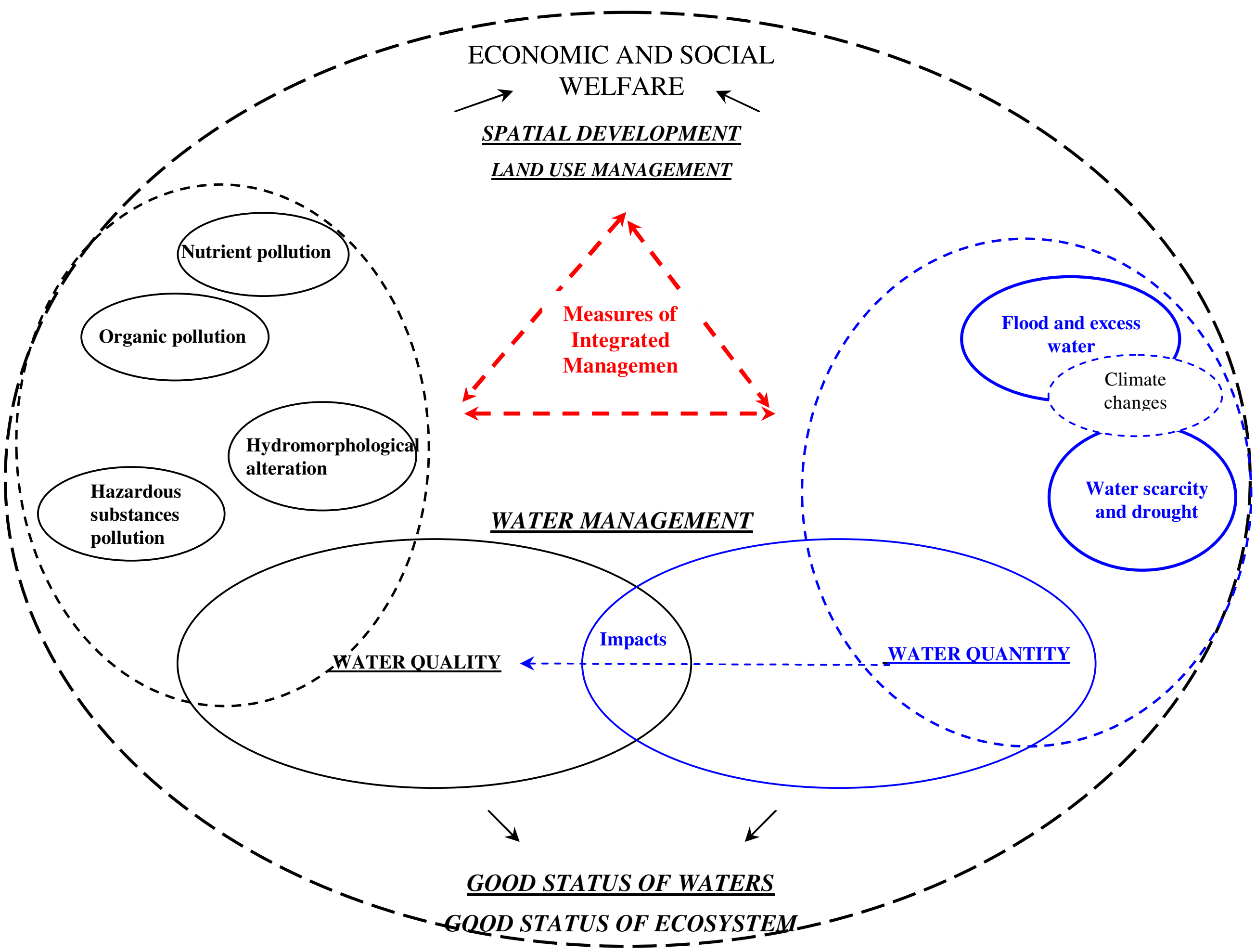

Figure I.3: Inter-linkages between the water quality and quantity related management issues identified by the ICPDR Tisza Group

2 Identified significant pressures

The initial characterisation results of the Tisza Analysis Report 2007 (analysis report) provide information on water bodies (surface water categories, surface water types and reference conditions, identification of surface water bodies) as well as indication of what and where the pressures affecting the water environment and impacts are.

The pressures assessment is based on the country specific emissions regarding organic, nutrient and hazardous substances pollution and should be seen in relation to the respective countries' share of the Tisza River Basin. Three key pressures of hydromorphological alterations are: the interruption of river and habitat continuity, the disconnection of adjacent wetlands/floodplains and – for hydrological alterations of tributaries with catchment areas larger than 1,000 km^2 – disconnected wetlands/floodplains larger than 100ha or of basin-wide significance. The pressures assessment for groundwater bodies is done for the 85 groundwater bodies of basin-wide importance. A size threshold of more than 1,000 km² was defined to select important groundwater bodies (both transboundary and national) to be included in the Integrated Tisza River Basin Management Plan (ITRBM Plan) and the Joint Programme of Measures (JPM), based on the criteria used in the analysis report. Additional criteria for selection of transboundary groundwater bodies (if less than 1,000 km²) were: socio-economic importance, uses, impacts, pressures, interaction with aquatic ecosystems, etc. Despite its focus on important transboundary groundwater bodies, this chapter also summarises information on important national groundwater bodies larger than 1,000 km².

2.1 Surface waters

2.1.1 Methodology for the identification of significant pressures in surface waters

For the development of the ITRBM Plan, the pressures assessment followed a similar approach and methodology as for the Danube River Basin Management Plan.

2.1.1.1 Methodology for the identification of organic, nutrient and hazardous substances pollution

This chapter addresses the pressures assessment in the Tisza River Basin, including the point and diffuse sources of pollution, and the accidental pollution.

It provides the basis for the Programme of Measures that responds to all significant pressures to achieve the agreed management objectives and vision on the basin-wide scale.

The pressures assessment is based on the country-specific emissions of organic, nutrient and hazardous substances pollution, which is presented in this chapter and should be seen in relation to the respective countries' share of the Tisza River Basin.

For the analysis report, the significance of pressures – in the sense of being of basin-wide importance – was identified and characterised using specific criteria based on the size of the pressure and/or the performance of treatment applied.

The assessment of significant pressures in the Tisza River Basin was based on the ICPDR Emission Inventory for Tisza River Basin and a set of criteria was used to define what is significant at the Tisza Basin level.

The identification criteria for the significant point sources for the basin-wide overview are given in **Annex 2**. These criteria refer especially to substances mentioned in Annex VIII of the EU Water Framework Directive (WFD), to the Urban Wastewater Treatment Directive (91/271/EEC), to the Integrated Pollution Prevention and Control Directive (96/61/EC) and to the Dangerous Substances Directive (2006/11/EC former 76/464/EEC). The thresholds used for defining significant point source pollution have been discussed and agreed upon for the Tisza River Basin in the frame of the preparation of the analysis report.

There were 92 significant point sources (51 municipal, 39 industrial and 2 agricultural) identified in the 2007 assessment.

For the development of the ITRBM Plan, the pressures assessment followed a similar approach and methodology as was used for the Danube River Basin Management Plan (**Annex 3** Pressures analysis in the Tisza River Basin).

Data collections are primarily based on existing binding EU reporting schemes or on existing international conventions. For urban wastewater discharges, the evaluation is based on the methodology of the EU Urban Waste Water Treatment Directive (UWWTD) and uses the data model and information that are also reported to the European Commission. The UWWTD concept is centred on the term "*agglomeration*" which means "an area where the population and/or economic activities are sufficiently concentrated for urban wastewater to be collected and conducted to an urban wastewater treatment plant or to a final discharge point". The UWWTD covers all agglomerations with ≥2000 PE[10].

For industrial emissions, the data and methodology of the European Pollutant Emission Register (EPER) was used. In future, the Pollutant Release and Transfer Register (PRTR), which supersedes the EPER, and which is currently being implemented in the Tisza countries, will be used.

Data from Serbia and Ukraine were collected in the same structure so that a basin-wide assessment was possible. Therefore, the new data collections and evaluations give a more complete picture on pollutant sources and emissions.

2.1.1.2 Methodology for the identification of hydromorphological alterations

The hydromorphological drivers on the Tisza Basin-wide scale are: hydropower generation, flood defence and navigation as well as water transfer, diversion and water abstraction. These drivers were discussed in the analysis report.

From 2008-2009, data collection was facilitated by the ICPDR Hydromorphological Task Group to evaluate the *three hydromorphological pressure components*, which have been identified for both the Danube and Tisza River Basins:

- Interruption of river and habitat continuity
- Disconnection of adjacent wetland/floodplains
- Hydrological alterations

Future infrastructure projects that may cause pressures are also introduced.

Compared to the Danube Basin, a more precise scale was introduced for the Tisza Sub-basin data collection, taking into account all Tisza River Basin tributaries larger than 1,000 km^2 as well as wetlands/floodplains larger than 100ha.

The results of the latter represent the current situation of significant *hydromorphological* pressures in the Tisza River Basin as basis for the JPM.

In cases where countries share river stretches it is likely that some hydromorphological components include double-counts. This is because the information has been reported separately by the Tisza countries and in some cases has not been bilaterally harmonised.

2.1.2 Organic pollution

The major cause of organic pollution is insufficient or lack of treatment for wastewaters discharged by agglomerations,[11] and by industrial and agricultural point sources (animal breeding farms, manure depots, etc.).

Organic pollution can cause significant changes in the oxygen balance of surface waters. As a consequence it can impact upon the composition of aquatic species/populations and therefore water status. Organic emissions and

[10] PE (Population Equivalent) describes the average untreated biological load generated by one person per day and equals 60g of BOD_5/d.

[11] Emissions from agglomerations: all releases of substances originating from the agglomeration reaching the environment (soil, water, air).

their status can be measured and expressed with parameters like chemical oxygen demand (COD), biological oxygen demand (BOD) and total organic carbon (TOC).

Many agglomerations in the Tisza River Basin have no, or insufficient, wastewater treatment and are therefore key contributors to organic pollution. Direct, as well as indirect, discharges of industrial wastewaters are also important. Very often industrial wastewaters are insufficiently treated or are not treated at all before being discharged into surface waters (direct emission) or public sewer systems (indirect emission).

The discharge of partially treated or untreated wastewater from urban areas is especially significant and does not meet the requirements of relevant EU legislation, in particular the UWWTD and the Directive for Integrated Pollution Prevention and Control (IPPC Directive). At present, significant water pollution problems still persist throughout a large part of the basin despite ongoing implementation

The ICPDR emission inventory (municipal, agricultural and industrial) was the exclusive database for the analysis report with regard to organic point source pollution, and provided basic information on pollution as well as supporting data such as the methods used for the measurement, the operating conditions of wastewater treatment and expected reduction of pollution.

The new reporting schemes, especially the UWWTD, introduced the concept of agglomeration, and the emission inventories were based only on previously existing urban wastewater emissions (existing pressures).

The results of the pressures assessment in 2007 presented the significant point sources and from diffuse sources of discharges of COD, BOD, N and P, as well as maps, tables and figures.

The analysis report showed that the discharges of BOD and COD from significant point sources (municipal, industrial and agricultural) were 21,285 tonnes and, 48,234 tonnes respectively.

A comparison in the first Tisza analysis of the significant point source emissions with the complete list of point sources in the emission inventory illustrates that only a few point sources (large agglomerations in Hungary and Romania) were responsible for about half of the point discharges into the Tisza River Basin. From this it has been concluded that reduction of emissions (organic substances and nutrients) from these sources would lead to a remarkable reduction of the total point source pollution.

The refinement of the pressures assessment regarding organic pollution in the Tisza River Basin as of 2009 was based on the need to harmonise the reporting requirements on urban wastewater under EU legislation (WFD, UWWTD).

The 2006/2007 data collection on the urban wastewater treatment plants for the Tisza River Basin was based on the same methodology as for the Danube River Basin Management Plan. The agglomeration level data sets for agglomerations which fall under the scope of the UWWTD (i.e. ≥ 2000 PE) reference year 2005/2006 have been prepared for the Tisza River Basin pressures assessment. The pressures assessment includes an estimation of the pollution loads discharged from the agglomerations to the Tisza catchment. According to the data model of the UWWTD, the data model of the ICPDR Municipal Emission Inventory 2007 considers the relation between agglomerations, urban wastewater treatment plants/collecting systems without treatment and discharge point.

2.1.2.1 Organic pollution from urban wastewater

To address organic pollution pressures in the Tisza River Basin, data collection and assessment on urban, industrial and agricultural wastewater have been organised for all Tisza countries, both the EU Member States and Non EU countries.

Details on the basic concept, the methodology and results of the assessment as well results of scenario calculations are presented in the **Annex 3**.

A total of **1,088 agglomerations** ≥2000 PE are located in the Tisza River Basin. Out of these, **22** agglomerations (4,693 million PE) are larger than 100,000 PE **(Figure II.1).**

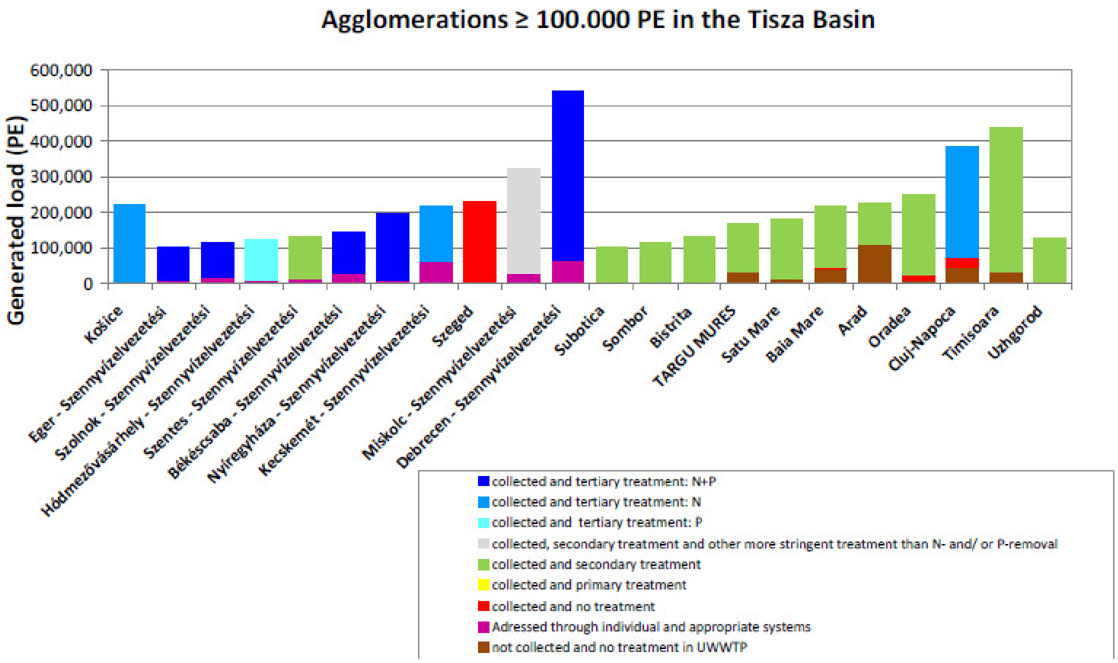

Figure II.1: Existing wastewater treatment plants; existing treatment levels and degree of connection to wastewater treatment for agglomerations >100,000 PE in the entire Tisza River Basin by agglomerations

From 377 agglomerations ≥2,000 PE located in the Tisza River Basin with collection systems and wastewater treatment, the generated load is of 9.226 million PE.

There are 894 agglomerations (3.9 million PE) in the class 2,000 -10,000 PE and 194 agglomerations can be classified with PE >10,000 (8.5 million PE) – (Reference Situation UWWT) (**Tables II.1 and II.2**). These figures clearly demonstrate the importance of addressing the organic pollution from this relatively small number of large communities (>10,000 PE), which contain the majority of the population.

Table II.1: Overview of agglomerations per country in the Tisza River Basin

Number of agglomerations in the Tisza River Basin

Size class (PE)	Ukraine	Romania	Slovakia	Hungary	Serbia	Total
2,000 - 10,000	17	596	70	116	95	894
>10,000	13	67	17	81	16	194
Total	**30**	**663**	**87**	**197**	**111**	**1088**

Table II.2: Overview of generated load from agglomerations per country in the Tisza River Basin

Overview of generated load of agglomerations (PE) per country in the Tisza River Basin

Size class (PE)	Ukraine	Romania	Slovakia	Hungary	Serbia	Total
2,000-10,000	79,690	2,427,877	256,190	797,056	326,026	3,886,839
>10,000	423,400	3,415,738	747,020	3,556,648	440,265	8,583,071
Total	**503,090**	**5,843,615**	**1,003,210**	**4,353,704**	**766,291**	**12,469,910**

There is still a high number of agglomerations ≥2,000 PE that are neither connected to a sewage collecting system nor to a wastewater treatment plant **(Figure II.2).** *In total, wastewaters are not collected at all in more than 590 agglomerations* (=2,242,595 PE which is 18% of the total generated load). *There are 111 further agglomerations that have collection systems that require treatment*. The construction of sewerage collecting systems for agglomerations ≥2000 PE will reduce the pollutants emitted directly and infiltrated to the ground; but at the same time this could also lead to a significant increase in organic pollutants if proper treatment is not applied before being discharged to surface waters.

Figure II.2 provides an overview of existing wastewater treatment plants, existing treatment levels and the degree of connection to wastewater treatment for each country in the Tisza River Basin.

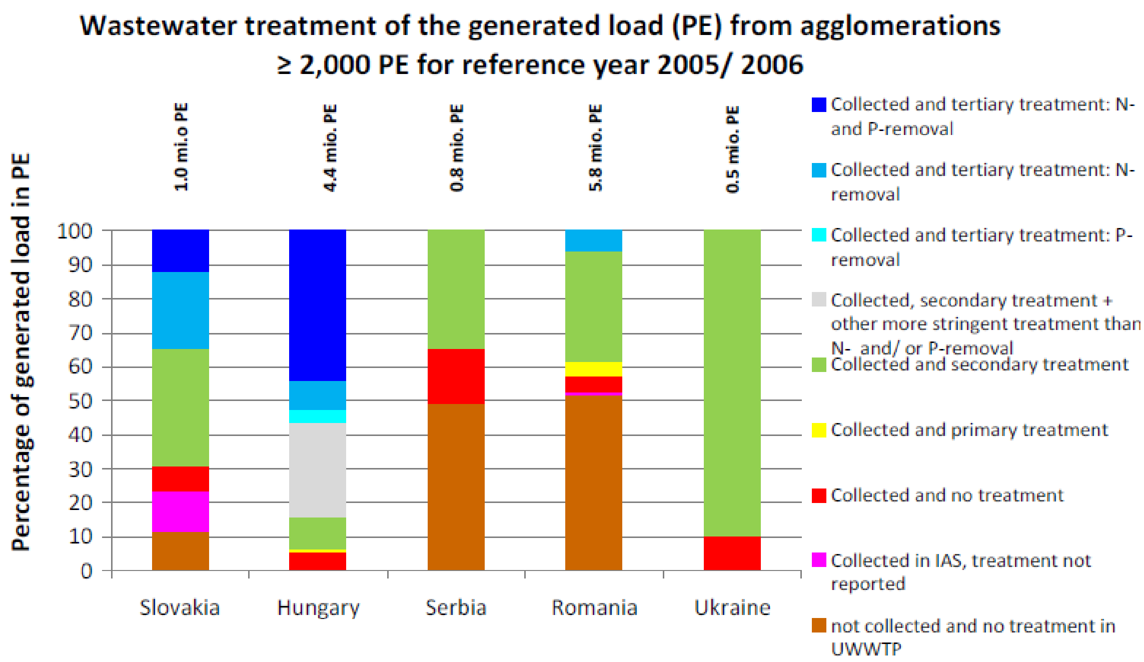

Figure II.2: Existing wastewater treatment plants; existing treatment levels and degree of connection to wastewater treatment for the entire Tisza River Basin by country.[12] (IAS: Individual and appropriate systems e.g. cesspools, septic tanks, domestic wastewater treatment plants)

The updated assessment of this Plan shows that the COD and BOD_5 emissions to the environment (water and soil) from large agglomerations (≥2,000 PE) in the Tisza River Basin are 230 kt/a and 129 kt/a respectively. **(See Table II. 3).**

Table II.3: COD and BOD5 emissions from agglomerations ≥2,000 PE for each Tisza country and the entire Tisza River Basin emitted through all pathways (reference year 2005/2006)

Overview of generated load of agglomerations per country in the Tisza River Basin

	UA	RO	SK	HU	RS	Total
Emission COD (kt/a)	1.7	170.5	13.5	23.0	21.3	**230**
Emissions BOD_5 (kt/a)	1.2	98.7	6.7	10.9	11.4	**128.9**

12 For some countries a collection rate of less than 100% does not indicate that the remaining percentage is not treated at all.

2.1.2.2 Organic pollution from industry

Industrial production has dropped drastically since the 1990s in the Tisza countries as in the rest of the Danube countries. In the Tisza River Basin, the main industrial regions are located in Romania and Hungary, although there are also some important industrial facilities in Ukraine, and Serbia. Currently, these facilities have an important share in the regional economy of the Tisza River Basin, as well as chemical, petrochemical, cellulose and paper, food, textile, and furniture industries.

The **chemical industry** operates mostly in the Upper and Middle Tisza in Hungary (Miskolc and Szolnok regions), in Romania (Târgu Mureş) and in the southern part of the Slovakia (Presov region). In recent years, production has been reduced because of the lack of market demand in Eastern Europe. **The petrochemical industry**, including oil refinery, storage and transport (pipelines), is an important sector in the Hungarian and Ukrainian parts of the Tisza River Basin.

The **cellulose and paper industry** is present in the Upper Tisza River Basin in the Slovakia, Romania and Ukraine. The **food industry** is mainly located in the Middle Tisza, although it is also a locally important sector in Ukraine and Serbia. Production has also been reduced in the last decade.

The **textile industry** has developed quickly in the Tisza River Basin due to the rapid transfer of technology and expertise. Since 1999, Romania has been the Central and Eastern European leader in textile exports to EU countries. The increasing demand for textile products represent an opportunity to augment the land surfaces cultivated with flax and hemp, crops that are well adapted to the climatic conditions of the Tisza River Basin. The use of modern technology reduces the textile industry’s impact on the environment.

The **furniture industry** is one of the few economic sectors that maintained a positive trade balance after 1990 and shares an important part of the industrial output in the Romanian and Ukrainian parts of the Tisza River Basin. Important investments are needed to implement integrated production cycles to avoid the degradation of the environment due to subsidiary products, such as sawdust. A number of related industries are represented in the Tisza River Basin, such as leather goods, porcelain and pottery, which is a large energy consumer.

However, due to the closure of many heavily polluting industrial activities which contributed to a decrease in organic pollution, industrial wastewaters are still discharged without any, or with insufficient, pre-treatment into the public sewerage network in many areas and several industrial installations require measures to meet IPPC requirements. The pressures analysis of this plan shows that emissions from industry are still lower than those from agglomerations but nonetheless important.

A preliminary analysis of industrial sources of organic pollution identifies a total of 95 facilities emitting directly or indirectly to water through urban sewers into the Tisza River Basin in 2006.

The degree of industrial development and amount of pollution caused by the industrial sector varies among the Tisza countries. In general, almost all industrial sectors produce organic pollution. However, the pulp and paper industry is the largest emitter, with significant emission contributions from the chemical, textile and various branches of the food industry. **Figure II.3** provides an overview of those key industries emitting directly into the waters of the Tisza River Basin and indicates respective generated load for EU Member States.

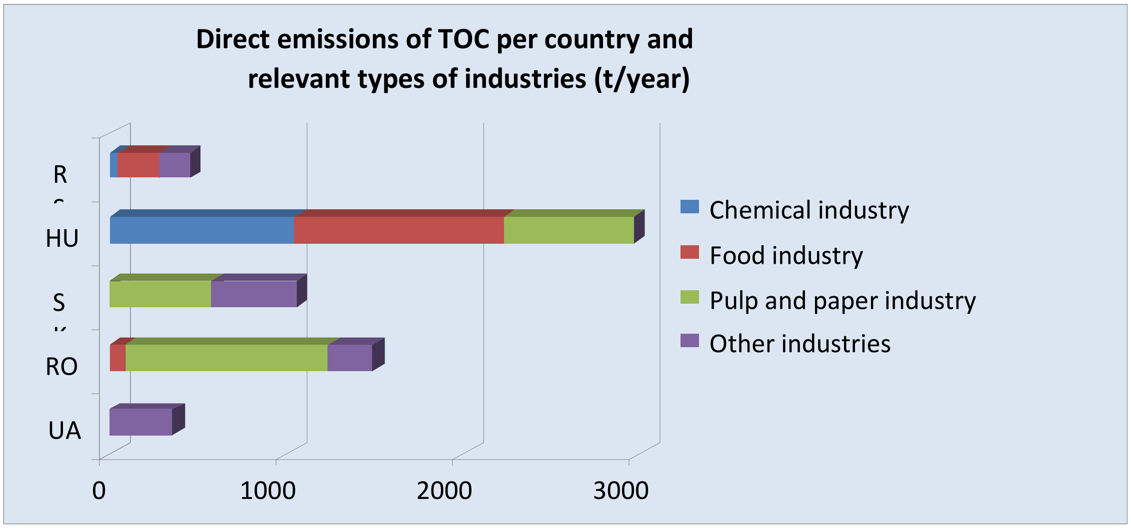

Figure II.3: Direct emissions of TOC per relevant types of industries

2.1.2.3 Organic pollution from agriculture

Among agricultural point sources of pollution, the pig and poultry farms are clearly the most relevant point sources of organic pollution. Related EPER data were collected on facilities for animal breeding for three EU Member States. Data gaps still exist for the Non EU Member States and need to be closed in the future in order to perform a comprehensive and more detailed analysis. The contribution of organic pollution from agricultural sources is well below the historical estimates of approximately 30% of the overall total emissions.

2.1.3 Nutrient pollution

Nutrient pollution – particularly by nitrogen (N) and phosphorus (P) – can cause eutrophication[13] of surface waters. Historically, the Danube alone has introduced some 35,000 tons of phosphorus and 340,000 tons of inorganic nitrogen into the Black Sea each year; the main sources are: agriculture, inadequate municipal and industrial wastewater treatment plants.

Agriculture is the major source of pollutants, including natural and chemical fertilisers and pesticides application as well as effluent from huge pig farms and agro-industrial units. Further, their emission and further discharge into coastal areas and the marine environment can significantly impact the status of those ecosystems.

Point source discharges are caused by single activities and are locally confined, whereas diffuse source discharges are caused by widespread activities like agriculture with multiple undifferentiated sources. The levels of diffuse pollution are not only dependent on anthropogenic factors such as land use and land use intensities, but also on natural factors such as climate, flow conditions and soil properties. These factors influence the pathways of the diffuse nutrient emissions and the retention and losses on the way from the origin to the inputs into the river system.

Whereas the load of substances from point discharges can be measured or calculated from measured concentrations and flows, the emissions of substances from diffuse sources cannot be measured and are difficult to define. The loads estimation of diffuse source pollution for large river catchments such as the Danube – and its largest sub-basin the Tisza – is only possible by mathematical modelling. Thus, in the frame of the Danube and Tisza River Basin Analysis, nutrient emissions into the river system through individual pathways were estimated using the MONERIS (MOdelling Nutrient Emissions in RIver Systems) model. The model used land use,

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[13] Definition of *eutrophication*: The enrichment of water by nutrients, especially compounds of nitrogen and/or phosphorus, causing an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned [Directive 91/271/EEC].

hydrological, soil and hydrogeological data collected in a Geographical Information System (GIS) as well as statistical information for different administrative levels.

Evidence shows that the North-western Black Sea coastal area has improved significantly since the early nineties due to the lower discharges of N and P to the Black Sea. This is due to political as well as economic changes resulting in the closure of nutrient discharging industries, significant decrease of the application of mineral fertilisers and the closure of large animal farms (agricultural point sources). Furthermore, the application of economic mechanisms in water management (e.g. the polluter pays principle) and the improvement of wastewater treatment have contributed to this decrease.

2.1.3.1 Inter-linkage between organic and nutrient pollution

Nutrient pollution is – as with organic pollution – mainly caused by emissions from the agglomeration, industrial and agricultural sectors. Furthermore, for agglomerations, the P emissions via household detergents play a significant role. Regarding nutrient emissions, respective pressures on water bodies can result from (i) point sources (in particular untreated/partially treated wastewaters), and/or (ii) diffuse sources (especially agriculture). The pressures assessment related to nutrient pollution took the synergies between organic and nutrient pollution fully into account. The same basic assumptions and facts regarding wastewater treatment for urban and industrial emissions for organic pollutions are also valid for nutrients (*see chapter 2.1.3*). The findings of point source analysis have been combined with those related to diffuse sources. The MONERIS model integrates these components, including the wetlands reconnection potential, and reflects the overall nutrient input in the Tisza River Basin in total and per Tisza country.

2.1.3.2 Nutrient point source pollution

2.1.3.2.1 Nutrient pollution from urban wastewater

Nutrient pollution from point sources is mainly caused by emissions from insufficiently or untreated wastewater into surface waters (from agglomerations, industry and agriculture). It should be mentioned that the operation of secondary and tertiary treatment levels at wastewater treatment plants is of particular importance for the respective elimination/reduction of N and P. An overview of treatment levels is provided in *chapter 2.1.2.*

Nutrient emissions and the eventual status from point sources can be measured and expressed with parameters such as inorganic nitrogen, Total nitrogen (N_{tot}), ammonia (NH_4), nitrate (NO_3), nitrite (NO_2) or Total phosphorus (P_{tot}) and phosphates (PO_4)

Organic point source pollution from agglomerations is outlined in chapter 2.1.2.

Table II.4: shows N_{tot} and P_{tot} generated load emitted to environment (water and soil) from agglomerations ≥2,000 PE for each Tisza country and the Tisza River Basin total generated load emissions (point and diffuse) for reference year 2006.

Table II.4: N_{tot} and P_{tot} emissions from agglomerations ≥2,000 PE for each Tisza country and the entire Tisza River Basin emitted through all pathways (reference year 2005/2006)

	UA	RO	SK	HU	RS	Total
Emission N_{tot} (kt/a)	1	17.9	2.2	4.2	1.8	**27.1**
Emissions P_{tot} (kt/a)	0.3	2.7	0.3	0.9	0.4	**4.6**

2.1.3.2.2 Industry

Many industrial facilities are significant sources of nutrient pollution, and the chemical sector is the most important contributor. The N_{tot} and P_{tot} emissions in t/a for **Figure II.4** and **Figure II.5** show direct emissions of N_{tot} and P_{tot} for the different types of industries.

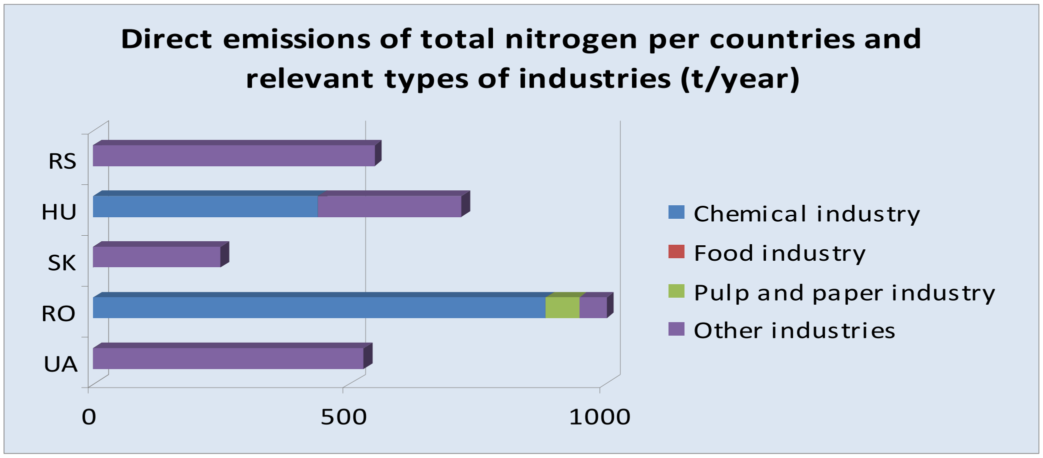


Figure II.4:Direct emissions of total nitrogen per country and relevant types of industries

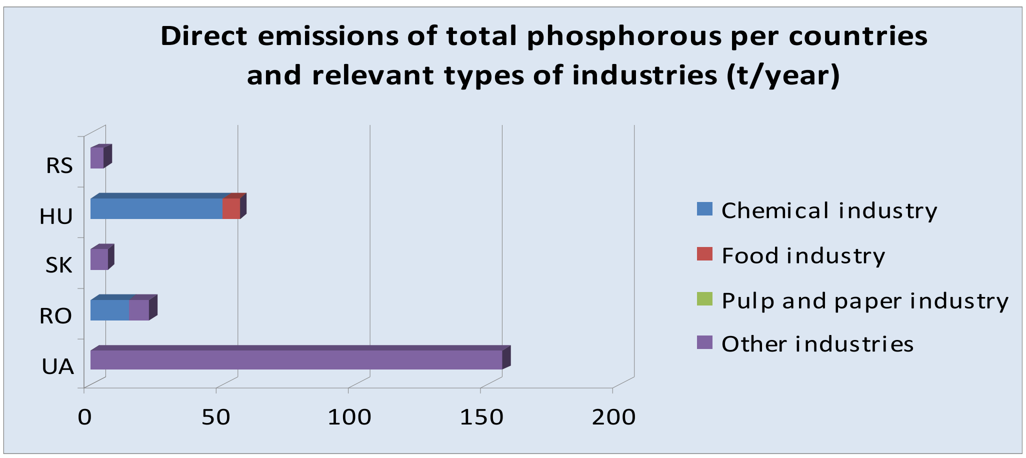


Figure II.5: Direct emissions of total phosphorus per country and relevant types of industries

2.1.3.2.3 Nutrient point source pollution from agriculture

For agricultural point source pollution, data gaps (that mainly exist for Non EU Member States as EPER data are available for EU Member States) need to be closed in the future in order to perform a comprehensive and more detailed analysis. However, agricultural emissions from diffuse sources are of even greater importance and are analysed by MONERIS (see below).

2.1.4 Nutrient diffuse source pollution

Diffuse source pollution is caused by widespread activities such as agriculture and other sources **(see Figure II.6).** The levels of diffuse pollution are not only dependent on anthropogenic factors such as land use, and land use intensity, but also on natural factors such as climate, flow conditions and soil properties. These factors influence pathways that are significantly different. For N, the major pathway of diffuse pollution is groundwater while for P it is erosion.

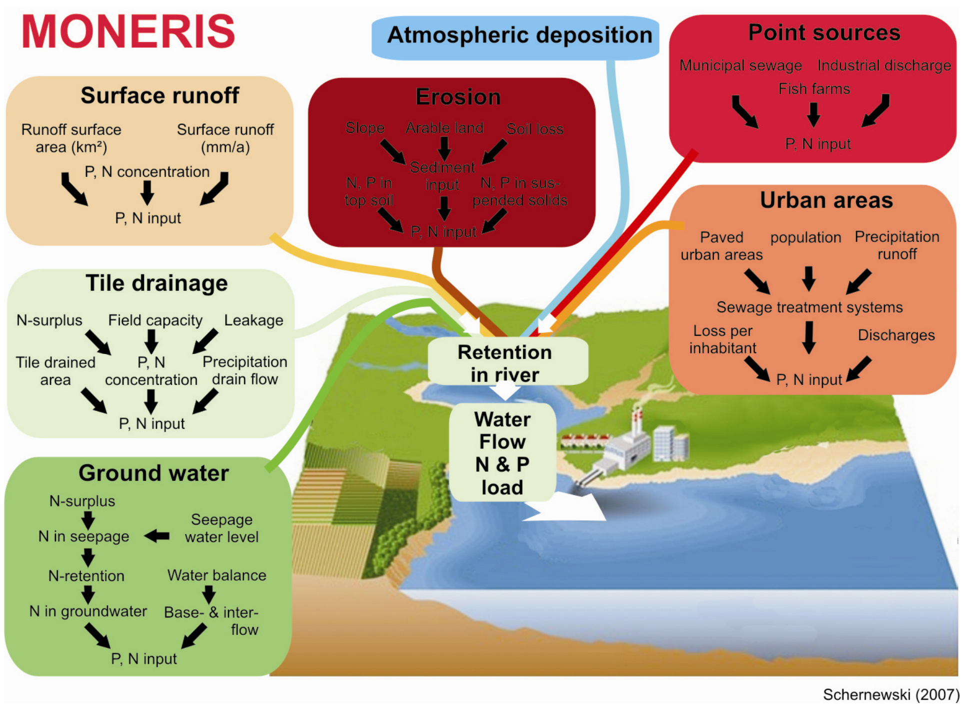


Figure II. 6: Schematic picture of main processes in relation to sources and pathways of nutrient inputs, including retention, into surface waters (MONERIS model)

In addition to what has been analysed for the development of the Danube River Basin Management Plan, and to strengthen the understanding of the role of riverine wetlands in nutrient reduction, further investigations and activities were proposed within the frame of the ITRBM Plan.

While nutrients are only completely removed from the system during harvest or by denitrification, long-term storage within wetlands can lead to reduced pollution loads in the main channel. In most riverine wetlands, sedimentation and denitrification are the dominant processes influencing, respectively, P and N cycling. These processes and the hydrogeomorphological factors that govern them (e.g. flooding) therefore determine whether specific wetlands function as a nutrient sink or source. To predict the role that a wetland will play in nutrient reduction, a specific assessment has been performed **(Chapter 8)** which demonstrated the reduced potential of wetlands to contribute to the reduction of nutrient pollution in the main river.

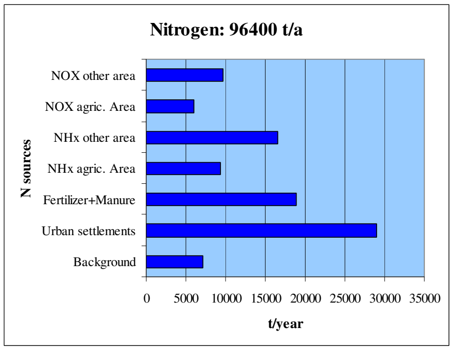
2.1.4.1 MONERIS – a model for point source and diffuse source emissions calculations

The emission of substances from diffuse sources cannot be easily measured. The emissions estimation of diffuse source pollution for large river catchments is possible through mathematical models. Nutrient emissions into the river system through individual pathways were calculated/estimated using the MONERIS model.[14] MONERIS considers point source emissions and combines them with emissions resulting from different diffuse source pathways (Figure II. **6**). Furthermore, MONERIS integrates various statistical information for different administrative levels, land use, hydrological, soil and hydrogeological data and works for Geographical Information System (GIS) illustration.

Figure II.7 shows the MONERIS results describing that altogether 96.4 kt of N and 8.5 kt of P in total are emitted annually into the Tisza River Basin. The main contributors for both N and P emission are agglomerations not served by sewerage collection and wastewater treatment. For N pollution, the input from agriculture (fertilisers, manure, NO_x and NH_x) is the most important (totalling 39% of total emissions). For P, emissions from agriculture (area under cultivation, erosion, intensity of production, specific crops and livestock densities) are the

[14] Behrendt et al. (2007): The Model System MONERIS (2007) – User Manual; Leibniz Institute for Freshwater Ecology and Inland Fisheries in the Forschungsverbund Berlin e.V., Müggelseedamm 310, D-12587 Berlin, Germany.

second largest source after input from urban settlements. The share of agricultural emissions differs significantly between countries **(see chapter 7).**



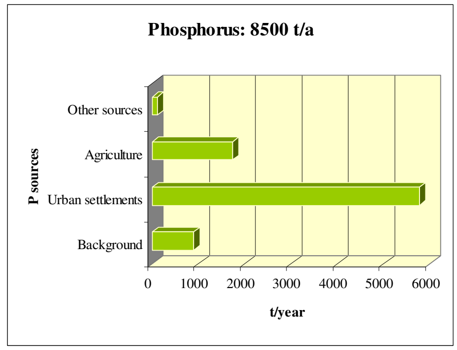


Figure II.7: Sources of nitrogen and phosphorus emissions (EU Member States and Non EU Member States) in the Tisza River Basin (MONERIS results 2009)

2.1.4.2 Phosphate input via detergents

The emission of phosphates via household detergents is significant in the Tisza River Basin and is included in the agglomerations contribution to total emissions.

When there is no wastewater treatment or treatment without a tertiary treatment, the P loads find a direct way into the aquatic environment. Currently, none of Tisza countries have introduced a phosphate ban for laundry detergents. Consultations between the ICPDR, the detergent industries and the environmental authorities on the introduction of P-free detergents are taking place in all Tisza countries[15].

The inhabitant specific consumption varies between 0.43 and 1.45 g/(inh.·day). All data for the inhabitant-specific consumption have been taken from RPA (2006)[16]. In countries with no detailed information, data from neighbouring countries with similar socio-economic conditions have been used.

2.1.4.3 Nutrient input via mineral fertilisers and livestock manure

The use of mineral fertilisers significantly contributes to nutrient pollution in the Tisza River Basin. The two most important plant nutrients applied as mineral fertilisers are N and P.

Fertiliser use dropped significantly in all Tisza countries after the economic collapse in the early 1990s. This led to a significant reduction in agricultural productivity in the region, including a decline in the use of mineral

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[15] As of 16th February 2010 Ministers, High Officials and the Member of the European Commission, being responsible for the implementation of the Danube River Protection Convention has adopted the Danube Declaration recognising the `*limitations on phosphate in detergents as a particularly cost effective and necessary measure to complement the efforts of implementing urban wastewater treatment*`

[16] Risk & Policy Analysts Limited (RPA) (2006): Non-surfactant Organic Ingredients and Zeolite-based Detergents - Final Report, prepared for the European Commission. Pp. 224. http://ec.europa.eu/enterprise/chemicals/legislation/detergents/studies/non_surfactant_organic_ingredients_and_zeolite_based_detergents.pdf

fertilisers. Data available from the FAOSTAT database[17] (2004) shows that the use of N fertilisers (kg N/ha) by farmers in Tisza countries is far below the EU average. In addition, the density of livestock per hectare on farms in Tisza countries is below the Danube average. It can be expected that the number of livestock will increase in due course leading to an increase in nutrient emissions[18] if it is not handled in a sustainable way.

The nutrient inputs from the agricultural sector, emissions from diffuse sources (such as those from mineral and organic fertilisers and manure) are not significant.

2.1.4.4 Nutrient input via atmospheric deposition

Contributions to atmospheric nutrient pollution stem from human activities including transportation, agriculture (livestock farming) and industry. In the Tisza River Basin, the share of nutrient pollution from atmospheric deposition is less significant. The share for N is 0.14% (1,390 t/a) and even much less for P (0.06%), which is 54 t/a (for the total Danube River Basin the amount is 402 t/a).

2.1.5 Hazardous substances pollution

Sources of hazardous substances in the Tisza River Basin are: industrial effluents; storm water overflow; pesticides and other chemicals applied in agriculture; discharges from mining operations and accidental pollution. For some substances atmospheric deposition may also be of significance.

Types of hazardous substances include: man-made chemicals; naturally occurring metals; oil and its compounds; endocrine disruptors and pharmaceuticals.

Article 16 of the WFD has put in place a mechanism through which a list of 33 priority pollutants has been created[19]. Their inclusion on the list was based on environmental quality standards and emission control measures (established in the mid 1990s) and ranked effects according to their measured or estimated concentrations in water or sediments. From this list of 33 priority substances, 11 priority hazardous substances have been identified, which are to be subject to cessation or phasing out of discharges, emissions and losses according to a timetable that shall not exceed 20 years.

A list of substances/parameters of relevance in the Danube River Basin was prepared by the ICPDR[20] consisting of two separate annexes:

- Annex A: 33 priority substances, in accordance with the Annex X of the EU WFD;
- Annex B: 8 additional substances (of which 4 are hazardous), divided into 2 groups:
  - B1: General Parameters (COD, NH4-N-ammonia, Total N, Total P) ;
  - B2: Danube Specific Substances (arsenic, copper, zinc, chromium).

Existing knowledge gaps

At this stage of analysis, out of the 33 priority substances identified, only 7 were included in the parameters assessed in the Transnational Monitoring Network. Very limited basin-wide information was available for the other 26 substances. For this ITRBM Plan, the respective lack of data on hazardous substances continues, although new reporting schemes, improved analytical capabilities and results from the Joint Danube Survey 2 (JDS 2) have resulted in some improvement. Adequate analytical instrumentation continues to be deficient as well in the Tisza River Basin countries.

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[17] FAOSTAT database: Data from the FAOSTAT database of the UN Food and Agriculture Organisation Pesticide Consumption in CEE countries and the EU15.

[18] Detailed information can be taken from the ICPDR Technical Report on MONERIS published in summer 2009.

[19] According to WFD Article 2(30), priority substances mean substances identified in accordance with Article 16(2) and listed in Annex X. Among these substances there are *priority hazardous substances* which are defined as substances identified in accordance with Article 16(3) and (6) for which measures have to be taken in accordance with Article 16(1) and (8).

[20] ICPDR document: List of Priority Substances 2001/2002 (see www.icpdr.org).

2.1.5.1 Hazardous substances pollution – industrial sources

Manufacturing industries are responsible for the large emission loads of a number of hazardous substances. Heavy metals and organic micro-pollutants in particular are of concern, in addition to traditional pollutants. The EPER covers 26 water pollutants. Information provided by the EU Member States (only for Hungary and the Slovakia as Romania started to report in 2005) in EPER reporting shows an increase of the reported load values of arsenic, cadmium, chromium, copper, mercury, nickel, lead and zinc in 2004 (compared with 2001 values). In the forthcoming PRTR, a total of 71 pollutants (including all priority and priority hazardous substances) will be covered.

2.1.5.2 Use of agricultural pesticides in the Tisza River Basin

Another major source of hazardous substances is pesticides used in agriculture. Information on use within the Danube countries prepared for the Danube Basin Analysis[21] showed that 29 relevant active ingredients were used in pesticide products. Of these, only three pesticides are authorised for use in all of the Danube River Basin countries, while seven are not authorised in any of the countries, despite the fact that they have been found in tests of water and sediments.

Compared with the average in the Danube countries, the level of pesticide use in Tisza River Basin countries is still relatively low.

2.1.5.3 Accidental pollution and the inventory of accident risk spots in the Tisza River Basin

Within the Tisza River Basin, there have been accidental spills of hazardous substances that have severely affected the aquatic environment and water quality. Accidents are concentrated in time and space and often have severe immediate as well as localised ecological consequences. Prevention is often possible and relatively easy if precautionary measures are taken. The ICPDR has elaborated a basin-wide inventory of potential accidental risk spots (ARS Inventory). An estimation of the real risk at a particular site was prepared and a set of checklists elaborated for prevention of accident risk.[22]

In addition to accidental pollution from operating industrial facilities *(e.g. in Someş/Szamos as well as in Criş/Körös rivers cadmium and copper pollution due to mining activities)*, pollution from sites contaminated by former industrial activities or waste disposal has been identified as significant. It is of specific importance for sites contaminated by hazardous substances to identify those substances that can be mobilised and enter water bodies in the event of a flood. The updated inventories should provide a clear picture on potential risk sites, as well as possible targets for reducing and controlling accidental pollution[23].

A survey in 2002 identified 261 such sites in the Danube River Basin. As a consequence, a methodology (M1) was developed to screen their risk potential[24]. It was agreed by the Danube countries that sites with a high risk potential should be investigated further to create a more concrete risk estimation and ranking.

In total, approximately 92 risk spots have been recorded for the Tisza River Basin in the 2009 assessment. This assessment is based on the ICPDR Working List of risk spots which is under development. These risk spots sites (industrial and wastes deposits) are assessed based on M2 methodology to evaluate the potential flooding risks.

[21] UNDP GEF Danube Regional Project: Inventory of Agricultural Pesticide Use in the Danube River Basin Countries.

[22] For the classification of potential risk spots, a common procedure was elaborated considering the findings of the International Commission for the Protection of the Elbe; the EU Seveso II Directive and the UN/ECE Convention on the Transboundary Effects of Industrial Accidents.

[23] Based on that estimation it is possible to elaborate a list of necessary immediate measures to enhance the safety level of a site. The selected M1 methodology for risk identification considers the properties of substances used or stored at a site and the quantity of the given substances. The properties of the substances determine the Water Risk Class (WRC) which – in combination with the amount of used/stored substances – determines the Water Risk Index (WRI), the quantitative indicator of the risk.

[24] UNDP GEF DRP: M1 & M2 Methodology on Risk Assessment for Contaminated Sites (2006) – www.icpdr.org.

Specifics of ITRBM Plan compared to DRBM Plan

Regarding the updated pressures analysis for organic, nutrient and hazardous substances pollution, the following specific conclusions for the Tisza can be drawn in comparison to the Danube Basin level:

- The surface water quality in the Tisza River Basin is mainly affected by municipal and industrial pollution, agricultural run-off and accidental pollution.
- Hazardous substances from mining cause a significant pressure due to existing abandoned tailing deposits and the accidental pollution risk from the operational mines. The risk of accidental pollution due to mining is much higher in the Tisza River Basin as compared with the Danube River Basin.
- The level of treatment of urban wastewater is relatively low. More than half of existing agglomerations in the Tisza River Basin lack collection and treatment of wastewater.
- Intensive agriculture is still practiced in the middle and lower Tisza regions. This has also led to an increase in soil pollution, erosion and agricultural run-off which contributed to surface and groundwater pollution.

2.1.6 Hydromorphological alterations

2.1.6.1 River and habitat continuity interruption as a significant pressure

Anthropogenic pressures resulting from various hydro-engineering measures can significantly alter the natural structure of surface waters that is essential to provide intact habitats and conditions for self-sustaining aquatic populations. The alteration of natural hydromorphological structures can have negative adverse effects on aquatic populations and therefore deteriorate the water status of surface waters.

The key driving forces causing river and **habitat continuity interruption** in the Tisza River Basin are mainly water supply (61%), flood protection (25%) and hydropower (12%). In many cases barriers are not linked to a single purpose due to their multifunctional characteristics. (**Figure II.8**.)

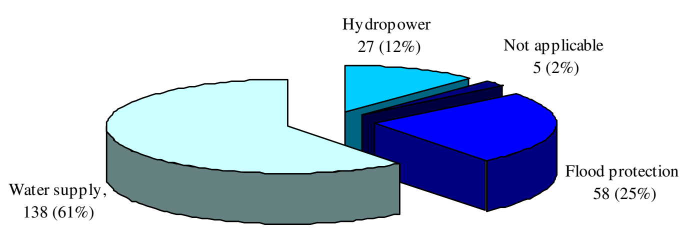

Figure II.8: Usage of Interruptions of river continuity in the Tisza River Basin

In the Tisza River Basin, 228 barriers are located in rivers with surface area larger than 1,000 km^2 (UA-1; RO-100; SK-60; HU-55; RS-12). Out of the 228 barriers, 67 are dams/weirs and 134 are ramps/sills (**Figure II.10**.). Only 27 are classed as other types of interruptions. 29 barriers are currently indicated to be equipped with functional fish migration aids (see **Figure II.9**.) Although river continuity interruptions exist in 100 cases in Romania, the objectives of the water bodies where interruptions are located are achieved in 44 cases.

Some 199 continuity interruptions (87%) remain a hindrance for fish migration as of 2009 in the Tisza River Basin.

It also has to be highlighted that the Tisza River itself and its tributaries in the upper section of the Tisza River Basin run free of dams and other considerable human impacts, which contribute to natural assets that are unique in Europe. [25]

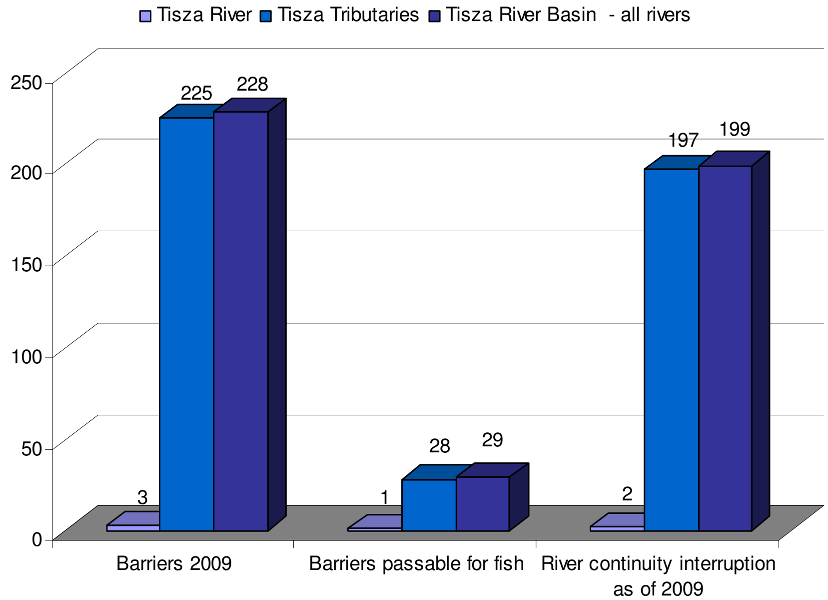

Figure II.9: Interruption of river continuity in the Tisza River Basin in 2009

Of the 228 interruptions, 3 are located in the Tisza River itself – Tiszalök Barrage, Kisköre Barrage (Hungary) and Novi Becej (Serbia) – **(see Map 5),** whereas only 1 provides fish migration aids. The key migration route of migratory fish species is significantly interrupted and habitats between the lower and middle Tisza River are disconnected, impacting the development of self-sustaining populations.

25 Hamar, J and A. Sárkány-Kiss, 1999

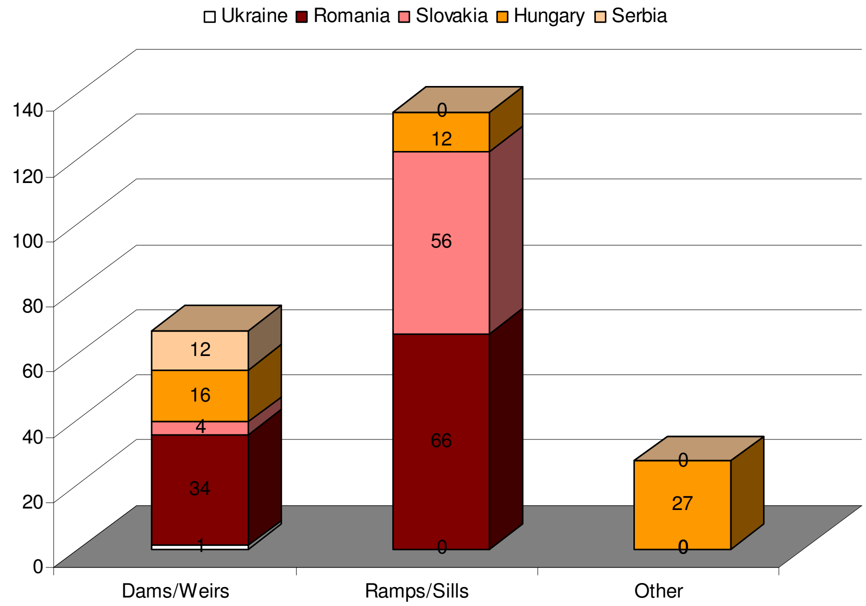

Figure II.10: Continuity interruption in the Tisza River Basin

2.1.6.2 Disconnection of adjacent wetlands/floodplains

Until the middle of 19th century, the Tisza and its tributaries repeatedly inundated some of 26,000 km^2 along their courses in the lowland. Compared to the 19th century small proportion of the former floodplains, wetlands remain in the entire Tisza River Basin. The pressures analysis focused on analysing the location and area of disconnected wetlands/floodplain at a higher resolution than in the Danube River Basin Management Plan (areas larger than 100 ha or which have been identified as of basin-wide importance) with a definite potential for reconnection by 2015.

In the Tisza River Basin, an area of 17,306 ha (173 km²) was identified with the potential to be reconnected to the Tisza River and its tributaries in Ukraine, Slovakia and Serbia[26].

Figure II.11 introduces the current situation regarding the area and percentage of Tisza River Basin wetlands/floodplains (>100ha or which have been identified by the Tisza countries as of sub-basin wide relevance) identified as having a potential for reconnection and/or improvement of water regime by 2015 and beyond.

Annex 4 lists the disconnected wetlands with reconnection potential. **Map 6** shows wetlands/floodplains (>100ha) with reconnection potential 2009 and expected improvement by 2015

[26] Source of information: ICPDR DanubeGIS

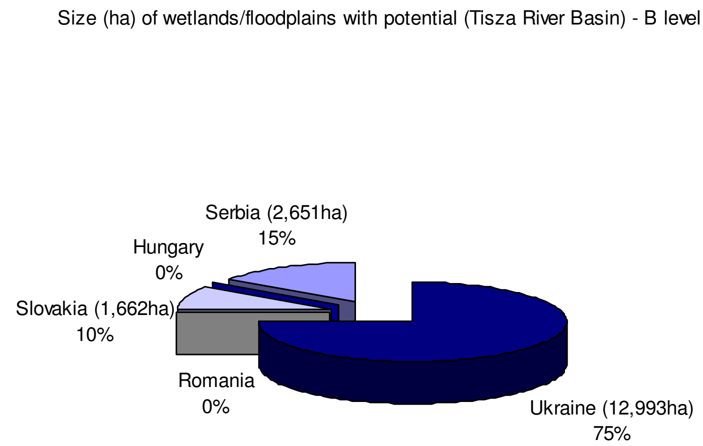

Figure II.11: Current situation regarding the area and percentage of Tisza River Basin wetlands/floodplains (>100ha or which have been identified by the Tisza countries as of sub-basin wide relevance) identified as having a potential for reconnection and/or improvement of water regime by 2015 and beyond

2.1.6.3 Hydrological alterations

Table II.5 gives an overview of the hydrological pressure types, provoked alterations and criteria for the pressure/impact assessment in the Tisza River Basin.

The main pressure types in the Tisza River Basin causing **hydrological alterations** are: 76 impoundments and 26 cases of water abstraction. (see **Map 7a-b**). Impoundments are the major hydrological pressure type in the Tisza River Basin. In the Tisza River Basin the key driving forces and water uses are causing significant alterations through water abstractions are mainly agriculture, forestry, fishing (including fish farms) (46%), irrigation (38%), public water supply (8%) and hydropower generation (4%) with the remaining 4% caused by other abstractions. **Figure II.12** indicates the number and length of impoundments in the countries of the Tisza River Basin.

Table II. 5: Hydrological pressure types, provoked alterations and criteria for the pressure/impact assessment in the Tisza River Basin

Hydrological pressure	Provoked alteration	Criteria for pressure assessment
Impoundment	Alteration/reduction in flow velocity of the river	Tisza River: Impoundment length during low flow conditions > 10 km Tisza tributaries: Impoundment length during low flow conditions > 1 km
Water abstraction/ Residual water	Alteration in quantity of discharge/flow in the river	Flow below dam < 50% of mean annual minimum flow of a specific time period (comparable with Q95)
Hydropeaking	Alteration of flow dynamics/discharge pattern in river	Water level fluctuation > 1m /day

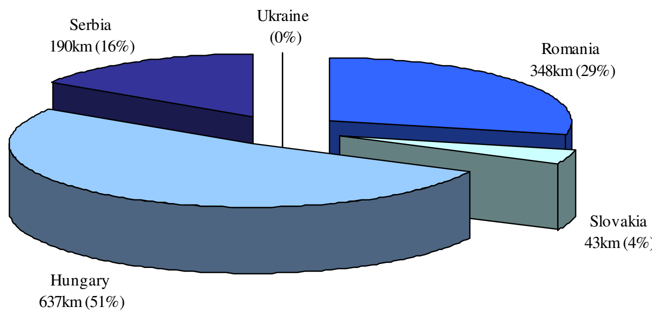

Figure II.12: Number and length of impoundments in the countries of the Tisza River Basin

2.1.6.4 Future infrastructure projects

In addition to the significant degradation of the Tisza and its tributaries caused by existing hydromorphological alterations, a considerable number of future infrastructure projects are at different stages of planning and preparation. These projects may provoke significant hydromorphological pressures on water status, which are described above. In addition to these severe ecological impacts (including the effects on drinking water supplies) from these future hydro-engineering projects, other pressures are likely to increase as well, e.g. the pollution loads from navigation (e.g. oil spills, antifouling agents, etc.).

The **future infrastructure projects** are listed based on specific selection criteria:

Tisza River: Future infrastructure projects are listed for which a Strategic Environmental Assessment (SEA) and/or Environmental Impact Assessments (EIA) are performed **OR** transboundary effects are provoked.

Tisza River tributaries: Future infrastructure projects are listed for which a SEA and/or EIA are performed **AND** transboundary effects are provoked.

A detailed list of all future infrastructure projects– including a brief description – can be found in **Annex 7** and are illustrated in **Figure II. 13** and **Map 8.**

In addition to already existing hydromorphological alterations, a considerable number of future infrastructure projects are at different stages of planning and preparation throughout the entire Tisza River Basin. According to the data uploaded by the Tisza countries, 31 future infrastructure projects are listed in the DanubeGIS database as relevant for the Tisza River Basin. Out of the 31, 28 projects (91%) are related to flood protection. Some 3 projects (all together 9%) will be implemented for hydropower generation (1), water supply (1) and for other purposes (**Figure. II.13**). Of the 31 projects, 3 are currently being implemented, 18 are officially planned and planning is being prepared for 10 projects. Some 22 projects are planned to be implemented by 2015 at the latest, mainly for flood protection purposes.

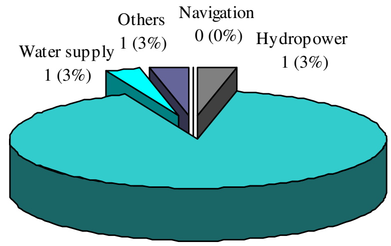

Figure II.13: Planned future Infrastructure projects and its main usage

Specifics of ITRBM Plan compared to DRBM Plan

Regarding the updated pressure analysis for hydromorphological alternations, the following specific conclusions for the Tisza can be drawn in comparison to the Danube Basin level:

- Based on present information, the main purpose of the future infrastructure projects in the Tisza River Basin is flood protection (91%). In the Danube River Basin the main purpose of future infrastructure projects is navigation (57%), and only 28% for flood protection. No future infrastructure projects were indicated in the Tisza River Basin for navigation purposes.
- For wetlands/floodplains, 9 (173 km^2) in the Tisza River Basin and 95 (6,127 km^2) in the Danube River Basin were identified as having the potential to be reconnected.

2.2 Groundwater

2.2.1 Introduction

This chapter provides an overview of identified significant pressures on important groundwater bodies in the Tisza River Basin, based on the data collected from the countries. A size threshold of more than 1,000 km² was defined to select important groundwater bodies to be included in ITRBM Plan and Joint Programme of Measures (JPM) (both transboundary and national), based on the criteria used in the 2007 Tisza Analysis Report (analysis report). Additional criteria for selection of transboundary groundwater bodies (if smaller than 1,000 km^2) were: socio-economic importance, uses, impacts, pressures, interaction with aquatic ecosystems, etc. Despite its focus on important *transboundary* groundwater bodies, this chapter also summarises information on important *national* groundwater bodies of the Tisza River Basin larger than 1,000 km².

The analysis report (**Chapter 4.4**) provides a detailed description of significant pressures identified on quality for the surface waters. The basic principles and the assessment of the pollution sources described in that chapter also provide relevant background information for groundwater, owing to the very close interrelation between these two water categories. This chapter summarises the significant pressures that have been identified for the 85 groundwater bodies of basin-wide importance. Detailed information on the relevant pressures for each groundwater body is given in **Annex 5**.

The current document is not intending to deal with drinking water quality standards. However, it is important to mention that in several cases the poor groundwater quality is naturally derived, as a result of geochemical characteristics of sediments. Chemical components such as iron, manganese, ammonia, NOM, methane, arsenic can be dissolved from rock by subsurface flow, which according to environmental isotope studies (Deâk, 1995), has been taking place for more than 10 000 years. The concentration of these components in groundwater often exceeds the drinking water quality standards (e.g. in Slovakia, Hungary, Romania and Serbia in case of arsenic).

2.2.2 Groundwater quality

Based on collected data for groundwater bodies of basin-wide importance, the main reasons for pollution of groundwater are:

- water pollution caused by intensive agriculture and livestock breeding,
- insufficient wastewater collection and treatment at the municipal level,
- inappropriate waste disposal sites,
- urban land use and
- insufficient wastewater treatment at industrial enterprises.

The poor chemical status of some groundwater bodies is caused by NO_3 and NH_4^+ from diffuse sources, including agricultural activities, non-sewered population and urban land use (run-off from urban, paved areas). Often, problems with diffuse pollution are coupled with quantity issues, such as over-abstraction.

In some cases diffuse sources of pollution are coupled with different point sources such as:

- Leakages from waste disposal sites (landfill and agricultural waste disposal);
- Leakages from contaminated sites;
- Mine water discharges;

Those leakages lead to the occurrence of other substances in groundwater bodies such as TCE (one groundwater body) at concentration levels over the threshold values.

An overall and comprehensive overview of the pressures in the Tisza Basin stemming from the organic pollution and pollution by nutrients and hazardous substances from point and diffuse sources is provided in **Chapters 2.1.2., 2.1.3. and 2.1.4.**

2.2.3 Groundwater quantity

Groundwater in the Tisza River Basin is of major importance and is subject to a variety of uses, with the main focus on drinking water, agriculture and industry. According to the analysis report, groundwater quantity is affected by groundwater abstraction for drinking water supply, industrial, cooling plants and agricultural purposes (**Figure II.14**). The expected development of the future water demand has to be taken into account when identifying water exploitation and protection strategies.

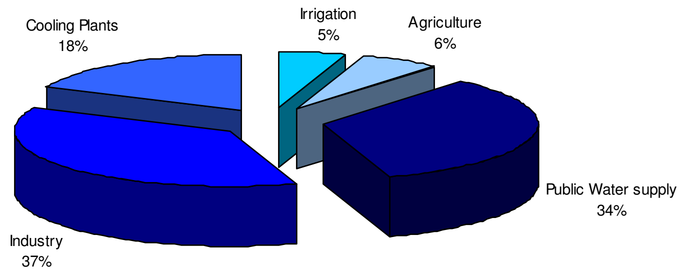

Fig.II.14: Estimation of the percentage of different groundwater uses in the Tisza River Basin

The assessment of pressures on the quantity of the groundwater bodies of basin-wide importance showed that over-abstraction prevents the achievement of good quantitative status for twelve groundwater bodies. For ten groundwater bodies, the most significant pressure on quantity is illegal abstractions and indirect abstractions, by drainage or gravel pits (in Hungary). Other significant pressures include abstractions for agriculture, public water supply and industry.

Specifics of ITRBM Plan compared to DRBM Plan

- The ITRBM Plan considered groundwater bodies >1,000 km^2 and of basin-wide importance. This means that in compared to the 11 identified transboundary groundwater bodies or groups of groundwater bodies of Danube Basin-wide importance, the Tisza countries have collected and evaluated information related to 85 – all national and transboundary groundwater bodies of importance to the Tisza River Basin.
- The assessment of pressures on the quantity of the groundwater bodies of basin-wide importance showed that over-abstraction prevents the achievement of good quantitative status for twelve groundwater bodies. For ten groundwater bodies, the most significant pressure on quantity is illegal abstractions and indirect abstractions, by drainage or gravel pits (in Hungary). Other significant pressures include abstractions for agriculture, public water supply and industry

2.3 Integration of water quality and quantity issues

Recognising the importance of water quantity issues and its significant impacts on water quality, the ICPDR Tisza Group has developed an integrated approach taking into account water quality, water quantity-related issues and their interactions. **Chapter 8** introduces the related visions, management objectives, the methodology and results in detail.

3 Protected areas

The information on protected areas in the Tisza River Basin has been collected according to the EU Water Framework Directive (WFD) Article 6 and Annex IV. At the Tisza River Basin scale, information has been compiled on protected areas for the conservation of habitats and species [27] **Other types of protected areas according to WFD Article 6 and Annex IV are not addressed at the Roof Level but are an integral part of the national river basin management plans**.

Figure III.1 and **Map 9 and Annex 14** illustrate protected areas >100 ha designated for the protection of habitats or species where maintenance or improvement of the water status is an important factor in their protection, including Natura 2000 sites[28].

Figure III.1 provides an overview of those protected area types for the Tisza River Basin. Out of 346 protected areas (38,223 km^2), 276 (16,671 km^2) have been designated following the EU Habitats Directive and 60 (20,295 km^2) are bird protected areas. Another 2 (15 km^2) areas are protected under both the Habitats Directive as well as the Birds Directive. Some 8 (1241 km^2) are protected area types of Non EU Member States.

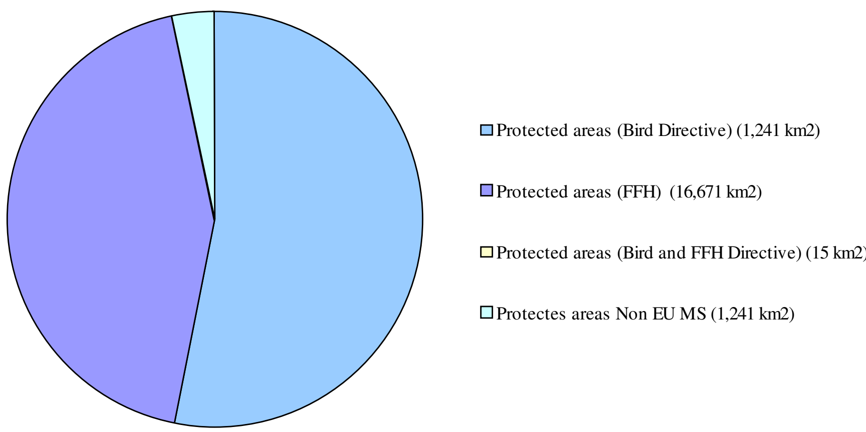

Figure III.1: Overview on area of WFD-relevant protected areas under the EU Habitats Directive and EU Birds Directive including reported protected areas for Non EU Member States (location and type of these protected areas are shown on Map 9 and Annex 14)

The total area of protected areas in the Tisza River Basin (38,223 km^2) corresponds to about a quarter of the total area for the protected areas in the Danube River Basin District.

[27] Map 26 of the Danube River Basin Management Plan identifies nutrient sensitive areas, including areas designated as nitrates vulnerable zones (EU Nitrate Directive) and areas designated as sensitive area (EU UWWT Directive) This designation is only illustrated for EU MS as it is not obligatory for non EU MS.

[28] Natura 2000 designation under the EU Directive 92/43/EEV and Directive 79/409/EEC.

4 Monitoring network and ecological/chemical status

4.1. Water status assessment

According to the EU Water Framework Directive (WFD), *good ecological and chemical status* has to be ensured and achieved for all surface water bodies. For existing constraints, surface water bodies can be designated as heavily modified or artificial, and for these water bodies *good ecological potential and chemical status* have to be achieved and ensured.

Monitoring results according to the WFD serve to validate the pressures analysis, and an overview of the impacts on water status is required to initiate measures.

4.1.1 Surface waters - Ecological status/ecological potential and chemical status definition and methods

Ecological status results from the assessment of the biological status of all WFD biological quality elements (fish, macroinvertebrates, phytoplankton, phytobenthos and macrophytes) and the supportive physico-chemical parameters (general and specific ones) and hydromorphological parameters.

Ecological potential includes the same biological and physico-chemical components and reflects given hydromorphological changes. It is assessed for heavily modified as well as artificial water bodies and aims for alternative environmental objectives than *ecological status.*

Both *ecological status* and *ecological potential* for surface water bodies are assessed on the basis of specific typologies and reference conditions, which have been defined by EU Member States according to WFD Annex V.

The methods regarding the assessment of ecological status vary between different EU Member States. However, the EU-wide intercalibration exercise will ensure the comparability of water status class boundaries (*high/good, good/moderate*) among different countries in accordance with the normative definitions of the WFD. The intercalibration exercise for the major area of the Danube River Basin District, including the Tisza River Basin is performed through the work of the Eastern Continental Geographical Intercalibration Group.

Chemical status has to meet the requirements of environmental objectives for surface waters outlined in WFD Article 4(1). *Good chemical status* must not exceed the environmental quality standards established in line with WFD Article 16(7), Annex IX and under other relevant EC legislation setting quality standards in EU Directive 2008/105/EC on environmental quality standards in the field of water policy.

The overall results of the status assessment can be found in **chapter 4.3**.

Status assessment was developed for the identified surface and groundwater bodies (**see Annex 8 and Annex 11**) of the EU Member States.

4.1.2 Transnational Monitoring Network in the Tisza River Basin - surface water monitoring network

Fulfilling the provisions of the Danube River Protection Convention, the Transnational Monitoring Network (TNMN) in the Danube Basin – and as part of it, in the Tisza River Basin – has been in operation since 1996. The original objective of the TNMN was (i) to enable a reliable and consistent trend analysis for concentrations and loads of priority pollutants; (ii) to support the assessment of water quality for water use; and (iii) to assist in the identification of major pollution sources.

The TNMN laboratories have a free choice of analytical method, providing they are able to demonstrate that the method in use meets the required performance criteria. Therefore, the minimum concentrations expected and the tolerance required of actual measurements have been defined for each determinant so that the method compliance can be checked. To ensure the quality of collected data, a basin-wide Analytical Quality Control (AQC) programme is regularly organised by the ICPDR.

Implementation of the WFD necessitated a revision of the TNMN. A revised TNMN has been in operation since 2007[29] and provides data for this report.

The major objective of the revised TNMN is to provide an overview of the overall status and long-term changes of surface water and, where necessary, groundwater status in a basin-wide context (with particular attention paid to the transboundary pollution load).

To meet the requirements of both the WFD and the Danube River Protection Convention, the revised TNMN for surface waters consists of the following elements:

- Surveillance monitoring I: Monitoring of surface water status;
- Surveillance monitoring II: Monitoring of specific pressures;
- Operational monitoring;
- Investigative monitoring.

Surveillance monitoring II is a joint monitoring activity of all ICPDR Contracting Parties, which produces data on concentrations and loads of selected parameters in the Danube and major tributaries including the Tisza River Basin. Surveillance monitoring I and operational monitoring is based on collection of data on the status of surface water bodies in the basin. Investigative monitoring is primarily a national task, but at the sub-basin level, the Tisza survey was developed to carry out investigative monitoring as needed.

In the Tisza River Basin all together 105 surface water monitoring stations were listed by the Tisza countries (UA-4; RO-13; SK-24; HU-61; RS-3). **Figure IV.1.** illustrates the number and dispersion of the monitoring stations.

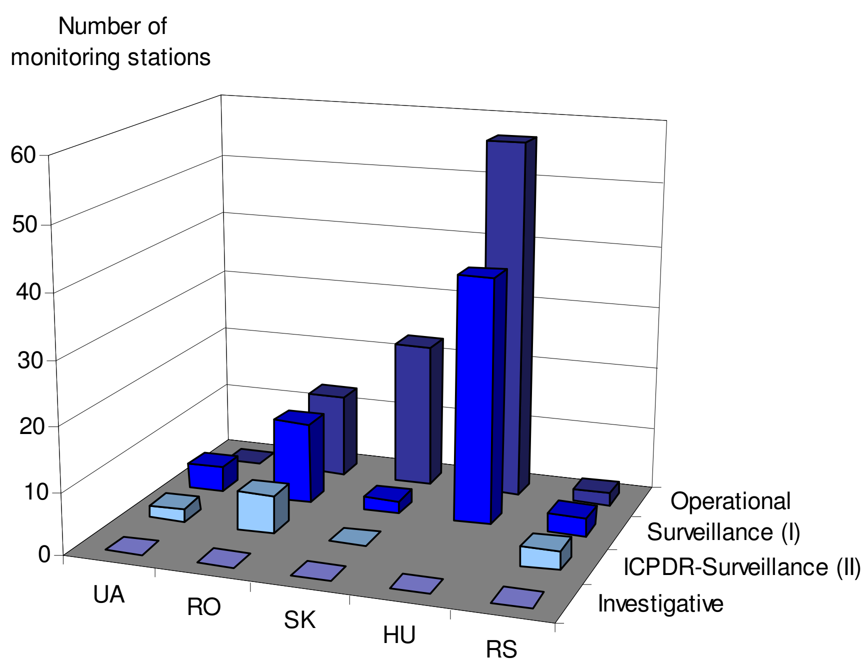

Figure IV.1. Number and dispersion of the monitoring stations among the Tisza countries

The locations of the surface water monitoring stations are shown in **Map 10**.

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[29] Water Quality in the Danube River Basin – 2005, TNMN (ICPDR, 2005).

4.1.3 Confidence in the status assessment

The actual confidence levels achieved for all data collected for a river basin management plan should enable meaningful assessments of status in time and space. According to WFD Annex V, estimates of the level of confidence and precision of results provided by monitoring programmes shall be given in the plan. For this purpose, a three-level confidence assessment system was agreed upon for surface water bodies regarding both ecological and chemical status.

Table IV.1 and **Table IV.2** illustrates the confidence levels for ecological status and confidence levels for chemical status.

Table IV.1: Confidence levels for ecological status (See Tisza River Basin part in the Tisza Map 11)

Confidence level of correct assessment	Description	Illustration in map
HIGH Confidence	***All* of the following criteria apply:** **Biology:** • WFD-compliant monitoring data; • Biological monitoring complies fully with preconditions for sampling/analysis • WFD-compliant methods included in the intercalibration process at the EU level; • Biological monitoring results are supported by: o Results of hydromorphological quality elements (for structural degradation); o Results of physico-chemical quality elements (for nutrient/organic poll.) and o Aggregation (grouping procedure) of water bodies in compliance with WFD shows plausible results. **Chemistry:** • National EQS available for specific pollution and sufficient monitoring data (WFD-compliant frequency) available; • Aggregation (grouping procedure) of water bodies in compliance with WFD shows plausible results.	
MEDIUM Confidence	***One or more* of the following criteria apply:** **Biology:** • WFD-compliant methods not included in intercalibration process at the EU level • WFD-compliant monitoring data, but: • biological results not in agreement with supportive quality elements or • only few biological data available (possibly showing different results); • Medium confidence in grouping of water bodies; • Biological monitoring does not comply completely with preconditions for sampling and analysis (e.g. use of incorrect sampling period). **Chemistry:** • National EQS available but insufficient data available (according to WFD); • Medium confidence in grouping of water bodies.	

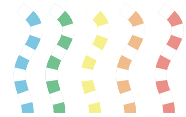
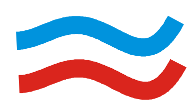
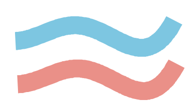
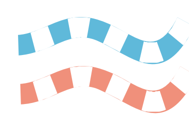
Confidence level of correct assessment	Description	Illustration in map
LOW Confidence	***One or more*** ***of the following criteria apply:*** **Biology:** • No WFD-compliant methods and/or monitoring data available; • Simple conclusion from risk assessment to EQS (updated risk assessment is mandatory). **Chemistry:** • No national EQS available for specific pollution, but data available (pollution detectable).	

Table IV.2: Confidence levels for chemical status (See Tisza River Basin part in the Tisza Map 12)

Confidence level of correct assessment	Description	Illustration in map
HIGH Confidence	***Either:*** • No discharge of priority substances; ***Or all*** ***of the following criteria apply:*** • Data/measurements are WFD-compliant (12 measurements per year); • Aggregation (grouping procedure) of water bodies in compliance with WFD shows plausible results.	
MEDIUM Confidence	***All*** ***of the following criteria apply:*** • Data/measurements are available; • Frequency is not WFD-compliant (less than 12 measurements per year available); • Medium confidence in grouping of water bodies.	
LOW Confidence	***One or more*** ***of the following criteria apply:*** • No data/measurements available; • Assumption that good status cannot be achieved due to respective emission (risk analysis).	

4.2 Designated heavily modified water bodies

There are 223[30] river water bodies identified by the riparian countries in the Tisza River Basin. Out of these, 19 are identified in the Tisza River and 204 in the tributaries. The full list of water bodies is given in **Annexes 6**.

From the river water bodies designated, the Tisza countries also identified heavily modified water bodies and artificial water bodies.

Heavily modified water body (HMWB) refers to a body of surface water that is substantially changed in character as a result of physical alteration by human activity. An *artificial water body* (AWB) is a surface water body created by human activity.

According to WFD Article 2 and 4(3), EU Member States may designate a body of surface water as *artificial* or *heavily modified*, when:

30 The number does contain double-counts, as for some transboundary sections countries designated a different number of water bodies. In the current count, all relevant country designations were taken into account. For the Tisza River, 11 were identified as state boundary river water bodies. Reference will be made as to whether the status assessment is harmonised for transboundary sections.

- its hydromorphological characteristics have substantially changed so that *good ecological status* cannot be achieved and ensured;
- the changes needed to the hydromorphological characteristics to achieve *good ecological status* would have a significant adverse effect on the wider environment or specific uses*;*
- the beneficial objectives served by the artificial or modified characteristics of the water body cannot reasonably be achieved by a better environmental option, which is:
- technically feasible and/or
- not disproportionately costly.

Designation of a water body as *heavily modified* or *artificial* means that instead of *ecological status,* an alternative environmental objective, namely *ecological potential,* has to be achieved for those water bodies, as well as *good chemical status*.

For *rivers* this ITRBM Plan includes the final HMWB designation for EU Member States. The Non EU Member States performed a provisional identification based on the criteria outlined in the analysis report. The criteria for the size of water sections >10 km were changed and all water bodies have been fully considered for the designation. The designation of HMWBs will be revised for every river basin management cycle (every six years).

For the ITRBM Plan, the designation of HMWBs for rivers was performed for:

a. The Tisza River
b. Tributaries in the Tisza River Basin >1,000 km^2

The HMWB designations for the Tisza River and its tributaries are based on national methods and reported information. The preconditions for the final basin-wide HMWB designation were to follow the EC HMWB CIS[31] guidance document, i.e. that the water body had to:

a. be *significantly physically altered* (not only in hydrology but also morphology) which has led to a change in character: the alteration is profound, widespread and permanent and
b. *fail 'good ecological status.'* This had to be proven with high confidence (that the biological monitoring result is based on a WFD-compliant assessment method and assessed worse than *good* status).

For *lakes* the HMWB/AWB designations were based on national methods.

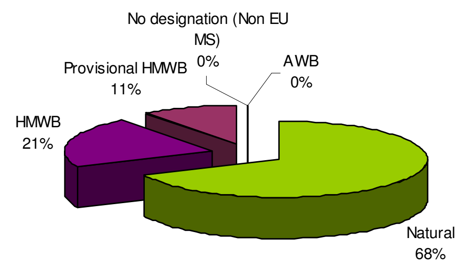
4.2.1 Results for the final designation of heavily modified water bodies for all Tisza Basin rivers with catchment area >1,000km^2

Out of 223 river water bodies in the entire Tisza River Basin (the Tisza River and its tributaries), 75 were designated as heavily modified (75 with final status, 4 with provisional status and 2 have unknown status) representing 34% of the total river water bodies. Further, 18 river water bodies were designated AWBs, representing 8% of the total number of river water bodies. There are no transitional water bodies as the Tisza River has no direct contact to the sea.

Figure IV.2. and Map 13 illustrate HMWBs and AWBs and natural water bodies a) of the Tisza River and b) of the Tisza River and its Tisza tributaries.

[31] EC HMWB CIS: European Commission's Common Implementation Strategy for HMWB.

a) Tisza River



b) Tisza River and its tributaries

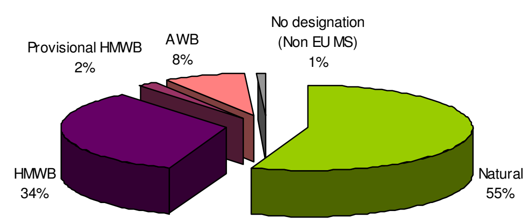


Figure IV.2. HMWBs and AWBs and natural water bodies a) of the Tisza River b) of the Tisza River and its Tisza tributaries.

4.2.2 Results for the final designation of heavily modified water bodies for the Tisza River

The total length of the Tisza River is 966 km. Of this, approximately 410km were identified as HMWB or provisionally HMWB (pHMWB) representing 42,4% of the Tisza River. (**Figure IV.3**)

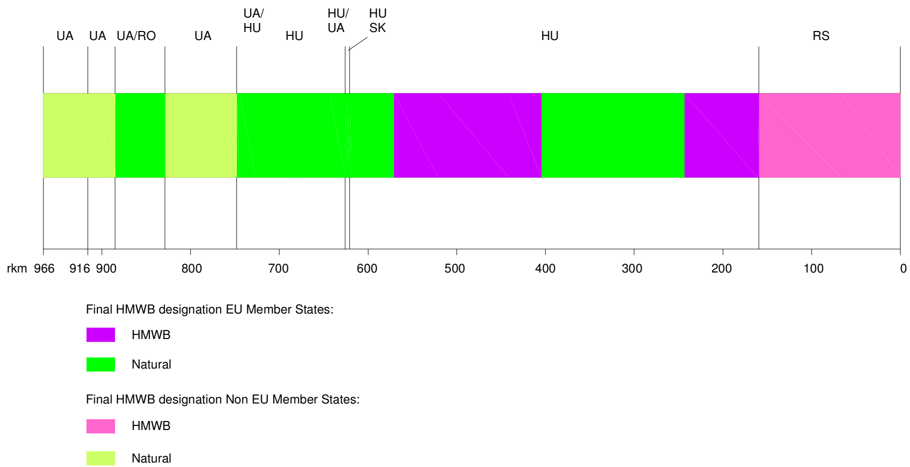


Figure IV.3. Heavily modified water bodies of the Tisza River

4.2.3 Results for the final designation of heavily modified water bodies for lakes

Only six lake water bodies were identified in the Tisza River Basin and all of them are located in Hungary. Out of these, two lake water bodies (33%) were designated as heavily modified and there were no lakes designated AWB. The total area of the six lake water bodies is 145.72 km^2.

4.3 Ecological and chemical status

In this chapter, the results of the monitoring programmes concerning the ecological and chemical status of rivers (carried out under Article 8 and Annex V of the WFD) are presented both in map form (**Maps 11-12**) and percentage values. More detailed results of the classification of all assessed surface water bodies according to particular biological, hydromorphological and chemical quality elements are provided in **Annex 8**.

4.3.1 Surface Waters

4.3.1.1 Rivers

Altogether 223 river water bodies were evaluated. Out of these, 51 (23%) achieved high and good *ecological status* and 51 (23%) achieved moderate or worse *ecological status*. Some 36 (16%) river water bodies achieved high and good *ecological potential* and 46 (21%) achieved moderate or worse status. The status of 39 river water bodies (17%) remained unknown in the Non EU countries.

Based on the data mentioned above, approximately **40%** of the river water bodies in the Tisza River Basin reached good or better ecological status or ecological potential and around **44%** have moderate or worse ecological status or ecological potential.

Figure IV.4 illustrates the water status regarding *ecological status*, *ecological potential* for the water bodies. **Figure IV.5** illustrates status classification for the Tisza River represented as a continuous band.

Regarding the chemical status, 107 (48%) of the 223 river water bodies reached good chemical status and 43 (19%) failed. The chemical status is unknown for 73 (33%) river water bodies (**Figure IV.6**.).

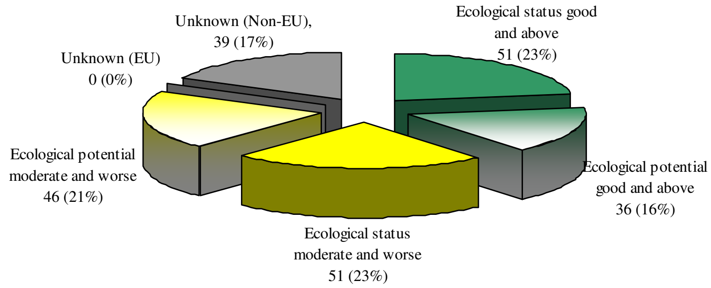


Figure IV.4: Ecological status (ES) and ecological potential (EP) for surface water bodies (rivers) indicated in numbers and relation to the total number of water bodies in Tisza River Basin (%)

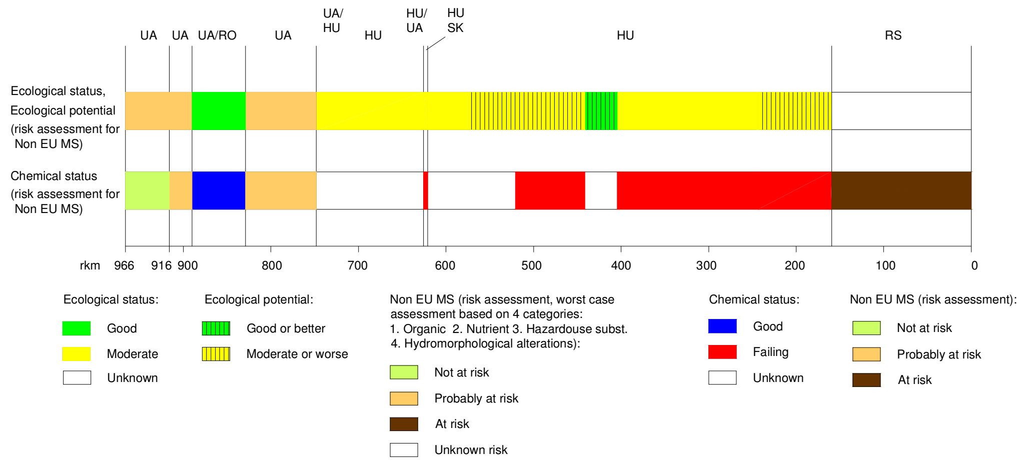


Figure IV. 5: Status classification for the Tisza River represented as a continuous band

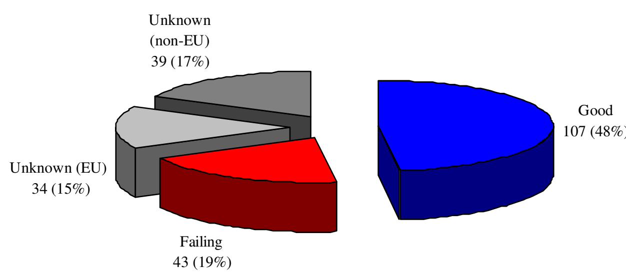
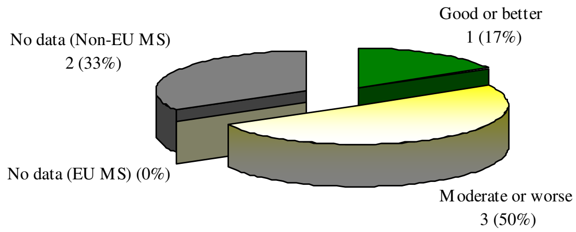


Figure IV.6: Chemical status of surface water bodies (rivers) indicated in numbers and relation to the total number of water bodies in the Tisza River Basin (%)

In the case of final HMWBs (EU Member States), 34 water bodies were assessed with good or high ecological potential and 41 with moderate or poor ecological potential. More information on ecological potential for HMWBs for all Tisza Basin rivers and the Tisza River itself is illustrated in **Figure IV.7**. The ecological potential for AWBs for all rivers in the Tisza Basin is illustrated in **Figure IV.8**. Of the 18 AWBs, 2 have good or high ecological potential and 5 have moderate or poor ecological potential.

a) Tisza River



b) Tisza River Basin Rivers

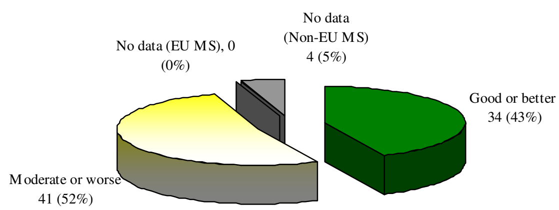


Figure IV.7: Ecological potential for HMWBs in relation to the overall number of HMWBs a) Tisza River b) Tisza Basin Rivers

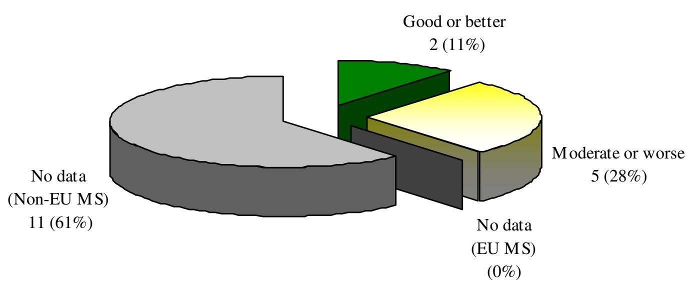


Figure IV.8: Ecological potential for AWBs in relation to the overall number of AWBs

Details and results on the confidence levels are provided in **Map 11**, **Map 12** and **Annex 8**.

4.3.1.2 Lakes

On the Tisza River Basin scale, natural lakes larger than 10km^2 were considered. Out of the six lake water bodies reported, one reached good ecological status, two ranked moderate and one classified as bad. Confidence levels for these water bodies are moderate (twice) and low (twice). Two water bodies were designated HMWBs; one with moderate ecological potential and one unknown. The chemical status of all lake water bodies is unknown.

4.3.2 Groundwater

4.3.2.1 Groundwater monitoring network

Following the requirements of the WFD, groundwater monitoring networks and monitoring programs were established in the Tisza River Basin, including both quantitative and chemical monitoring. These monitoring programmes should provide the information necessary to assess whether the WFD environmental objectives will be achieved. Monitoring information is required for:

- Validation of the risk assessment,
- Assessment of groundwater status,
- Use in the assessment of long term trends both as a result of changes in natural conditions and through anthropogenic activity'
- Establishing the presence of significant and sustained upward trends in the concentrations of pollutants and a reversal of such trends,
- Support for groundwater body characterisation,
- Assessment of whether drinking water protected area objectives are achieved and to support the establishment and assessment of programmes of measures and the effective targeting of economic resources and
- Estimating the direction and rate of flow in groundwater bodies that cross Member States' boundaries.

In all countries the network design was based on previously existing national monitoring programs, which, in some cases, are still being adapted to WFD Article 8 requirements. Different design criteria have been used by the countries to select the appropriate monitoring sites. Aquifer characterisation (porous, karstic and fissured aquifers, confined and unconfined groundwater) has been considered the primary criterion. Another criterion was the depth of the groundwater body since deep groundwater bodies are more difficult and costly to access for monitoring than shallow groundwater bodies. The flow direction was also considered by some countries (special

WFD requirements for transboundary groundwater bodies) as well as the existence of associated drinking water protected areas or ecosystems (aquatic and/or terrestrial).

In general there is an irregular distribution of the monitoring points in groundwater bodies in Tisza countries, as a result of differing hydrogeological conditions, existing pressures on quality/quantity of groundwater but also different national approaches to the design of monitoring networks. An overview of monitoring networks in Tisza countries is presented in **Table IV.3**. More detailed data on monitoring networks in each groundwater body can be found in **Annex 9.**

Table IV.3: Number of monitoring stations and range of density of stations per groundwater body in the Tisza River Basin (see also Annex 9)

	Number of monitoring stations*				**Density (km²/st.)**		
	quant_monit	**ch_operat**	**ch_sur**	**total**	**quant_monit**	**ch_operat**	**ch_sur**
UA	no data	no data	no data	no data	no data	no data	no data
RO *	411	103	411	**411**	22-2662	40 (59)-4288	40-2662
SK	133	30	3	**142**	14-18	0-4 (56-150)	490 (488)
HU	245	0	246	**458**	30-835	/	31-243
RS	29	0	15	**29**	161-1034	/	354-1322
TOTAL	908 (818)	80	356	**1130(1040)**			

*Data regarding RO monitoring stations from the table IV.3 and from the Annex 9 refers only to the B level GWB's

Chemical monitoring programs, include all the mandatory parameters set by the WFD (dissolved oxygen, pH-value, electrical conductivity, nitrates and ammonium). Other parameters (such as T and the set of major ions), are also monitored as a part of existing national monitoring programs. In addition to the core parameters, selective determinants need to be monitored at specific locations, or across groundwater bodies, where assessments indicate a risk of failing to achieve WFD objectives.

Regarding *quantitative monitoring*, according to Annex V of the WFD, the only parameter for the classification of quantitative status is groundwater level regime. In addition to groundwater levels in boreholes or wells, spring flows are monitored, and water abstraction is an optional parameter for some monitoring stations.

4.3.3 Status assessment methodology and threshold values (TVs)

All countries have established different methodologies for status assessment, generally following the principles set up in the CIS Guidance Document No. 18 "Guidance on groundwater status and trend assessment" and/or based on results of other projects at the national level.

In Hungary, the methodology to assess status consists of a series of classification tests (for both quantitative and chemical status). To assess *chemical status*, these tests cover drinking water source protection areas (for present drinking water sources and those designated for future drinking water abstraction), surface water bodies, groundwater dependent wetland and terrestrial ecosystems potential. For shallow and karstic groundwater bodies in particular, tests are performed for nitrate and ammonium pollution. *Quantitative status* is determined by performing three kinds of tests: water balance tests, surface water tests and tests of groundwater dependent wetlands and terrestrial ecosystems. A groundwater body is considered to be of poor status if 20% of its area has continuous decreasing of water level or the groundwater abstraction exceeds the available groundwater resource. For groundwater-dependent water bodies, the groundwater body is classified as of poor status if the remaining spring rate or base flow in the river is smaller than the ecologically required flow, due to reasons of groundwater abstraction.

In Romania, the methodology to assess chemical status followed the recommendations of EU Working Group C. The first step was to check for any exceedances of TVs. The first step was to check for any exceedances of TVs. If there is exceedance of some chemical parameters then the tests are carried out to assess if the total area of exceedance is greater than 20% of the total area of the groundwater body (the limit for poor status assessment) or there is significant diminution of associated surface water chemistry and ecology due to transfer of pollutants from the groundwater body. The load of the pollutant transferred from the groundwater body to the surface water body is compared to the total load in the surface water body (not to exceed 50%). Also, tests are performed for GWDTEs (*groundwater dependent* terrestrial ecosystems) for the transfer of pollutants from the groundwater body, and DWPAs (*Drinking* Water Protection Areas) if there is evidence of increased treatment due to changes in water quality.

To assess the chemical status in Slovakia, the proposed methodology stems from the feasibility of the input information, conceptual model and the hydrogeochemical and hydrogeological interpretation of conditions in the Slovakia. The TV was determined as a half the interval between the determined NBL (natural background levels) and the reference (national drinking water standard). Criteria for assessing the groundwater chemical status for this test were drinking water standards and TVs. In the case of non exceedances, the groundwater body is recommended to be of good chemical status for the relevant parameters. An acceptable extent of exceedance would not exceed 20% of the total groundwater body. To determine the overall quantitative status for groundwater bodies, four tests were applied: water balance test, groundwater level and discharge test, surface water flow test and groundwater dependent terrestrial ecosystems test.

Serbia and Ukraine have not yet established status assessment methodology or threshold values. A more detailed description of status assessment methodologies can be found in **Annex 10**.

4.3.4 Status of groundwater bodies of basin-wide importance

A summary overview of the chemical and quantitative status for the important transboundary and national groundwater bodies is presented in **Table IV.4**. Detailed information on the status for each groundwater body is given in **Annex 11** and **Maps 14-15** show chemical and quantitative status for most upper layers and main layers groundwater bodies.

Table IV.4: Overview of chemical and quantitative status of important groundwater bodies in the Tisza River Basin

Status of groundwater bodies		**UA**		**RO**		**SK**		**HU**		**RS**		**Total**	
		Nat.	Tran.	Nat.	Tran.	Nat.	Tran.	Nat.	Tran.	Nat.	Tran.	Total Tisza River Basin	Total
Chemical Status	Good	no data for 3 ground water bodies	6	2	7	5	2	17	21	4	10	74	85
	Poor		-	1	1	0	0	2	4	0	0	8	
Quantitative Status	Good	no data for 3 ground water bodies	6	3	8	5	2	14	18	2	5	63	85
	Poor		-	0	0	0	0	5	7	2	5	19	

Nat – National groundwater bodies, Tran – Transboundary groundwater bodies

4.3.5 Groundwater quality

The results of chemical status assessment show that out of 85 groundwater bodies of basin-wide importance, good chemical status was observed in 74 (87%). Eight groundwater bodies have poor chemical status. No chemical status data are available for three groundwater bodies from Ukraine. (**Figure IV.9.** and **Maps 14-15**)

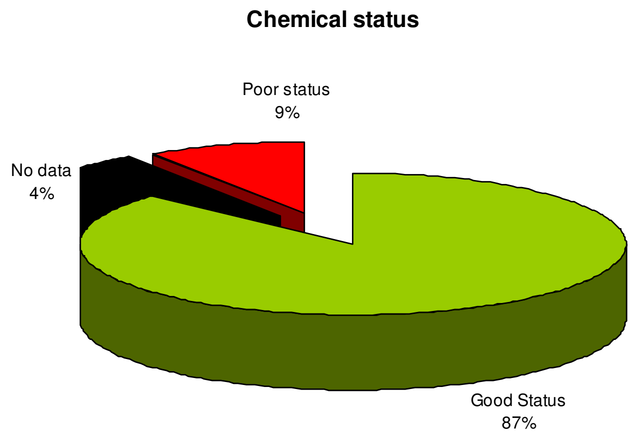


Figure IV.9: Chart with percentage of groundwater bodies in good/poor chemical status in the Tisza River Basin

Annex 10 provides a description of the methodology for chemical status assessment and information on threshold values for poor status, including their relation to background values and to environmental quality objectives.

Poor chemical status is either caused by values higher than the groundwater quality standard for nitrates, or by values higher than the threshold value for other substances established individually by Member States. It should be stated that poor status can be caused by more than one pollutant.

Table IV.5 gives an overview of groundwater bodies of poor chemical status by country, caused by different pressures.

Table IV.5: Number of important groundwater bodies in the Tisza River Basin which are of poor chemical status caused by different pressures

Sources	Number of groundwater bodies with poor chemical status /Pressures posing poor chemical status	UA	RO	SK	HU	RS	Total Tisza River Basin*
Point sources	Leakages from contaminated sites	-	-	-	2	-	2
	Leakages from waste disposal sites (landfill and agricultural waste disposal)	1	-	-	-	-	1
	Leakages associated with oil industry infrastructure	-	-	-	-	-	0
	Mine water discharges	1	-	-	-	-	1
	Discharges to ground such as disposal of contaminated water to soakways	-	-	-	-	-	0

Sources	Number of groundwater bodies with poor chemical status /Pressures posing poor chemical status	UA	RO	SK	HU	RS	Total Tisza River Basin*
	Other relevant point sources	-	-	-	-	-	0
Diffuse sources	Due to agricultural activities	4	2	-	6	-	12
	Due to non-sewered population	4	2	-	2	-	8
	Urban land use	-	-	-	5	-	5
	Other significant pressures	-	-	-	-	-	0

*poor status can be caused by more than one type of pressure

Only the risk assessment is available for Serbia since no groundwater monitoring was established according to WFD requirements.

For shallow groundwater bodies with overlying strata less than 5 meters, poor chemical status of groundwater in most cases is caused by extensive agricultural activities and non-sewered settlements. In such cases, the characteristics of the strata separating an aquifer from the land surface, in terms of how easily pollutants can reach the aquifer from the ground surface, show low capacity to attenuate the pollutants. Evidently, high vulnerability of some groundwater bodies, combined with the absence of wastewater collection and treatment systems and/or the use of fertilisers requires the application of systematic measures to improve the quality of shallow groundwater.

4.3.6 Groundwater quantity

The results of quantitative status assessment show that out of 85 groundwater bodies of basin-wide importance, good quantitative status was observed in 63 water bodies (74%), out of which 39 are transboundary and 24 national groundwater bodies (**Map 15**). There are 19 groundwater bodies with poor quantitative status, 7 national and 12 transboundary (**Figure IV.10**). There is no data on quantitative status for three groundwater bodies from Ukraine.

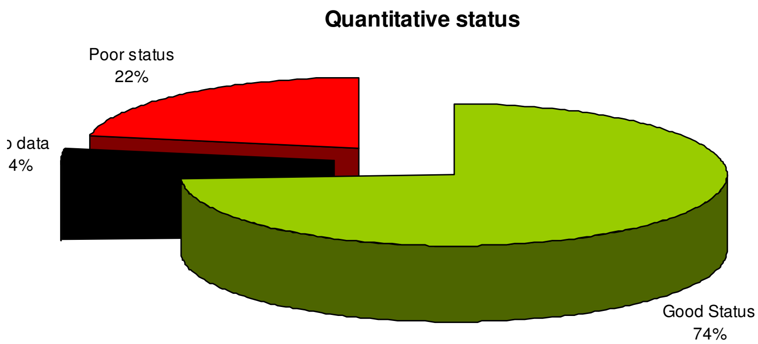


Figure IV.10: Chart with percentage of groundwater bodies in good/poor quantitative status in the Tisza River Basin

In most cases poor quantitative status is caused by exceeding available groundwater resource due to abstractions for different purposes (agriculture, public water supply and industry). **(Table IV.6.)**

Table IV.6: Different pressures causing poor quantitative status of groundwater bodies in the Tisza River Basin

Pressure	Number of groundwater bodies with poor quantitative status /Pressures posing poor quantitative status	UA	RO	SK	HU	RS	Total Tisza River Basin*
Water abstractions	Abstractions for agriculture	-	-	-	-	7	7
	Abstractions for public water supply	2	-	-	-	7	9
	Abstractions by industry	-	-	-	-	7	7
	IPPC activities	-	-	-	-	-	0
	Non-IPPC activities	-	-	-	-	-	0
	Abstractions by quarries/open cast coal sites	-	-	-	2	-	2
	Other major abstractions (specify)	-	-	-	10	-	10
Artificial recharge	Discharges to groundwater for artificial recharge purposes	-	-	-	-	-	0
	Returns of groundwater to groundwater body from which it was abstracted (e.g. for sand and gravel washing)	-	-	-	-	-	0
	Mine water rebound	-	-	-	-	-	0

Pressure	Number of groundwater bodies with poor quantitative status /Pressures posing poor quantitative status	UA	RO	SK	HU	RS	Total Tisza River Basin*
	Other major recharges (specify)	-	-	-	-	-	0

*Other major abstractions include: illegal water abstraction and indirect abstraction by drainage and gravel pits;
**Infiltration ponds supplied from surface waters
***poor status can be caused by more than one type of pressure
Only the risk assessment is available for Serbia since no groundwater monitoring was established according to WFD requirements.

Among other types of groundwater utilisation, abstractions for agriculture and irrigation have comparable significance to that of drinking water. From the input received, it can be deduced that impacts on quantity status of groundwater in some countries (Hungary, Serbia) are widespread (reduction of borehole yields, significant water level decline and water shortage for depending ecosystems).

4.4 Gaps and uncertainties

The status assessment was based on the data uploaded by the countries to the DanubeGIS templates. For the Tisza River, 19 water bodies were reported by the five countries and there were several overlaps regarding river kilometres.

There are still significant data gaps for the chemical status of the surface water, as well as for the ecological potential of AWBs.

The assessment of ecological status according to the requirements of the WFD was a challenge for all EU Tisza countries. The WFD-compliant methods for the analysis of biological quality elements (BQEs) and their assessment had to be applied for the first time. Enormous efforts were needed to apply the new sampling methods for all BQEs, to establish appropriate classification systems and to put these new methods into practice at the national level. The intercalibration exercise of the Eastern Continental Region, aiming for international harmonisation and comparability of status class boundaries, demanded additional efforts and has not been fully completed so far.

Those ambitious activities logically brought along a number of gaps and uncertainties that were reported by the countries and which have to be taken into account when interpreting the results of the status analysis in the ITRBM Plan.

So far, most of the countries have not managed to use all BQEs for the ecological status assessment as required by the WFD (**Annex 8**). The key data absent were those for macrophytes as well as for phytobenthos and fish. In the intercalibration exercise performed for the Eastern Continental Region, only one country (Slovakia) completed the harmonisation exercise for their river classification schemes, although only for one BQE (benthic macroinvertebrates). However, efforts are currently underway to finish the EC GIG intercalibration exercise by 2011.

Regarding the confidence of the ecological status assessment, almost all Tisza countries reported some cases of a preliminary assessment using the risk assessment data or insufficient monitoring data requiring further investigations and/or monitoring. In general the reasons usually reported for low and medium confidence of the ecological status assessment were:

- Lack of or insufficient monitoring data;
- Missing intercalibration of biological methods for individual quality elements;
- Impossibility of statistical correlations between BQEs and physical and chemical support elements because of monitoring data collected at different times;
- Missing data on hydromorphological elements and
- Lack of WFD-compliant methodologies for certain BQEs.

Although bilateral coordination in the transboundary groundwater bodies has been established to some extent (see Chapter 5.1.1. on the analysis report), there is still need for cross-border harmonisation for groundwater bodies. Common conceptual models for each transboundary groundwater body (as a whole) need to be developed to better understand groundwater systems. This is essential for all further bilateral activities such as setting monitoring networks and programmes, harmonising risk assessment and status assessment methodologies etc.

Generally, most uncertainties concerning status assessment arise from the fact that threshold values for transboundary groundwater bodies are set separately for each country, and hence may differ. Therefore, coordination in setting threshold values between these countries is needed, as required by Articles 3.3 and 3.4 of Directive 2006/118/EC (Groundwater Directive), otherwise discrepancies in status assessment may result in different quality targets in neighbouring countries.

This entails the need for intensive bilateral and multilateral cooperation to harmonise data sets for transboundary groundwater bodies. In addition, the interactions of groundwater with surface water or directly dependent ecosystems need further attention.

5 Environmental objectives and exemptions

5.1. Environmental objectives

The EU Water Framework Directive (WFD) requires the achievement of the following environmental objectives by 2015, in principle:

- good ecological/chemical status of surface water bodies;
- good ecological potential and chemical status of heavily modified water bodies (HMWBs) and artificial water bodies (AWBs);
- good chemical/quantitative status of groundwater bodies.

The Integrated Tisza River Basin Management Plan (ITRBM Plan) provides an overview of status assessment results for both surface water bodies and groundwater bodies relevant to the Tisza basin, as well as risk assessment classifications for the Non EU Member States (see **Chapter 4**). However, the ITRBM Plan differs from national river basin management plans (Part B) in terms of objectives and the complexity related to each significant water management issue (SWMI) and groundwater.

Defined visions and specific operational management objectives for all SWMIs on the Danube Basin were complemented by the specific management objectives for the Tisza basin, to harmonise the two approaches.

The Tisza River Basin management objectives aim to fulfil those outlined in the Significant Water Management Issue Document (ICPDR Document IC/WD/268) for the Danube Basin. These objectives guide the Danube countries (including the Tisza countries) towards agreed upon aims of basin-wide importance by 2015 and also serve the achievement of the overall WFD environmental objectives. The SWMI visions are based on shared values and describe the principle objectives for the Danube River Basin (as well as Tisza basin) with a long-term perspective. The management objectives describe the steps towards fulfilling the environmental objectives in 2015 explicitly: they are less detailed than those at the national level and more detailed than those expressed in the Danube River Protection Convention (DRPC) as well as in the Danube Declaration (2004). The management objectives for the Danube River Basin and also for the Tisza River basin are to:

- describe the measures that need to be taken to reduce/eliminate existing significant pressures on the basin and basin scale for each SWMI and for groundwater,
- improve the linkage between measures on the national level and their agreed coordination on the basin and basin level to achieve the overall WFD environmental objectives and
- ensure that environmental objectives are fully considered along with impacts of climate changes in the planning process of new structures with possible adverse effects on status of waters related to increased water demand, flood protection, measures for land use development (water quantity management objectives).

With 2015 as a target, measures reported from the national to the international level have been compiled in such a way that they reflect their effectiveness in reducing and/or eliminating existing pressures/impacts on the basin-wide scale.

The visions and management objectives are listed for each SWMI in **Chapter 7** (the Joint Programme of Measures), which includes the relevant conclusions regarding the achievement/failure of the basin-wide aims.

5.2. Exemptions according to WFD Articles 4(4), 4(5) and 4(7)

This chapter provides an overview of water bodies which are subject to environmental exemptions for both surface water bodies and groundwater bodies. The exemptions relate to WFD Article 4(4) - extension of deadline, Article 4(5) - less stringent objectives and Article 4(7) - for future infrastructure projects that would lead to deterioration in water status. The current plan focusing on exemptions related to hydromorphological alteration of surface waters and groundwater. The application of exemptions (related to groundwater and hydromorphological alteration) is summarised here, and additional details on the application of the different types of exemptions are part of the national Part B reports.

For the 223 river water bodies included in the ITRBM Plan, WFD Article 4(4) is applied for 66 water bodies (30%) in Hungary, Slovakia and partly in Romania **(Map 16)**. Of 223 surface water bodies, WFD Article 4(4) exemptions are applied for 70, and Article 4(5) is not indicated at all for water bodies in the Tisza River Basin. Article 4(7) is applicable for 13 water bodies (**Map 8**). Of six lake water bodies (all in Hungary), WFD Article 4(4) exemptions are applied for five, and Article 4(5) is not implemented at all. Further details on exemptions according to WFD Article 4(4) for all three components of hydromorphological alterations (river and habitat continuity interruption, reconnection of wetlands/floodplains and hydrological alterations) are part of **Chapter 7.1.4**. Information on the application of WFD Article 4(7) during the planning process of future infrastructure projects is provided in **Chapter 7.1.4.6** and also in **Map 8**.

In the Tisza River Basin nine groundwater bodies need Article 4(4) exemptions for quantitative status (only in Hungary), three for chemical status and for two for both quantitative and chemical status (**Map 17)**. An extension of the deadlines set in Article 4(1) (b) is need for these groundwater bodies for phased achievement of the WFD objectives.

6. Economic analysis of water uses

6.1. EU Water Framework Directive economics

The EU Water Framework Directive (WFD) requires that river basins across Europe are described in both physical and economic terms. Economic principles are foremost addressed in Article 5 (and Annex III) and Article 9 of the WFD. As required in Article 5, an economic analysis of water uses was carried out in 2004 on a river basin district scale as part of the WFD's river basin management approach. Annex III complements Article 5 by detailing which factors need to be included in the economic analysis. Article 9 requires that Member States take account of the principle of cost-recovery, including environmental and resource costs, by 2010. The 'polluter pays' principle is key to establishing who should pay for existing and future water services. More specifically, Member States have to ensure by 2010 that water pricing policies provide adequate incentives for water users to use water efficiently and to secure that different water uses contribute adequately to the recovery of the costs of water services. Article 11 of the WFD requires each Member State to ensure a programme of measures, taking account of the results of the analyses carried out under Article 5, for each river basin district or for the part of an international river basin district within its territory.

Therefore, Annex III requires the economic analysis conducted as required by Article 5 to be in sufficient detail for preparation of the selected programmes of measures on the basis of cost effectiveness. In addition to these direct and explicit references to economic instruments, the WFD refers implicitly to economic principles in many of its articles, for "disproportionate costs".

6.2. Results of economic analysis 2007

The economic analysis conducted in 2007, with the reference year 2004/2005, for the Tisza River Basin covered the following issues:

(1) socio-economic characterisation,
(2) of current levels of recovery of costs for water services.

Regional differences in GDP values are influenced by political agenda, including the requirements for new EU standards (Hungary, Slovakia and Romania) as well as noticeable variations of the industrial sector growths in each of the Tisza countries.

The assessment of current levels of cost recovery of water services, in the frame of WFD Article 9, performed in 2007 was based only on pricing and tariffs data and gives a short basin-wide overview on water pricing in the Tisza River Basin based on national contributions. The information was not sufficient to investigate other key elements such as the status of water services, the institutional set-up for cost-recovery, the extent of the recovery of the costs (financial, environmental and resource costs) of the water services, the contribution of key water uses to the costs of these services or the incidence of subsidies.

As a result of different economic, financial and institutional settings in the Tisza River Basin countries, water pricing systems vary considerably among these countries. Current drinking water tariffs and wastewater pollution charges are well below economic levels in most of the water utilities in the basin.

6.3. The Tisza economic analysis 2009

The knowledge, the experience and the understanding of the issues raised in the 2004 and 2009 economic assessment at the Danube River Basin level, as well in the 2007 economic analysis at the Tisza basin level, were necessary to evaluate data quality, ensure correct spatial scale, and to restructure available data and information according to hydrological boundaries.

As part of the WFD's river basin management approach, key reporting units are derived from hydrological boundaries. However, only a very small percentage of the data required for the economic analysis is available currently in accordance with hydrological boundaries. Existing data collection systems are normally conceptualised on the basis of administrative entities and data are gathered at the municipal, regional (county), state or national level. To make these data applicable to WFD reporting, the data collected for the Integrated Tisza River Basin Management Plan (ITRBM Plan) have been restructured, depending on the particular indicator, according to the sub-catchments or water bodies within national share in the sub-basin.

The economic analysis for the ITRBMPlan used the same methodology as for that of the Danube River Basin. Therefore, the Tisza Economic Analysis 2009 addressed so-called *horizontal economic issues* linked with the pressures from the four significant water management issues (SWMIs).

The horizontal issues are:

a. Baseline scenario up to 2015,
b. Cost recovery analysis,
c. Cost-effectiveness analysis and
d. Cost-benefit analysis.

The national data collection systems used for the Danube River Basin Management Plan were adapted in a way that reduces the inconsistencies in data definition and collection and methodological difficulties that arose in 2007, based on agreed upon templates.

6.4. Description of relevant water uses and economic meaning

6.4.1 The economic analysis of water use

An economic analysis of water uses was carried out to assess the importance of water use for the region's economy and the socio-economic development of the Tisza River Basin. This analysis provides an economic profile for the river basin in terms of general macroeconomic indicators, such as GDP and GVA, and it is strongly connected to the assessment of SWMIs reported to the public in 2007.

Data concerning the general socio-economic situation in the Tisza countries have been collected and compiled at the basin level **(Table I.3.)**, and reveals similarities between economic circumstances in three Tisza countries (Slovakia, Romania, and Hungary) and significant differences for the other two (Serbia and Ukraine). The assessment shows a clear difference in GDP – for example, Slovakia, Hungary and Romania have a GDP between 4,000 EUR and 5,500 EUR per capita/year, which is twice that of Serbia and five times that of Ukraine. One important observation from this current assessment is that the spread of growth in GDP, GDP per capita and productivity over the last ten years varied more among regions than among countries. This great heterogeneity that exists among regions translates into marked differences in their economic performances. Still, if this assessment is compared to the situation observed some years ago, it is obvious that there are opportunities for growth in all Tisza Basin regions, including not only investment in hard infrastructure, but also rural regions and industrialisation **(Figure VI.1).** Economic analysis in the future should take into account the potential of market developments in the Tisza River Basin.

Water abstraction among Tisza countries is divided as follows: approximately 40% for agriculture, 40% for industry (including energy production) and 20% for urban use.

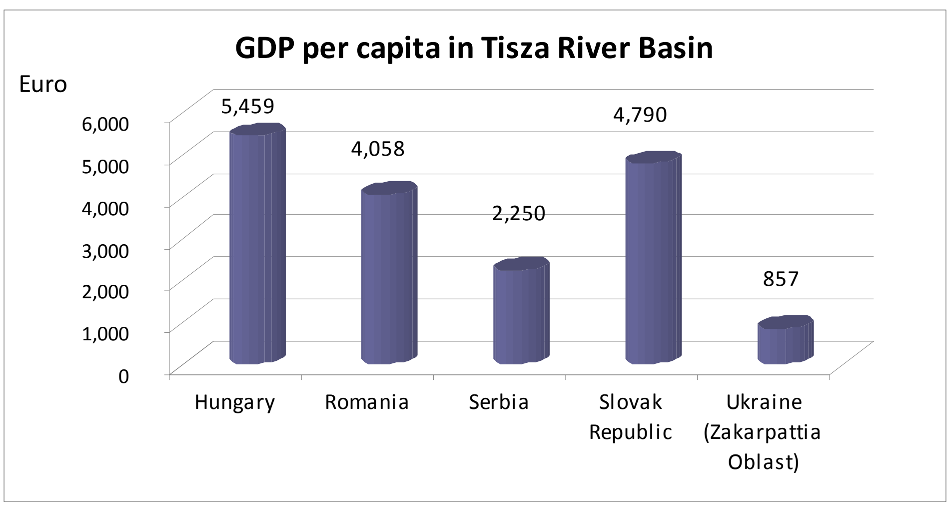


Figure VI.1: GDP per capita in the Tisza River Basin

Romania has the highest share of economic capacity of different economic sectors (agriculture and industry), followed by Slovakia, Hungary, and Serbia. The economic figures **(Table I.3.)** indicate an increasing trend in agricultural production in the Tisza River Basin, including plant production and livestock, particularly in cattle and sheep stocks. The same positive tendency is found for industrial sector development, due to the improvement of the metallurgical industries, as well as of the chemical, petrochemical, cellulose and paper, food, textile, and furniture industries **(Figure VI.2)**.

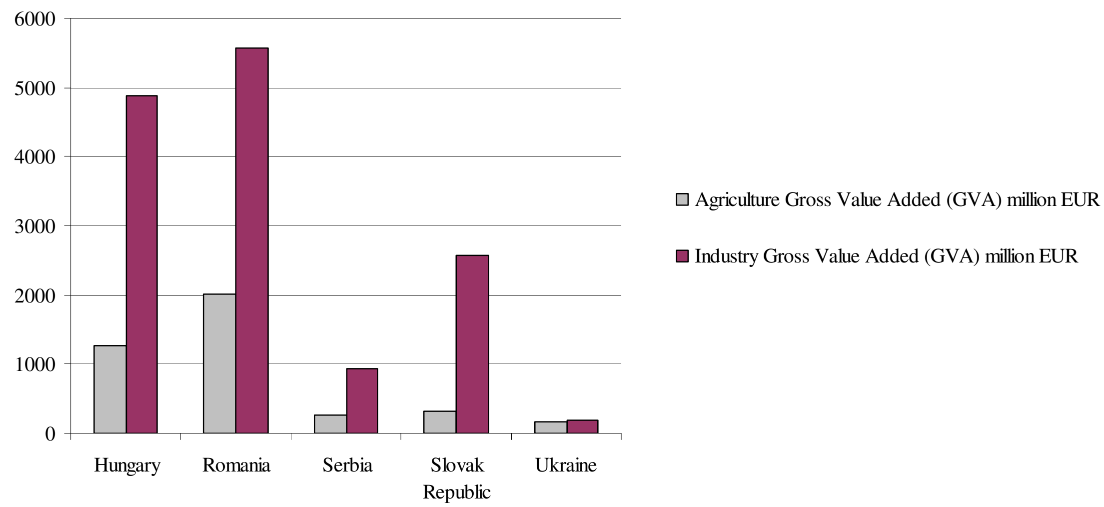


Figure VI.2: Agricultural and Industrial Gross Value Added (GVA) in the Tisza River Basin

6.4.1.1. Characteristics of water services

Water services are defined according to WFD Article 2(38) as:

(a) abstraction, impoundment, storage, treatment and distribution of surface water or groundwater;
(b) wastewater collection and treatment facilities that subsequently discharge into surface water.

Basic information regarding water services and connection rates of the population to public water supply, public sewerage systems and wastewater treatment plants are presented in **Figure VI.3**. (Current rates represent the national average for Slovakia)

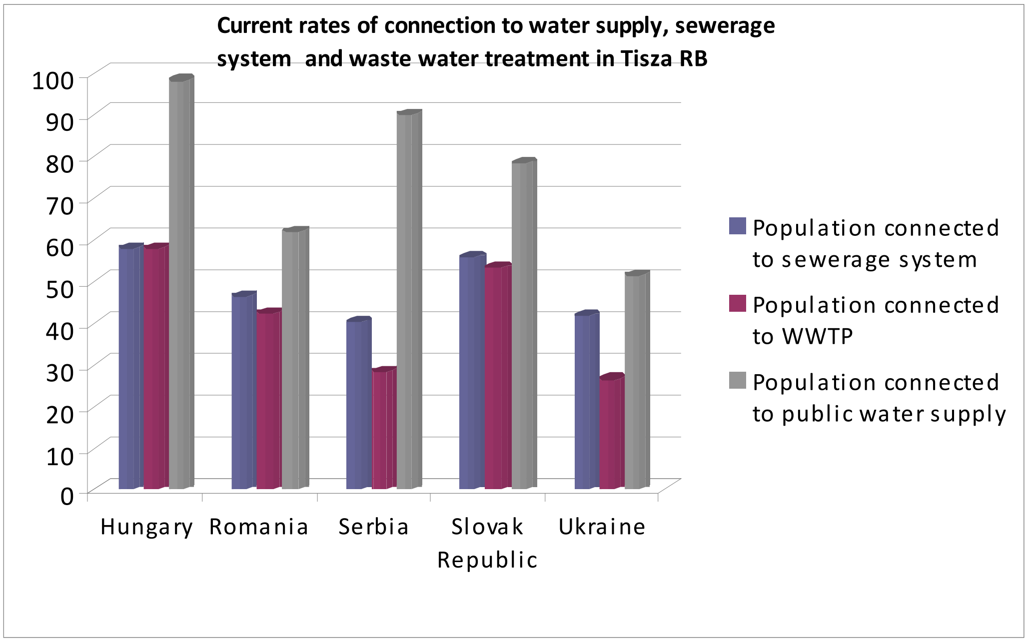


Figure VI.3: Current rates of connection to water supply, sewerage system and wastewater treatment in the Tisza River Basin

The share of population connected to public water supply varies from 51.3% in Ukraine to 98.3% in Hungary.

Water supply networks are generally in poor condition, lacking maintenance and demonstrating ineffective operation as a consequence of the economic decline of the past decade. Leakage is generally high; 30-50% of the water is lost in many cases. The extent of piped drinking water supplies to households varies between urban and rural areas, with rural populations less well provided in some countries.

The share of the population connected to public sewer systems is more heterogeneous at around 50%, with the largest share in Hungary. Many agglomerations in the Tisza River Basin continue to discharge untreated municipal waste into water bodies.

Sewage treatment in a large number of agglomerations is also limited to screening before being discharged directly into rivers. This assessment considers reports on urban wastewater treatment development in the Tisza River Basin (agglomerations ≥ 2,000 PE).

A number of urban sector improvements in all Tisza countries have been realised in recent years and have improved the collection level and treatment of sewage. Tertiary treatment (N and P removal) is also being applied in a large number of the upgraded and new wastewater treatment plants, though not in all cases.

6.4.1.2. Characteristics of other water uses

The WFD requires the identification of water uses (abstraction for drinking water supply, irrigation, leisure uses, industry, etc) and characterisation of the economic importance of these uses. Water use means water services together with any other activity identified under Article 5 with a significant impact on the status of water (such as abstraction, flow regulation, losses in the distribution, water transfer or artificial recharge).

6.4.1.3. Present water consumption

The aggregated annual water consumption of the Tisza River Basin is 4,076.5 million m^3 for the population connected to centralised water supply systems. Urban water use has decreased in almost all Tisza River Basin countries as a result of measures to reduce demand and as a consequence of economic restructuring. An overview of the economic importance of most relevant water uses is provided in **Annex 12** and **Tables 3-7**.

6.5. Projecting trends in key economic indicators and drivers up to 2015

A Baseline Scenario (BLS) has been developed to assess key economic drivers likely to influence pressures (see **Chapter 2**), and thus water status, up to 2015. The BLS evaluates trends in water supply and water demand, with a focus on changes in general socio-economic variables (e.g. population growth), economic growth of main sectors and changes in implementation of planned investments linked to existing regulation.

In the Tisza River Basin, the main industrial regions are located in Romania and Hungary, although there are also some important industrial facilities in Ukraine, the Slovakia and Serbia. Due to the economic decline and stagnation during the last decade, industrial sectors are now mainly oriented towards local resources. Currently, the mining and metallurgical industries have an important share in the regional economy of the Tisza River Basin, as well as the chemical, petrochemical, cellulose and paper, food, textile, and furniture industries (see also **Chapter 2.1.2.1.**).

Future trend projections for developments of relevant sectors up to 2015 are considered in the BLS calculation for measures **(Annex 12** and **Table 7)**.

6.5.1.1. Projection of water demand

The water demand projection for 2015 is based on national methodologies considering minimum, average and maximum scenarios. The total water demand projected for up to 2015 is 4,214 bln m^3. The scenarios identified by all Tisza countries indicate a small increasing trend of water abstraction as a consequence of increases in water demand at the basin level in industrial, urban and agricultural sectors **(Annex 12** and **Table 7)**.

As a consequence of an increased connection rate to centralised water supply, water abstractions for urban needs will increase slightly.

As in the case of other countries in the Danube Basin, technological changes in the Tisza countries will increase water use efficiency in the industrial sector and thus lead to reductions in water demand. Additionally, water demand for agriculture is expected to become more significant due to intensification of agriculture and anticipated climate changes.

6.5.1.2. Projection of wastewater discharge

The aggregated wastewater generation of the population connected to central sewerage systems is anticipated to increase. This should not result in increased pollution, as the amount of untreated wastewater will be significantly reduced through the construction of wastewater treatment plants and several measures to be implemented will contribute to reducing water pollution (such as reduction of losses, increased water efficiency in industry, proper norms for irrigation and effective pricing policies).

6.6. Economic control tools

6.6.1 Cost recovery as an incentive for efficient use of water resources and as a financing instrument

The WFD requires accounting related to the recovery of costs of water services, and information on who pays, how much and what for. Cost recovery for specific water services is defined as the ratio between the revenue paid for a specific service and the costs of providing the service. In most countries, the assessment of cost recovery focuses mainly on water supply as well as sewerage services for industry and households. Costs include management costs, depreciation, interests, taxes and fees, and the environment and resource costs. Environment and resource costs are not taken directly into account in most countries as part of the economic analysis, due to both a lack of methodology and information. In some countries, existing economic instruments that are intended to partly internalise environmental and resource costs are considered separately in the cost recovery assessment.

All Tisza River Basin countries have problems providing well-functioning water utility services at adequate costs. Considerable investments are required to upgrade and update current facilities to comply with EU environmental and health requirements. A huge investment volume is needed over the next 15 years, which would mean huge tariff increases of several hundred percents, of tariffs which are already very high in Tisza countries as compared to EU countries. For example, people in Hungary pay an average of 2% of their income compared to 0.5-1% in other EU countries.

The issue of cost recovery is an issue of primary national importance.

6.6.1.1. Water pricing and pricing policies

The system of water resource fees to be paid in proportion to water uses, has been introduced in **Hungary** to regulate the utilisation of water resources based on the aim of the water use and the type of water used. Water resource fees account for a relatively small part of the total costs of abstraction in the industrial, agricultural and the public utility sectors.

A water load fee was introduced on 1 January 2004 for all polluters – including companies that operate public water utilities – who discharge pollution into surface water, in proportion to the quantity of pollutants discharged. A soil load fee was introduced on 1 July 2004 for all those who do not connect their facilities to the public sewage system (where such a system exists) and thereby pollute groundwater.

In Hungary there are two types of water price systems (price structures) for basic services: a one-factor system based on unit price, block tariffs and fixed price, and a two-factor system based on the basic price and service fee (variable part).

Water abstraction charges are the same throughout **Romania**, but differ according to the source of water (inland rivers, the Tisza River and groundwater) and the category of user (industry, household, power plant, agriculture or fisheries). Prices of drinking water are set at the municipality level, taking into account local conditions and costs associated with providing drinking water.

The effluent charges are levied on a set of pollutants and aimed at reducing their content in the rivers to within limits set by the law. If limits are exceeded, fines or penalties are levied. Penalties are levied for non-compliance for both water intake and discharge of wastewater. The penalties are used as income for the Water Fund, and the income from all water charges is used to cover operating costs.

The drinking water and sewage and wastewater treatment tariffs are based on the production and exploitation costs, maintenance costs, depreciation costs, loan rates according to the obligations of the loan contracts and credit reimbursement.

The income from all water charges is used to cover operating costs. The penalty revenues according to Law 310/2005 are a source of income for National Administration Apele Romane.

The water management funding at the national level is defined in the Water Law in **Serbia**. The major sources are: the budget (including fees for the use and protection of water and charges for extraction of material) and revenues from fees assessed by public water companies (drainage fees, irrigation fees and fees for the use of the infrastructure). Additionally, local governments and utilities invest in the water sector through local activities (primarily municipal water supply and wastewater disposal), as do other legal entities and individuals, to meet their needs or protect their property.

The basic problem associated with water sector funding arises from the fact that there is a large gap between needed funding and secured funding. Namely, ‘user pays’ and ‘polluter pays’ principles are not fully applied in water and service pricing, resulting in an extremely low level of self-funding and a major reliance on the budget. Further, fees for the use and protection of resources are far below required levels, and the management of accounting, invoicing and collection does not ensure full revenues.

Current drinking water tariffs and removal of wastewater charges are well below economic levels. In addition, fines for non-compliance with wastewater discharge are too low and poorly enforced.

According to the 2004 Water Act, two categories of payments for water use exist in **Slovakia**:

(1) payment for water abstraction from water courses, utilisation of hydropower potential of water courses with certain install capacity, water abstraction from water courses for energy production, utilisation of hydropower potential of water coursers for water constructions according to international agreement, utilisation for navigation and other services in the public interest;

(2) charges for groundwater abstraction, wastewater discharge.

Most of the revenues from payments are income for the Slovak Water Management Enterprise (SWME) and are used to operate water courses and river basins. Charges are collected by SWME and they have been a funding source for the Slovak Environmental Fund since 2004.

The household drinking water bill is calculated on the volumetric consumption of water (price multiplied by volume of delivered water). According to recent wording of the 364/2004 Water Act, the polluter is obliged to treat wastewater according to state-of-art technologies (secondary treatment at minimum). The Water Act also requires treating wastewater to meet emission limits. Therefore, there are cases where the polluter must add a tertiary treatment to meet standards. According to the Regulation on Pollution Charges from 1979, each polluter must pay a water effluent charge. Currently, the water effluent charge is paid according to the 364/2004 Water Act and Decree of Government of the Slovakia No. 755/2004.

Ukraine has several laws and other secondary laws regulating issues of drinking water, water supply and sewage water. According to the 2002 Law of Ukraine 'On Drinking Water and Drinking Water Use' communal enterprises of territorial communities (vodocanals) provide central water supply services. These enterprises have their own property and are financially independent. Vodocanals set tariffs for water supply and sewage water themselves and approve them in local village or city councils.

The tariffs do not take into account the source from which the water in-take is made (surface or groundwater).

Tariffs differ for various consumer groups: population, governmental organisations and industry. Vodocanals only supply drinking water; there is no technical water for industry. Tariffs increase from year to year for all groups of consumers, and they are highest for industry.

According to the current legislation, all water users have to treat wastewater. If a water user does not make a direct discharge, it should discharge wastewater to the vodocanal wastewater treatment facilities. A separate agreement for subscriber service provision is made in this case.

The discharge of pollutants into surface waters by vodocanals and by the water user with direct discharge is regulated by the 1999 Decree of Cabinet of Ministers of Ukraine 'About Approval of Order of Establishment of Charges for Pollution of Environment and Getting the Charges'.

6.6.2. Cost-effectiveness as a criterion for selecting measures to achieve reduction targets

Cost-effectiveness analysis (CEA) can be a decision support tool at the national level to select the most cost-effective combination of measures for inclusion in the Programme of Measures as described in WFD Article 11. The application of CEA might be useful in assessing the effectiveness of supplementary measures relevant in a transboundary context. Achieving nutrient reduction targets cost-effectively, for example, requires analysis of the costs and effects of potential measures. Cost functions of various measures to reduce nutrients are planned to be added to the MONERIS scenario calculations.

6.7. Conclusions

Information on economic variables and factors remains central to the WFD implementation. The economic analysis shows an increase in the availability of data that are comparable across countries and a large number of useful studies on the costs and prices of water services (including environmental and resource costs). With respect to the challenging environmental objectives of the WFD and the necessary financial resources (which may exceed the capabilities of some Tisza countries in the short term), it seems essential to establish a pragmatic, targeted and integrated view of the economic analysis that is applicable within the first implementation cycle of the WFD.

The basic problem associated with water sector funding arises from the fact that there is a large gap between needed funding and secured funding. Namely, 'user pays' and 'polluter pays' principles are not fully applied in water and service pricing, resulting in an extremely low level of self-funding and a major reliance on the budget. Further, fees for the use and protection of resources are far below required levels, and the management of accounting, invoicing and collection does not ensure full collection.

The economic analysis in the Tisza River Basin also shows an increasing tendency of the local authorities in to take more responsibility in environmental and water management strategies, due to their increasing role in national policy. Additionally, local water policies will have to consider the transboundary nature of border rivers and the need to take measures and decisions together with neighbouring communities by implementing solutions at the local or regional scale wherever possible.

Still, the role of environmental authorities at the local level needs to be strengthened by integrating environmental considerations into economic development. There are areas where the absence of adequate policy instruments and institutional capacity to support water use monitoring leads to increased service costs and the eventual deterioration of the resource and supporting service infrastructure.

Sustainable development in the Tisza River Basin requires an 'enabling environment', permitting and attracting viable long term investment and continuous and enhanced international cooperation. Success will depend on thorough implementation of actions and commitments of the countries and on the effective and coordinated contribution of the international community.

Specifics of ITRBM Plan compared to DRBM Plan

Regarding the updated evaluation for economics, the following specific conclusions for the Tisza River Basin can be drawn in comparison to the Danube Basin level:

- To ensure full compliance with WFD requirements, Tisza countries need to introduce water pricing policies that take into full account the water users' effects on water resources and provide the price on pollution as well on the water scarcity. The WFD requires policies that "provide adequate incentives for users to use water resources efficiently" by 2010. Additionally, local water policies will have to consider the transboundary nature of border rivers and the need to take measures and decisions together with neighbouring communities by implementing solutions at the local or regional scale, wherever possible.

7.Joint Programme of Measures

The Tisza River Basin approach to define the Joint Programme of Measures (JPM) follows the same concept as for that of Danube River Basin. The effectiveness of specific measures is assessed based on the agreed upon vision and management objectives[32].

The JPM builds on the results of the pressures analysis (Chapter 4), the water status assessment (Chapter 5) and includes – as a consequence – the measures of basin-wide importance oriented on the agreed upon visions and management objectives for 2015. The JPM is based on the national programmes of measures, which shall be made operational by December 2012, and describes the expected improvements of water status by 2015. Priorities for the effective implementation of national measures on the basin-wide scale are highlighted and are the basis of further international coordination. The JPM also presents additional joint initiatives and measures on the basin-wide scale that show transboundary character.

The JPM is structured according to the Significant Water Management Issues (SWMIs): organic, nutrient and hazardous substances pollution; hydromorphological alterations and groundwater. In addition, it includes other issues on water quantity and integration relevant for the Tisza River Basin.

The JPM represents more than a list of national measures, as is also estimates and presents the effect of national measures on the Tisza Basin scale. Key findings and conclusions on identified measures, their basin-wide importance as well as priorities regarding their implementation on the basin-wide scale are summarised as part of the JPM. The implementation of measures of basin-wide importance is ensured through their respective integration into the national programme of measures of each Tisza country. A continuous feedback mechanism from the international to the national level and vice versa will be crucial for the achievement of basin-wide objectives to improve the ecological and chemical status of water bodies.

The specific inter-linkages between the three SWMIs have been taken into account and are based on the approach and methodology developed in the frame of the ICPDR Pressures and Measure Expert Group.

The JPM does not separately address basic and supplementary measures (WFD Article 11(3) & (4)). However, as they are nationally important, they have been fully taken into account and are therefore indirectly reflected.

7.1. Surface waters: rivers

7.1.1. Organic pollution

7.1.1.1. Vision and management objectives

The ICPDR's Tisza basin-wide vision for organic pollution is zero emission of untreated wastewaters into the waters of the Tisza River Basin.

The vision will be achieved through the implementation of the following **management objectives by 2015:**

[32] The basin-wide approach must be complementary and inspirational to national planning and implementation, and vice versa. To enable this approach in practice, international visions and specific operational objectives (management objectives) have been defined to guide the Danube and Tisza countries towards a commonly agreed upon aim. Basin-wide and long-term visions based on shared values, and specific management objectives will guide the Tisza countries toward these common goals. The management objectives will describe the first steps toward identifying the measures and their implementation needed to meet the environmental objectives of the WFD by 2015.

EU Member States:

Phasing out – by 2015 at the latest – all discharges for untreated wastewater from towns with >10,000 PE and from all major industrial and agricultural installations, through:

- Implementation of the Urban Waste Water Treatment Directive (UWWTD)[33].
    - Where required, construction and/or improvement of wastewater treatment plants according to the ICPDR Emission Inventory by 2015.
    - Increase in the efficiency and level of treatment thereafter when necessary.
- Implementation of the Sewage Sludge Directive (86/278/EEC) and the Integrated Pollution Prevention Control Directive (96/61/EC).
- Reduction of the total amount of organic pollutant discharged into the Tisza River system to levels consistent with the achievement of the good ecological status/chemical status/good ecological potential in the Tisza River Basin by 2015.

Non EU Member States:

- Specification of the number of wastewater collecting systems (connected to wastewater treatment plants) planned to be constructed by 2015.
- Specification of the number of municipal and industrial wastewater treatment plants planned to be constructed by 2015 including:
    - Specification of treatment level (secondary or tertiary treatment)
    - Specification of emission reduction targets

7.1.1.2. JPM approach to the 2015 management objectives

Data for the JPM have been collected in combination with pressure information. Details on the data collection and evaluation can be found in **Annex 3**. The JPM considers and addresses pollution pressures from agglomerations, industries and agriculture as identified in **Chapter 2**.

A *scenario approach* has been developed to estimate the effectiveness of specific measures regarding the reduction of organic pollution on the basin-wide scale. The scenario approach is relevant for both organic and nutrient pollution when point sources are addressed. To a certain degree the scenarios are also relevant for the reduction of hazardous substances in the Danube River Basin.

As a starting point, the scenario approach describes the status quo of wastewater treatment in the Tisza River Basin (Reference Situation) and further its potential future development (three scenarios) using different assumptions. The **Reference Situation-UWWT 2005/2006** (RefSit-UWWT) gives an overview of current wastewater treatment and treatment efficiency in the Tisza River Basin (**see Map 18**).

7.1.1.2.1. Baseline Scenario-UWWT 2015 (BS-UWWT):

This scenario describes the agreed upon measures for the first cycle of WFD implementation in the Tisza River Basin until 2015 (see **Map 19**). Measures that are legally required for EU Member States and other measures that are realistic to be taken by the Non EU Member States have been considered. The Baseline Scenario is based on the fact that Romania has designated all of its territory (including its coastal waters) as a *sensitive area* under the UWWTD, to protect the Black Sea environment against eutrophication. Accordingly, the entire Danube River Basin is considered a catchment area for the sensitive area under Article 5(5) of the UWWTD. This means that discharges from urban wastewater treatment plants situated in the Danube catchment area, including the Tisza River Basin, need to apply more stringent treatment from agglomerations >10,000 PE. These provisions do not apply to individual plants if it can be shown that the minimum percentage of reduction of the overall load in that area is at least 75% for total P and 75% for total N. The following assumptions for measures to be implemented by 2015 have been taken:

- EU Member States (Slovakia and Hungary, except Romania): Implementation of the UWWTD. For EU Member States that have already fulfilled Article 5(4) of UWWTD by 2005/2006, the same reported treatment levels for agglomerations >10,000 PE were taken into account for the scenario. If there was further improvement of wastewater treatment since 2005/2006 (for agglomerations <10,000 PE), this has been considered within the calculated scenario.

33 For Romania, the implementation year is 2018 regarding agglomerations 2,000-10,000 PE.

- Romania (transition period for full UWWTD implementation: 31/12/2018): The scenario considers agglomerations >10,000 PE are equipped with N and P removal (secondary and tertiary treatment). Further agglomerations 2,000-10,000 PE are equipped with secondary treatment for 77% of the total biodegradable load.
- Non EU Member States Serbia and Ukraine: The scenario considers the reported number of wastewater treatment plants with secondary treatment/more stringent treatment to be constructed by 2015 (see **Table VII.1** for specifications).

More information on the Baseline Scenario-UWWT 2015 can be found in **Annex 13**.

TableVII. 1: Reported number of agglomerations in Non EU Member States for which wastewater treatment plants will be constructed / rehabilitated by 2015 and indication of the respective generated load.

	RS	UA	Total
Number of agglomerations for which wastewater treatment plants will be constructed / rehabilitated by 2015	4	14	**18**
Generated load (PE)	141,900	638,600	**780,500**

Two additional scenarios have been developed describing further steps toward the vision for organic pollution, to aid future policy decisions:

7.1.1.2.2. Midterm Scenario-UWWT (MT-UWWT):

This scenario is based on the BS-UWWT. In addition, it assumes P removal for agglomerations >10,000 PE for Non EU Member States to achieve management objectives. This measure would clearly be a major step towards achieving the vision. Removal of P from all water treatment plants (>10,000 PE) is crucial for protecting waters in river basins, economically justified and technically simple. In contrast to N removal, P removal can be realised more easily (see **Map 20**).

7.1.1.2.3. Vision Scenario-UWWT (VS-UWWT):

This scenario goes beyond the BS-UWWT as well as the MT-UWWT and therefore far beyond the requirements of the UWWTD. It is based on the assumption that the full technical potential of wastewater treatment, regarding the removal of organic influents and nutrients, is exploited for both EU and Non EU Member States. If such a scenario is to be realised, it is assumed that agglomerations >10,000 PE are equipped with N and P removal (secondary/tertiary wastewater treatment), whereas all agglomerations >2,000 PE are equipped with secondary treatment (see **Map 21**).

7.1.1.3. Summary of measures of basin-wide importance

7.1.1.3.1. Implementation of UWWTD

The implementation of the UWWTD in the EU Member States and the development of wastewater infrastructure in Non EU Member States are the most important measures to reduce organic pollution in the Tisza River Basin by 2015 and beyond.

At present, extensive improvements in urban wastewater treatment are under implementation throughout the basin. For full implementation of the UWWTD by EU Member States in the Tisza River Basin, facilities >10,000 PE have to be subject to more stringent treatment since the Danube River Basin discharges into a *sensitive area*. Alternatively, requirements for individual plants need not apply for sensitive areas if it can be shown that the minimum percentage of overall load reduction entering all urban wastewater treatment plants in that area is at least 75% for Total P and at least 75% for Total N. Extensive efforts are underway in the Tisza countries to improve wastewater treatment. The overall application of nutrient removal technologies are expanding, particularly in response to the UWWTD in new EU Member States. It is necessary that the investments in wastewater collection and treatment in Non EU Member States also consider nutrient removal technologies during upgrade or new construction. This is necessary so that the overall increase in wastewater flow that will occur as more communities are connected to sewerage collection systems does not create excessive amounts of nutrient pollution.

Regarding P removal, regulatory demands (under the UWWT Directive) for implementation of tertiary treatment are variable among the Tisza countries and are dependent upon the classification in national legislation of *sensitive areas* of surface water. The majority of projects under construction or planned in the new EU Member States contain tertiary treatment technology for P removal, as a result of legislative transposition during the EU accession period. Among municipal projects, N removal is more prevalent than P removal.

7.1.1.3.2. Results from calculated scenarios

The calculation results and the effects of agreed upon measures for the BS-UWWT 2015 (BOD/COD emissions) are presented in **Figure VII.1**. **Figure VII.1** also illustrates the potential for further reduction as described by the MT-UWWT and VS-UWWT. These results regarding the achievement of the WFD environmental objectives are described in the end of this chapter.

Not all emissions of untreated wastewater from agglomerations with >10,000 PE will be phased out by 2015 (see **Map 19**: BS UWWT 2015). For the reference year 2005/2006, 182 wastewater treatment plants serve a total of 194 agglomerations (>10,000 PE) in the Tisza River Basin. However, 111 agglomerations ≥ 2,000 PE with sewerage collecting systems still lack wastewater treatment plants (for parts of the collected wastewater) which need to be realised by 2015. There are 590 agglomerations ≥ 2,000 PE without sewerage collecting systems and no wastewater treatment is in place for the entire generated load. There are 377 agglomerations ≥ 2,000 PE reported to be served by 412 wastewater treatment plants (see **Map 18:** Reference situation-UWWT).

As can be seen from **Figure VII.1**, the implementation of collecting systems (without treatment) for agglomerations ≥2,000 PE in the Tisza River Basin will lead to a significant increase of organic pollutants and nutrients discharged to surface waters. To avoid a deterioration of the current situation, it is recommended to build collecting systems and to implement appropriate wastewater treatment techniques. These techniques include nutrient removal as the entire Danube Basin is a *catchment of sensitive area* under the UWWTD.

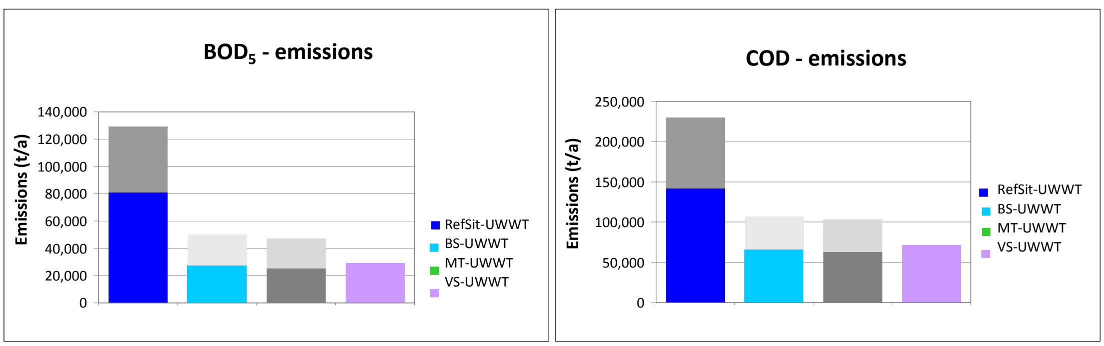


Figure VII. 1: Emissions of BOD5 and COD for the Reference Situation UWWT (RefSit-UWWT) and the three different scenarios (Baseline Scenario-UWWT 2015; Midterm Scenario-UWWT; Vision Scenario-UWWT) in the Tisza River Basin. [The lighter coloured parts of the columns represent wastewater emissions that are not collected in sewerage systems and not treated in a wastewater treatment plant.]

There are approximately 1,088 agglomerations >2,000 PE in the Tisza River Basin, generating a load of more than 12.0 million PE There are 22 large cities >100,000 PE in the Tisza River Basin that produce about 38% of the total wastewater load generated.

7.1.1.3.3. Implementation of the Sewage Sludge Directive

The progressive implementation of the UWWTD in the EU Member States is increasing the quantities of sewage sludge requiring disposal. This increase is mainly due to the practical implementation of the Directive as well as the slow but constant rise in the number of agglomerations connected to sewage systems and the improvement of treatment (tertiary treatment with removal of nutrients). Full implementation will ensure that contaminated sewage sludge no longer contributes to soil pollution via application in the agricultural sector.

7.1.1.3.4. Implementation of the IPPC Directive

Organic point source pollution coming from industrial units is partly addressed by the IPPC as well as a number of specialised EU Directives covering specific sectors and specific Best Available Techniques (BAT) regulations. According to the IPPC, authorities need to ensure that measures of pollution prevention and control are up-to-date with the latest developments in BAT. The main reporting requirement of the IPPC is the publication of an inventory of chemical emissions and sources called the European Pollutant Emission Register (EPER).

The EU Member States have been implementing the IPPC and, as of end 2006, about 100 facilities had permits which were reported to EPER. Romania received gradual transition periods for IPPC implementation up to 2015 and additional facilities would be receiving permits and implementing BREF (Best Available Techniques Reference Documents under IPPC) up to this date. It is expected that all facilities in the EU Member States will meet the IPPC requirements according to the legal timelines.

7.1.1.3.5. ICPDR BAT industrial sector recommendations

In the framework of the ICPDR, the Tisza countries have also adopted the Recommendations on BAT in the following industrial sectors: chemical, food and chemical pulping and papermaking.[34]

In developing the ITRBM Plan, the ICPDR's role is to encourage all Tisza countries to adopt and implement IPPC legislation. The majority of countries have a mandatory obligation to the EU, while the remaining countries could be encouraged to adopt legislation requiring the application of BAT as basic measures in the JPM.

7.1.1.3.6. Recommendation on BAT at agro-industrial point sources

Agriculture is an important source of organic pollution, and the wastewater discharged by agro-industrial point sources contains large amounts of organic substances. Installations for the intensive rearing of poultry or pigs must meet the requirements of the IPPC, and the application of BAT is seen as a way to reduce this pollution. For EU Member States, biodegradable industrial wastewater from food industry plants representing ≥4,000 PE that does not enter urban wastewater treatment plants before discharge to receiving waters must respect conditions established in the UWWTD.

The ICPDR has developed a recommendation on BAT at agro-industrial units including (i) in-plant technical measures for the reduction of wastewater volume and abatement of pollution load; (ii) reduction of pollution load by end-of-pipe measures and (iii) environmental management improvement actions. Additional measures are proposed to improve environmental compliance at the plant and enforce the permitting environmental authority. The full application of these BATs for agro-industrial units is recommended to take place in the Non EU Member States not covered by the IPPC.

The recommendation also includes a provision that all agro-industrial units be required to prepare a Manure Management Plan when applying for a permit to discharge.

7.1.1.3.7. Estimated effects of national measures on the basin-wide scale

In comparison with the RefSit-UWWT, a reduction of organic pollution emissions will be achieved by the implementation of any of the three scenarios. However, it can be concluded that:

- The BS-UWWT implements the management objectives but will not ensure the achievement of the WFD environmental objectives on the basin-wide scale for organic pollution by 2015 (see **Map 19**).
- The MS-UWWT goes beyond the 2015 management objectives, however, will not ensure the achievement of the WFD environmental objectives on the basin-wide scale for organic pollution by 2015. The measures proposed are not fully able to be implemented by 2015 for economic, administrative and technical reasons.
- The VS-UWWT goes beyond the 2015 management objectives (beyond the BS-UWWT and MT-UWWT and therefore beyond the requirements of the UWWTD) and would ensure the achievement of the WFD environmental objectives on the basin-wide scale by 2015 for organic pollution. However, the measures proposed within this scenario are not able to be fully implemented by 2015 for economic, administrative and technical reasons.

[34] ICPDR Doc IC 033: Recommendation on Best Available Techniques in the Food Industry (2000); ICPDR Doc IC 034 Recommendation on Best Available Techniques in the Chemical Industry (2000); ICPDR Doc IC 035 Recommendation on Best Available Techniques in the Chemical Pulping Industry (2000) and ICPDR Doc IC 037 Recommendation on Best Available Techniques in the Paper Making Industry (2000).

The effectiveness of measures for the reduction of organic pollution from industry and agriculture in the Danube River Basin is not yet sufficiently quantified, but further efforts will be undertaken in this regard within the next WFD cycle.

Specifics of ITRBM Plan compared to DRBMP

Regarding the JPM related to organic pollution, the following specific conclusions for the Tisza can be drawn in comparison to the Danube Basin level:

- more than half of agglomerations in the Tisza River Basin lack both collection and wastewater treatment, which represents a much higher proportion as compared with the Danube River Basin;
- the reduction of BOD and COD in all future scenarios is significantly higher than for the Danube River Basin as many agglomerations will have introduced secondary treatment and
- the effect of the implementation of urban wastewater treatment measures is more visible at a smaller scale in the Tisza River Basin than for the Danube River Basin.

7.1.2. Nutrient pollution

7.1.2.1. Vision and management objectives

The ICPDR's Tisza basin-wide vision for nutrient pollution is the balanced management of nutrient emissions via point and diffuse sources in the entire Tisza River Basin so that neither the waters of the Tisza River Basin, the Danube River Basin or the Black Sea – via the Tisza River Basin – are threatened or impacted by eutrophication.

Implementation of the following **management objectives is foreseen by 2015:**

EU Member States and Non EU Member States:

- Reduction of the total amount of nutrients entering the Tisza and its tributaries to levels consistent with the achievement of the good ecological/chemical status in the Tisza River Basin by 2015.
- Reduction of discharged nutrient loads in the Black Sea Basin to such levels that permit the Black Sea ecosystems to recover to conditions similar to those observed in the 1960s.
- Reduction of phosphates in detergents, preferably by eliminating phosphates in detergent products.
- Implementation of the management objectives described for organic pollution with additional focus on the reduction of nutrient point source emissions.
- Implementations of best environmental practices (BEP) regarding agricultural practices for reduction of non-point sources.
- Create baseline scenarios of nutrient input by 2015 taking the preconditions and requirements of the Tisza countries (EU Member States and Non EU Member States) into account.
- Definition of basin-wide, sub-basin and/or national quantitative reduction targets (i.e. for point and diffuse sources) taking the preconditions and requirements of the Tisza countries into account.

In addition, for EU Member States:

- Implementation of the UWWTD (91/271/EEC) as described for organic pollution (see above) taking into account the designated sensitive areas.
- Implementation of the EU Nitrates Directive (91/676/EEC) taking vulnerable zones into account for natural freshwater lakes or other freshwater bodies of the Tisza River Basin that are found to be eutrophic or in the near future may become eutrophic.
- Implementations of BEP regarding agricultural practices linked to EU Common Agricultural Policy (CAP).

7.1.2.2. JPM approach towards the 2015 management objectives

The Danube countries committed themselves to implementing the Memorandum of Understanding adopted by the International Commission for the Protection of the Black Sea (ICPBS) and the ICPDR in 2001[35], and agreed that *"the long-term goal is to take measures to reduce the loads of nutrients discharged to such levels necessary to permit Black Sea ecosystems to recover to conditions similar to those observed in the 1960s"*. In 2004 the Tisza countries adopted the Tisza Declaration[36] in the framework of the ICPDR Ministerial Meeting and agreed that in the coming years they would aspire *"to reduce the total amount of nutrients entering the Tisza and its tributaries to levels consistent with the achievement of good ecological status in the Tisza River and to contribute to the restoration of an environmentally sustainable nutrient balance in the Black Sea"*.

The inter-linkages between nutrient emissions and organic pollution are considered within the working methodology. In addition to measures related to the improvement of wastewater treatment and the application of BAT for industry and agriculture, measures to control diffuse nutrient pollution are required. Further, measures to reduce phosphate emissions from household laundry and dishwater detergents are addressed and, finally, nitrogen pollution from atmospheric deposition is also dealt with.

Nutrient removal is required to avoid eutrophication in many surface waters and the Black Sea North-western Shelf, in particular taking into account the character of the receiving coastal waters as a *sensitive area* under the UWWTD. The nutrient loads discharged from the Tisza River Basin are an important factor responsible for the deterioration and eutrophication of parts of the Black Sea ecosystem.

The MONERIS model has been applied to the assessment of the effects of measures to reduce nutrient pollution by 2015 (see **Annex 3**). The model takes into account both nutrient point sources as well as diffuses emissions. The scenarios presented (see below) are based on assumptions for organic pollution regarding wastewater treatment. MONERIS compares the calculated nutrient input (scenario 2015) with the observed nutrient loads (reference situation average 2001-2005) in the rivers of the Tisza Basin and allows for conclusions on the implementation of measures.

In addition, supplementary investigations have been performed for the ITRBM Plan considering the role of wetlands in the reduction of nutrient pollution. The results will be incorporated in the final draft (after the public consultation).

7.1.2.3. Summary of measures of basin-wide importance

On the basin-wide level, basic measures (fulfilling the UWWTD, IPPC and EU Nitrates Directive) for EU Member States, implementation of the ICPDR Best Agricultural Practices Recommendation for Non EU Member States and building the committed number of urban wastewater treatment plants are the main measures contributing to nutrient reduction.

7.1.2.3.1. Implementation of measures regarding urban wastewater treatment

The implementation of the UWWTD by EU Member States and the reported measures of Non EU ember States significantly contribute to the reduction of nutrient point source pollution, as outlined above. **Map 18** illustrates the RefSit-UWWT regarding nutrient point source pollution in the Danube River Basin. **Maps 19-21** show the three different scenarios for UWWT (BS-UWWT 2015, MS-UWWT, and VS-UWWT) and therefore the future development and improvement regarding point source pollution. It is clear from the results that an additional measure to decrease phosphates in detergents would further contribute to the P emission reduction.

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35 ICPDR Document IC 027: Memorandum of Understanding between the ICPBS and the ICPDR, 2001 (www.icpdr.org).

36 ICPDR Document IC 089: The Danube Basin – Rivers in the Heart of Europe (Danube Declaration), 2004 (www.icpdr.org).

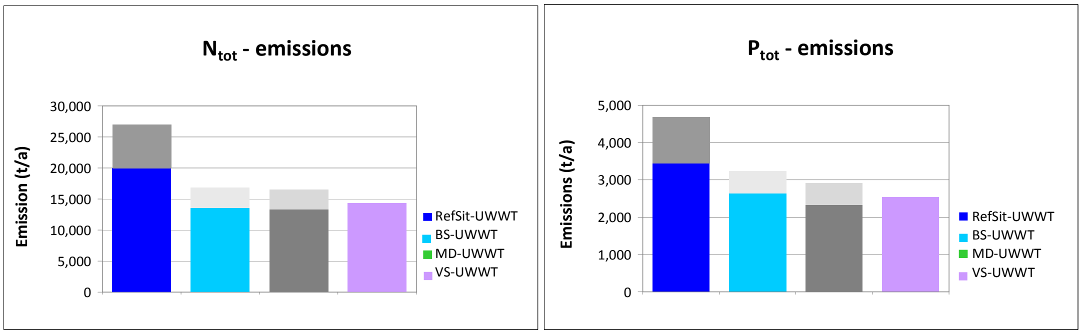

Figure VII. 2: Emissions of Ntot and Ptot for the RefSit-UWWT and the three different scenarios (BS-UWWT 2015; MS-UWWT; VS-UWWT). [The lighter coloured parts of the columns represent wastewater emissions that are not collected in sewerage systems and not treated in a wastewater treatment plant.]

7.1.2.3.2. Implementation of the EU Nitrates Directive

A key set of measures to reduce nutrients relates to farming practices and land management. Nitrates in particular leach easily into water from soils that have been fertilised with mineral fertilisers or treated with manure or slurry. The EU Nitrates Directive limits the amount of nitrate permitted and the resulting concentrations in surface waters and groundwater.

7.1.2.3.3. Implementation of Best Agricultural Practice

The concept of Best Agricultural Practices (BAP)[37] has been developed in the Danube River Basin. This is different but complementary to the existing EU concepts of Codes of Good Agricultural Practice (GAP) under the EU Nitrate Directive and verifiable standards of Good Farming Practice (GFP) under the EC Rural Development Regulation 1257/1999.

To be effective, any BAP must not only be technically and economically feasible, it must also be socially acceptable to the farming community. As such, BAP can be applied as a uniform concept across the whole Tisza Basin, but the level of environmental management/performance that can be expected from farmers in different regions/countries will vary significantly according to: (i) the agronomic, environmental and socio-economic context in which they operate, and (ii) the availability of appropriate policy instruments for encouraging farmers to adopt more demanding pollution control practices.

A key action for successful implementation of BAP is ensuring adequate storage capacity for manure generated on farms and the application of advanced techniques for spreading manure. It is apparent that implementation of BAPs should be linked to the CAP. Future reforms of the CAP, its funds and strategic priorities can also contribute to WFD objectives. In particular, the voluntary agro-environmental measures can be used to address diffuse and point sources of agricultural water pollution (nitrates, phosphates and pesticides) as well as soil erosion.

7.1.2.3.4. Implementation list of possible measures to control diffuse pollution

The information provided by countries in the national programmes of measures to control diffuse pollution has been used in the development of the ITRBM Plan. Possible measures include: soil and manure sample analysis; a parcel-specific field balance for each growing season and annual farm balance for N and P. These are not costly but require a commitment and the proper technical support.

The development of appropriate and well written agricultural advisory messages is therefore essential, as are demonstration platforms, training for advisors and other capacity building measures for agricultural extension services.

7.1.2.3.5. Basic considerations on the introduction of phosphate-free detergents

The ICPDR has initiated a process to support the introduction of P-free detergents in Danube countries. On 16 February 2010, Ministers, High Officials and the Member of the European Commission responsible for the

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[37] The concept of BAP in the DRB is defined as: "…the highest level of pollution control practice that any farmer can reasonably be expected to adopt when working within their own national, regional and/or local context in the Danube River Basin".

implementation of the Danube River Protection Convention adopted the Danube Declaration, recognising the "*limitations on phosphate in detergents as a particularly cost effective and necessary measure to complement the efforts of implementing urban wastewater treatment*"[38]. This measure is part of the **Phosphate Ban Scenario-Nutrients** (see **Figures VII. 3** and **VII. 4**). Currently, none of the Tisza countries have completely replaced phosphates in laundry detergents.

The introduction of P-free detergents is considered to be a fast and efficient measure to reduce nutrient emissions into surface waters. For the large number of settlements of <10,000 PE, the UWWTD does not legally require P removal. A reduction of phosphate in detergents could have a significant influence on decreasing nutrient loads in the Tisza, particularly in the short term before all countries have built a complete network of sewers and wastewater treatment. Dishwashing detergents are an important and increasing source of that pollutant in all Danube countries.

National consultation meetings have already been initiated in Tisza countries, both to disseminate and share the experience as well to plan further steps towards introduction of P-free detergents with the cooperation of the detergent industry.

7.1.2.3.6. Scenarios for nutrient reduction

MONERIS[39] takes into consideration seven input pathways into surface waters outlined in **Chapter 2**. The effect of nutrient reduction measures are estimated for point and diffuse sources using MONERIS and scenarios for nutrient reduction have been calculated and are presented.

The catchment area considered in the model covers about 19% of the Danube River Basin. Five countries contribute to the Tisza River Basin: Hungary, Romania, Serbia, Ukraine and Slovakia (**Figure VII.3**).

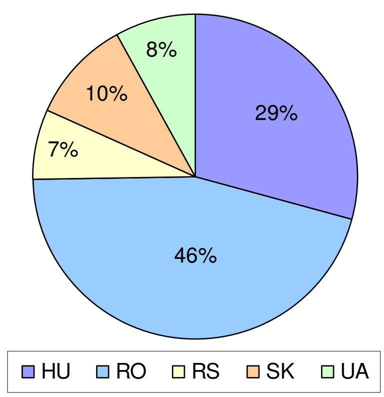

Figure VII.3.: Share of the countries on the Tisza River Basin

Although agricultural land covers almost 50% of the total area of the entire Tisza Basin (**Figure VII.4**), comparatively low N surplus indicates extensive agricultural land use.

[38]Danube Declaration, 16 February 2010: (18) see the introduction of limitations on phosphate in detergents as a particularly cost effective and necessary measure to complement the efforts of implementing urban wastewater treatment and as Ministers of the Danube countries commit ourselves to initiate the introduction of a maximum limit for the content of total phosphorus of 0.2 to 0.5% P weight/weight, in laundry detergents for consumer use, if possible by 2012 and to work towards a market launch of polyphosphate-free dishwasher detergents for consumer use until 2015.`

[39]Behrendt et al. (2007): The Model System MONERIS (2007) – User Manual; Leibniz Institute for Freshwater Ecology and Inland Fisheries in the Forschungsverbund Berlin e.V., Müggelseedamm 310, D-12587 Berlin, Germany.

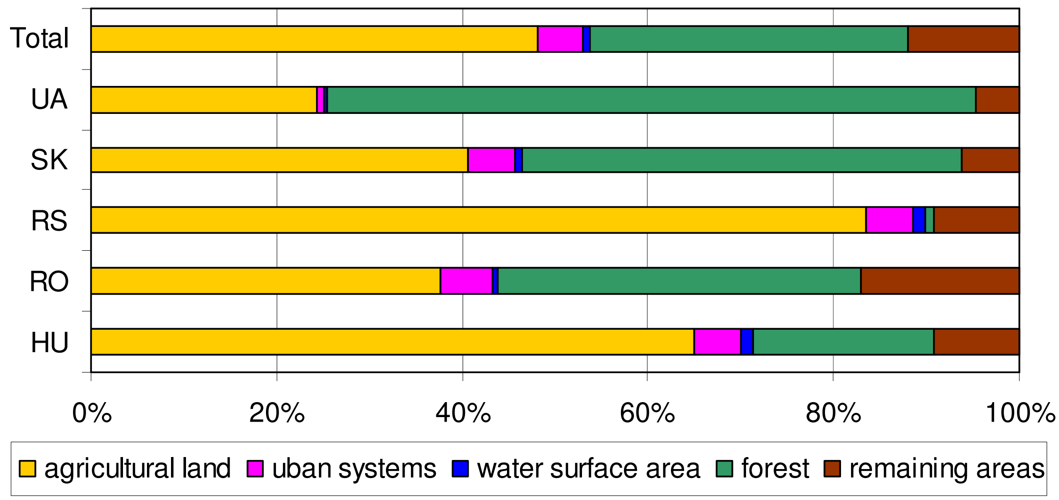

Figure VII.4: Share of the land covers of the countries on the Tisza River Basin

Forests contribute the second largest share of the total area, with 34%. Remaining areas, such as wetlands and open areas, add another 12% of the area of the Tisza River Basin. Consequently, large parts of the catchment do not receive any fertiliser application other than atmospheric deposition, which indicates a low potential to actively influence nitrogen emissions. Urban areas (5% of the total area) are often a main source for phosphorus emissions, especially if wastewater treatment plants are insufficiently equipped.

The Reference Situation-Nutrients (RefSit-Nut) describes (as a starting point) the status quo of nutrient emissions in the Tisza River Basin (see **Map 22**). The RefSit-Nut describes the mean diffuse and point source emissions of nitrogen and phosphorus during the years 2000-2005. The RefSit-Nut is used as basis for all following comparisons and the evaluation of different measures to reduce emissions.

The total nutrient emissions for the RefSit-Nut in the Tisza River Basin amounts to 105,000 t/a (TN) and 8,850 t/a (TP). **Figure VII.5.** shows the contribution of the countries on the total emissions.

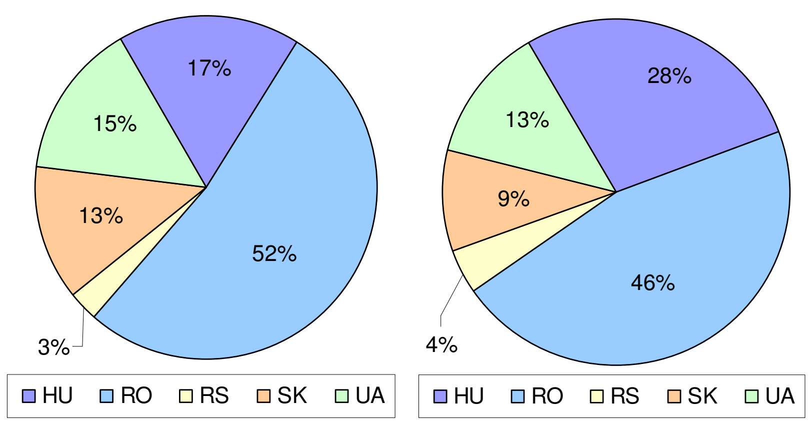

Figure VII.5: Share of the countries on the total TN (left) and TP (right) emissions in the Tisza River Basin .

Comparing area contributions, Ukraine and Slovakia deliver an above average share and Serbia delivers a below average share of total emissions. Above average shares of total nutrient emissions are delivered by Romania (TN) and Hungary (TP). The mean specific emission in the Tisza River Basin is 6.8 kg/ha/a (TN) and 0.57 kg/ha/a (TP). The specific TN emissions are lower and the specific TP emissions are higher than in the Danube River Basin, which can be explained by a less intensive agricultural land use (TN) and a less sufficient wastewater treatment (TP) than that of the Danube.

Regarding the Reference Situation, about 46% of the N emissions are related to agriculture (31% directly due to fertiliser and manure application; 15% indirectly due to NHy deposition coming from agriculture). About 40% of the TN emissions originate from atmospheric deposition and cannot be directly influenced by the Tisza countries, as it is partly due to atmospheric deposition from sources outside the Tisza Basin. Some 23% of the TN emissions come from urban systems (wastewater treatment plants, impervious urban and inhabitants connected to decentralised treatment systems). The share of agricultural land, urban area and forests of the different sources varies between the different countries (**Figure VII.6**).

Phosphorus emissions from urban systems are much more dominant and deliver a mean of 56% of the total emissions, while 30% of TP emissions come from agricultural areas (**Figure VII.7**).

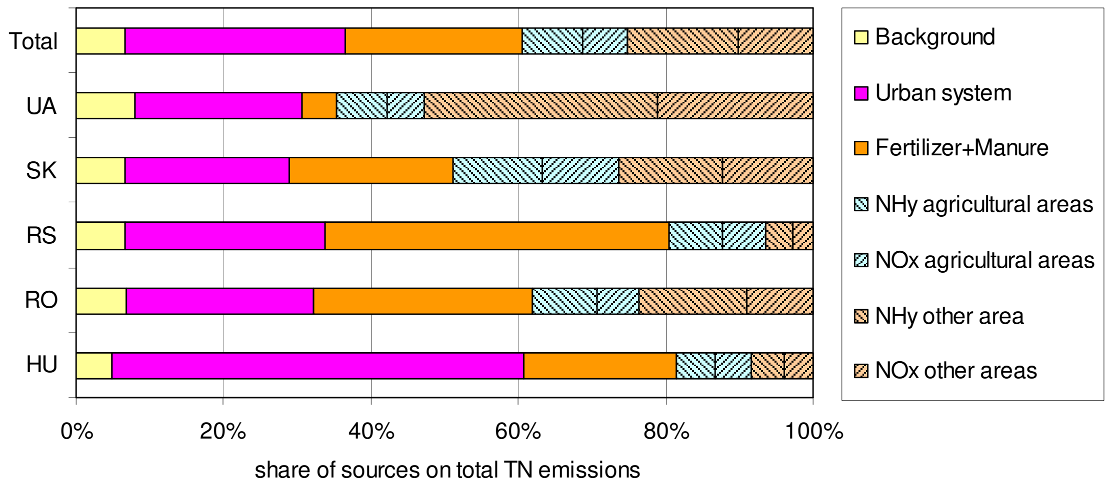

Figure VII.6: Share of the sources on the total TN emissions (RefSit) for countries and the entire catchment of the Tisza River Basin.

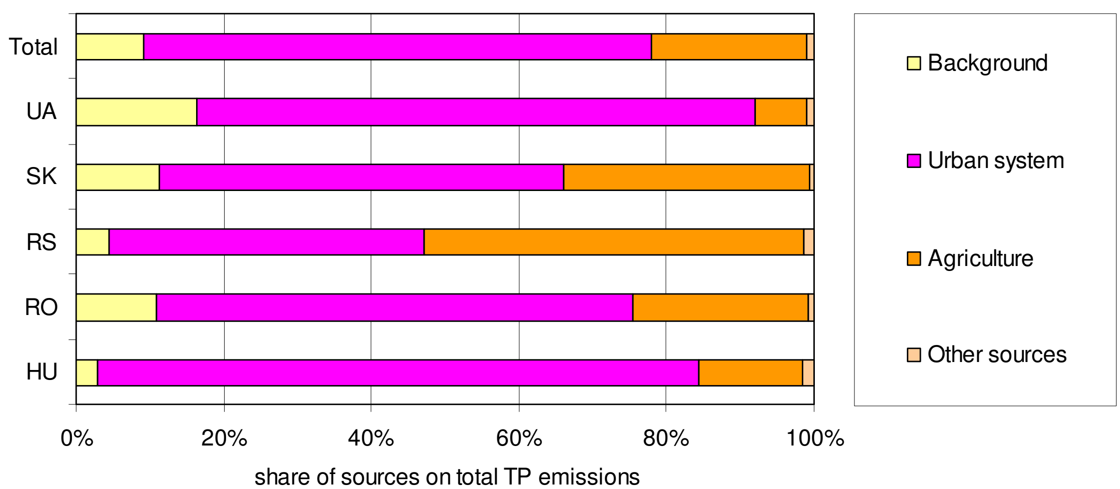

Figure VII.7: Share of the sources on the total TP emissions (RefSit) for countries and the entire catchment of the Tisza River Basin.

To explore the potential and effect of nutrient reduction measures, a set of scenarios have been developed on the basis of data provided by the countries and using additional assumptions.

The scenarios can be distinguished from those referring to wastewater treatment plants (UWWTP) or those referring to diffuse emissions, especially agricultural areas and atmospheric deposition. These scenarios have been developed by the ICPDR in agreement with the Tisza countries.

Scenarios for urban wastewater treatment are as follows:

- **Baseline Scenario-UWWT 2015 (BS-UWWT):** Implementation of the UWWTD for EU Member States; implementation of commitments by Non EU Member States.
- **Midterm Scenario-UWWT (MT-UWWT):** Baseline scenario plus additional, momentarily not financially secured projects in Non EU Member States, implementing at least P-Elimination for treatment for agglomerations above 10,000 PE.
- **Vision Scenario-UWWT (VS-UWWT):** N and P removal for all agglomerations above 10,000 PE in all countries.

There are major uncertainties related to future agricultural development. To account for this situation, three different options have been considered and used for scenario calculations.

The first scenario Baseline Scenario-Agriculture 2015 combines the best estimates of the countries for future agricultural development. It is based on moderate development of the agricultural sector and the implementation of measures foreseen by the countries. Two additional agricultural scenarios (Agricultural Scenario-Nutrients 1 2015 and Agricultural Scenario-Nutrients 2 2015) consider an increase in the level of intensity of agricultural development. These two scenarios use different sets of estimates for relevant input parameters, especially N surplus.

The agricultural scenarios are:

- **Baseline Scenario-Agriculture 2015 (BS-Agri-Nut):**
  This reflects a moderate development of agriculture and builds on agreed upon measures to reduce nutrient emissions in the Danube River Basin. This scenario forecasts the future NO_x deposition and incorporates changes in agriculture.
- **Agricultural Scenario-Nutrients 1 2015 (I-Agri-Nut-1)**:
  This assumes that the N surplus of Tisza countries will be the same as for the EU 15 Member States in 2000 (i.e. 57 kg/ha/a). Further, it is assumed that no change in atmospheric deposition will occur.
- **Agricultural Scenario-Nutrients 2 2015 (I-Agri-Nut-2):**
  This assumes that the N balance for the Tisza countries will be same as the Danube upstream countries. Further, it is assumed that no change in atmospheric deposition will take place and N surplus in the remaining countries stays unchanged.

A further scenario estimates the impacts of a phosphate ban for laundry and dishwasher detergents:

- **Phosphate Ban Scenario-Nutrients (PBan-Nut):**
  This explores the reduction potential of introducing a ban on phosphates in laundry detergents and dishwashers as recommended by the Resolution of the 10th ICPDR Ordinary Meeting, December 2008.

After exploring the reduction potential of the measures addressing various sources of nutrient inputs, the **overall Baseline Scenario-Nutrients (BS-Nut-2015)** combines the most likely developments in different sectors (urban wastewater, agriculture and atmospheric deposition) and describes the expected nutrient emissions in 2015. This scenario has been compared to the expected emissions of nutrients based upon application of the management objectives for the basin-wide scale.

7.1.2.3.7. Nutrient reduction potentials until 2015

Agricultural scenarios: The reduction of emissions from agriculture basically considers the reduction of nitrogen surplus on agricultural areas. As mentioned above, about 31% of the total emissions (RefSit) come from manure or fertiliser application and should have a high potential for reducing emissions. But as agricultural productivity in the Tisza countries is fairly low, only a very small reduction can be realistically assumed. In contrast, an increase of nitrogen surplus is assumed for Romania and Serbia as agriculture is more likely to intensify there. Overall potential, consequently, is very limited. If agricultural land use develops to a level similar as to that in western European countries (EU 15), an increase of TN emissions by 50% could be expected **(Figure VII.8**).

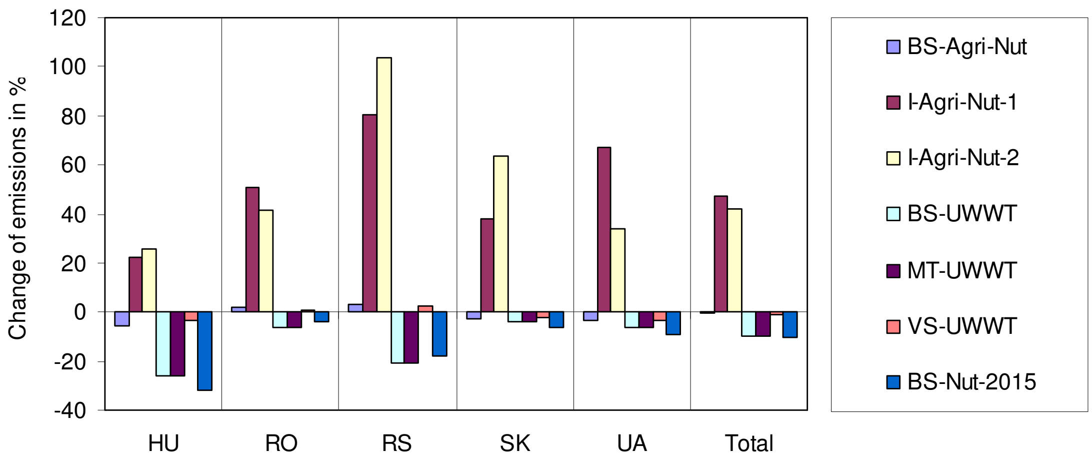

Figure VII.8: Effect of the different scenarios on the total TN emissions in comparison to the reference situation (RefSit).

UWWT Scenarios: There is a high potential to reduce TN and TP emissions by connecting inhabitants to wastewater treatment plants. The baseline scenario already suggests a reduction potential of 10% (TN) and 18% (TP). The more cost intensive measures according to the midterm and vision scenario will only lead to smaller additional reductions of TN and TP emissions. The reason for this is that people who are not connected to a sewer system often are connected to septic tanks which discharge via a soil and groundwater passage to the surface waters. The retention capacity of soils and of groundwater is likely to be in the same order of magnitude as smaller wastewater treatment plants.

A significance P reduction can be achieved by banning phosphates in detergents (laundry and dishwashers detergents). With a full ban of phosphates in all detergents in combination with the Baseline Scenario, a total reduction of 30% could be achieved for the Tisza River Basin. (**Figure VII.9**)

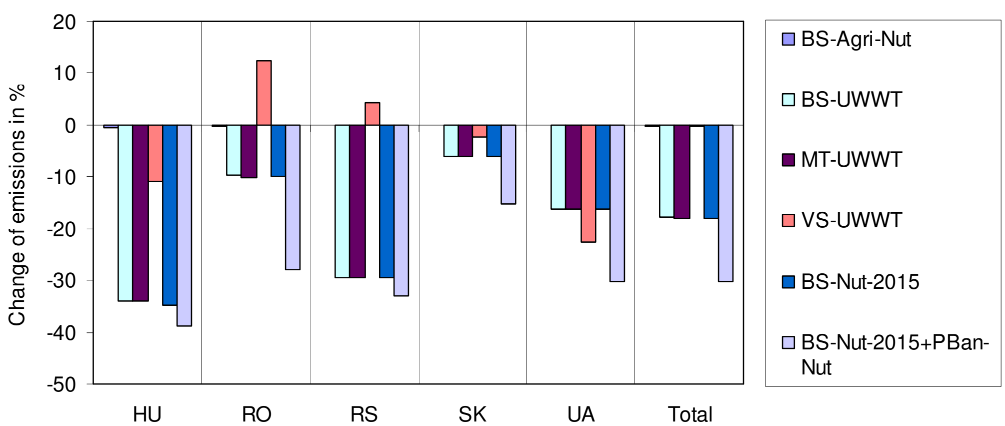

Figure VII.9: Effect of the different scenarios on the total TP emissions in comparison to the reference situation (RefSit).

7.1.2.4. Estimated effects of national measures on the basin-wide scale

The effect of the baseline scenario to reduce emissions varies between the different pathways and from country to country. In all countries, a 13 to 15% reduction of emissions via direct atmospheric deposit to surface waters and via overland flow has been calculated on the assumption that NOx deposits will decrease by 33%. As N-surplus is expected to increase in some of countries, an increase of emissions from tile drained areas can also be expected. This pathway will significantly gain importance as N-surplus rises to the level of western European countries (EU

15). The effect for emissions via groundwater will be similar but delayed due to the residence time in the groundwater.

Reducing emissions from urban systems has a strong reduction potential, especially for phosphorus, but this very much depends on the specific situation in the countries. Connecting remote villages to wastewater treatment plants is very cost intensive and it may take a long time before these households can be connected to a central system. For the coming years, decentralised systems seem to be more favourable and faster to be implemented.

No measures to reduce emissions via erosion and overland flow have been considered yet. If agriculture land-use intensifies, these measures could become relevant for the nutrient budget of the Tisza River Basin.

The overall reduction goals for the Danube River Basin have been used to assess the effect of the measures implemented in the Tisza River Basin.

According to these, a reduction of TN loads by 40% and of TP loads by 15% are needed to reach levels of the 1960s, or good ecological status.

At the outlet of the Tisza River Basin, the BS-Nut-2015 would reduce TN loads by 12% and TP loads by 26%. The effect on the total loads of the Danube to the Black Sea would be much smaller, with -2% (TN) and -4% (TP).

As for the Danube River Basin, the reduction goals for TN will probably not be met for the Tisza River Basin by only implementing the measures suggested here. The BS-Agri-Nut shows only a very limited potential to reduce TN emissions, as agricultural practices are expected to intensify for some countries.

According to the other agricultural scenarios, there is a strong potential for an increase of TN emissions from agriculture, which could also lead to an overall increase of TN emissions in Tisza River Basin.

The reduction goals for phosphorus could be reached by implementing the phosphate ban alone. This relatively cost effective and easy to implement measure could be one the first solutions to be realised. Although the Tisza River Basin countries would reach the reduction goals, it would be necessary to implement other measures, *especially* the improvement of wastewater treatment, to reach the reduction goals for the Danube River Basin.

Specifics of ITRBM Plan compared to DRBM Plan

For the JPM related to nutrient pollution, the following specific conclusions for the Tisza River Basin can be drawn in comparison to the Danube Basin level:

- Assessment of other measures (implementation of UWWTD) indicates a visible reduction of nutrients, which will contribute to the overall reduction at the Black Sea.
- As for the Danube River Basin, the reduction goals for TN will probably not be met for the Tisza River Basin. The BS-Agri-Nut shows only a very limited potential to reduce the TN emissions, as agricultural practices are expected to intensify for some countries.
- According to the other agricultural scenarios there is a strong potential for an increase of TN emissions from agriculture, which could also lead to an overall increase of TN emissions in Tisza River Basin.
- The reduction goals for phosphorus could be reached by implementing the phosphate ban alone. This relatively cost effective and easy to implement measure could be one of the first solutions to be realised. Although the Tisza River Basin countries would reach the reduction goals, it would be necessary to implement other measures, especially the improvement of wastewater treatment, to reach the reduction goals for the Danube River Basin.

7.1.3. Hazardous substances pollution

7.1.3.1. Vision and management objectives

The ICPDR's Tisza basin-wide vision for hazardous substances pollution is no risk or threat to human health and the aquatic ecosystem of the waters in the Tisza River Basin as well in the Danube River Basin District and that Black Sea waters are not impacted by the Tisza River discharge.

The vision will be achieved through the implementation of the following **management objectives by 2015:**

EU Member States and Non EU Member States:

- Reduction/Elimination of the total amount of priority/priority hazardous substances (specially arising from industrial, agricultural and mining activities) entering the Tisza River and its tributaries to levels consistent with the achievement of the good chemical status by 2015.
- Implementation of Best Available Techniques and Best Environmental Practices including the further improvement of treatment efficiency, treatment level and/or substitution.
- Exploration of the possibility to set quantitative reduction objectives for pesticide emission in the Tisza River Basin.

In addition, for EU Member States:

- Implementation of the IPPC (96/61/EC), which also relates to the Dangerous Substances Directive (76/464/EEC), Priority Substances Directive (which will come into force)[40] and Mining Waste Directive (2006/21/EC).

7.1.3.2. JPM approach towards the 2015 management objectives

Article 16 of the WFD sets a 'Strategy against pollution of water' which demands specific measures against the pollution of water by individual pollutants or groups of pollutants presenting a significant risk to or via the aquatic environment (e.g. by drinking water consumed). Further, Article 16 has put a mechanism in place through which a list of 33 priority pollutants has been created. The substances were chosen based on environmental quality standards and emission control measures established in the mid-1990s and ranked according to their measured concentrations or estimated concentrations in water or sediments. From this list of 33 priority pollutants, a group of 11 priority hazardous substances has been identified which will be subject to cessation or phasing out of discharges, emissions and losses within an appropriate timetable that shall not exceed 20 years.

For priority substances, a combined approach has to be applied in line with the WFD, and harmonised European emission controls and water quality standards will be elaborated for all substances.

Hazardous substances may affect organisms by inhibiting vital physiological processes (acute toxicity), or they may cause effects threatening population on a long-term basis (chronic toxicity). If a substance is persistent (its degradation process exceeds a certain time span), it remains in the environment and leads to continuous and/or long-term exposure.

Reducing hazardous substances emissions is a complex task requiring tailor-made strategies, as the relevance of different input pathways is highly substance-specific and generally shows a high temporal and spatial variability.

Although there is insufficient information on the magnitude and implications of problems associated with hazardous substances at a basin-wide level, it is clear that continued efforts are needed to ensure the reduction and elimination of discharges of these substances. This is particularly the case because hazardous substances can remain in the environment for a very long time, can bioaccumulate and can harm ecosystems and human health, even in very low concentrations.

The sources of hazardous substances can include: direct and indirect discharge from industrial point sources (including air pollutants); municipal wastewater from households and urban runoff; direct application of pesticides and other hazardous substances and accidental pollution. Therefore, measures to reduce or eliminate hazardous substances need to be based on a variety of approaches addressed to the individual pressures and sectors.

40 Hungarian comment: 2008/105/EC

7.1.3.3. Summary of measures of basin-wide importance

7.1.3.3.1. Implementation of measures regarding urban wastewater treatment

Due to the synergies between measures to address organic, nutrient pollution and hazardous substances, further implementation of the UWWTD for EU Member States contributes to the reduction of hazardous substances pollution from urban wastewater and from indirect industrial discharges. For Non EU Member States, the construction of 18 municipal wastewater treatment plants by 2015 will improve the situation – although it should be noted that the construction of new sewerage collecting systems which are not connected to wastewater treatment plants may have a detrimental effect.

A further area of importance is the input from urban areas via storm water overflows. Here, the reduction of emissions requires improved storm water management.

7.1.3.3.2. Implementation of measures regarding the industrial sector

For the industrial sector, the implementation of the IPPC is the most important measure for EU Member States. The IPPC is a comprehensive instrument to integrate and address different aspects of pollution control for large-scale industrial activities. EU Member States must ensure that installations of a specified size are neither established nor altered without an IPPC permit. One of the main obligations for operators of facilities is to ensure that BAT are applied. In addition, the implementation of other EU Directives will reduce hazardous substances pollution as well.

Measures include reducing point source emissions, especially from industrial sources, by applying BAT as a first, inevitable step. These measures have been proven to bring significant reduction in a short time period. BAT, as required by the implementation of the IPPC and the ICPDR BAT recommendations for Non EU Member States, comprise technological changes in the production process, substitution of specific substances and the use of end of pipe technologies.

Other relevant measures for substances released into the environment include chemical management measures. These are mostly based on EU regulations, such as REACH (EU regulation on Registration, Evaluation, Authorization and Restriction of Chemicals) or the Pesticides Directive, and involve bans/substitution of certain substances or measures which ensure the safe application of products (such as pesticides) – often referred to as Best Environmental Practices (BEP).

The implementation of BAT in different industrial sectors, outlined for EU Member States by the IPPC and for Non EU Member States by relevant ICPDR recommendations, will further contribute to achieving the management objectives.

7.1.3.3.3. Implementation of measures regarding the agricultural sector

For agro-industrial installations, implementation of the IPPC and application of BAT and BEP are relevant measures for EU Member States. With regard to the use of pesticides and other hazardous substances in agriculture, the concept of BAP is expected to result in positive effects both in EU Member States and Non EU Member States. For EU Member States, the EU Common Agricultural Policy (CAP) offers the potential for additional reductions in pollution from agriculture.

7.1.3.3.4. Implementation of measures regarding accidental pollution

For accidental pollution, the most important measures are the prevention of accidents and effective contingency planning in the case of an incident. In the framework of the ICPDR, the Tisza countries have taken important steps to ensure such mechanisms are in place. An Accident Early Warning System is in use and is continually maintained and improved.

The Accident Emergency Warning System in the Danube River Basin

The need for Accident Emergency Warning System (AEWS) in the Danube River Basin is recognised in Article 16 of the Danube River Protection Convention. Established in the early 1990s, the AEWS is an integral part of the activities of the ICPDR, and all Danube countries, with the exception of Montenegro, are involved. The AEWS is activated whenever there is a risk of transboundary water pollution, or threshold danger levels of hazardous substances are exceeded. The system sends out international warning messages to countries downstream, helping national authorities put environmental protection and public safety measures into action. Principal International Alert Centres in each country form the central points of basin-wide cooperation in early warning. The ICPDR Secretariat maintains the central GMS communications system, which is integrated within the ICPDR Information system (Danubis).

In addition, the ICPDR has developed an inventory of potential accidental risk spots (ARS Inventory). The Tisza countries reported a total of 92 contaminated sites that have the potential for accidental risks. Out of 23 contaminated sites, *short, middle and long-term-measures* have been recommended for 21 contaminated deposit sites. Information is limited for contaminated industrial and/or abandoned industrial sites. For approximately 32% of the reported contaminated industrial sites, *short, middle and long-term-measures* are necessary.

7.1.3.4. Estimated effects of national measures on the basin-wide scale

The Dangerous Substances Directive, the IPPC and UWWTD implementation by EU Member States, as well as widespread application of BAT/BEP throughout the Danube River Basin, will improve but not solve problems regarding hazardous substances pollution. **Reducing or eliminating the amount of hazardous substances entering the Tisza and its tributaries to levels consistent with the achievement of *good chemical status* may not be possible by 2015 and further efforts are needed.**

Due to the lack of reliable information, an assessment as to whether the management objectives will be achieved by 2015 is not possible.

Against this background, an overall improvement in the information available on the use and input to water of hazardous substances is a priority task for the ICPDR in the future. Experience in other basins has shown that simply ensuring the availability and calculation of data on hazardous substances discharged has initiated a sustainable reduction.

Therefore, it is an important additional objective of the JPM to **improve knowledge** on sources and relevant input pathways of the various hazardous substances. To this extent, the JPM should use the inventory of emissions, discharges and losses required under the EU Daughter Directive on Priority Substances, adopted by the Environment Council in October 2008.

Specifics of ITRBM Plan compared to DRBM Plan

Regarding hazardous substances pollution measures in the JPM, the following specific conclusions for the Tisza can be drawn in comparison to the Danube Basin level:

- Considering the high environmental risk due to pollution accidents (especially in mining areas), the relevance of preventive measures is much higher in the Tisza River Basin than for the Danube River Basin scale. Special attention is needed to update the inventories of accidental risk spots, including industrial sites, solid waste disposal, and abandoned tailing deposits.
- There is a strong need to investigate options for emergency management procedures during accidental pollution events in a transboundary context (such as mutual assistance or contingency planning).

7.1.4. Hydromorphological alterations

The pressures analysis and water status assessment show that surface waters of the Tisza River Basin are impacted by hydromorphological alterations to a significant degree (see **Maps 26-27**). In fact, most surface waters fail the WFD objectives because of these alterations, signalling the need for measures to achieve the management objectives and WFD environmental objectives. Interruption of river and habitat continuity, disconnection of adjacent wetland/floodplains, hydrological alterations and future infrastructure may impact water status and are therefore addressed as part of the JPM.

On the European level, measures related to the improvement of hydromorphological alterations are exclusively foreseen and required by the EU WFD and not by any other European Directive. Therefore, management objectives for the Tisza River Basin have an important role in guiding the joint improvement of ecological water status. The objectives are the same for EU Member States and Non EU Member States.

Measures reported by the Tisza countries to restore hydromorphological alterations have been screened for their estimated effect on the basin-wide scale in the event that good ecological status/good ecological potential is not achieved. Priorities for implementation on the basin-wide scale and the expected status improvement between 2009 and 2015 are summarised for each hydromorphological component, such as (i) restoration (interruption) of river and habitat continuity, (ii) reconnection of adjacent floodplains/wetlands, (iii) hydrological alteration and (iv) future infrastructure projects.

7.1.4.1. Hydromorphological alterations (1) - Interruption of river and habitat continuity - vision and management objectives

7.1.4.1.1. Vision and management objectives

The ICPDR's Tisza basin-wide vision for hydromorphological alterations is the balanced management of past, ongoing and future structural changes of the riverine environment, that the aquatic ecosystem in the entire Tisza River Basin functions in a holistic way and is represented with all native species.
This means in particular, that

- *anthropogenic barriers and habitat deficits do not hinder fish migration and spawning any longer – sturgeon species and other specified migratory species are able to access the Tisza River and relevant tributaries. Sturgeon species and specified other migratory species are represented with self-sustaining populations in the Tisza River Basin according to their historical distribution.*

The way towards the vision will be achieved through the implementation of the following **management objectives by 2015:**

EU Member States and Non EU Member States:

- Construction of fish migration aids and other measures to achieve/improve river continuity in the Tisza River and tributaries to ensure reproducing and self-sustaining of migratory species, which are intended to be implemented by 2015 by each country.

- Specification of the number and location of fish migration aids and other measures intended to be implemented by 2015 by each country to achieve/improve river continuity.

- Restoration, conservation and improvement of habitats and their continuity intended to be implemented by 2015 by each country for migratory species in the Tisza River and tributaries.
  - Specification of the location, extent and type of measure intended to be implemented by 2015 by each country.

7.1.4.2. JPM approach toward the management objectives by 2015

The rivers of the Danube and Tisza Basins include crucial living and spawning habitats, vital to the life cycles of fish species. These rivers can be classified as ecologically very sensitive, as they are the key routes and *starting points* of fish migration for medium and long distance migratory fish species.

The overall goal of the restoration of river and habitat continuum is free migration routes for the Danube River Basin, including the Tisza River and its other major rivers, as this is crucial for achieving and maintaining *good ecological status/potential* for the future. However, due to the objectives set at the national level (related to the application of WFD Article 4(5) for rivers which are not included in the ITRBM Plan) some restoration measures will not be implemented.

An ecological prioritisation approach was developed by the ICPDR for continuity restoration as part of the Danube River Basin Management Plan[41] (see Chapter 7.1.4.1.2 of the Danube River Basin Management Plan). The current chapter will refer on one hand to the achievement of the ICPDR's step-by-step approach to jointly ensure the fulfilment of the management objectives for the restoration of river and habitat continuity interruptions in the Danube River Basin with relevant information for the Tisza River and its tributaries (catchment area > 4,000 km^2). On the other hand it will summarise the additional data collection related to the interruption of river and habitat continuity.

7.1.4.2.1. Summary of measures of basin-wide importance

The Tisza countries have reported the measures that will be undertaken by 2015 to ensure fish migration, such as the construction of fish migration aids. As of 2009, 228 interruptions of river and habitat continuity are located in the Tisza River Basin.

For 44 river continuity interruptions in Romania, no measures are needed at water body level, because these water bodies (where 1 or more interruptions are located) already achieve their environmental objectives (good ecological potential for HMWB and good ecological status for natural ones).

By 2015, 39 measures will be implemented, and 84 measures are subject to exemptions according to WFD Article 4(4). There was no measure indicated for 76 interruptions (see **Figure VII.10**).

As for the Danube Basin, the numbers indicate that most restoration measures will not be taken until the second and third WFD cycle.

Consequently, **160** interruptions of river continuity will remain impassable for fish migration by 2015 and good ecological status and good ecological potential my not be ensured.

[41] DRBM Plan, 2009 ICPDR

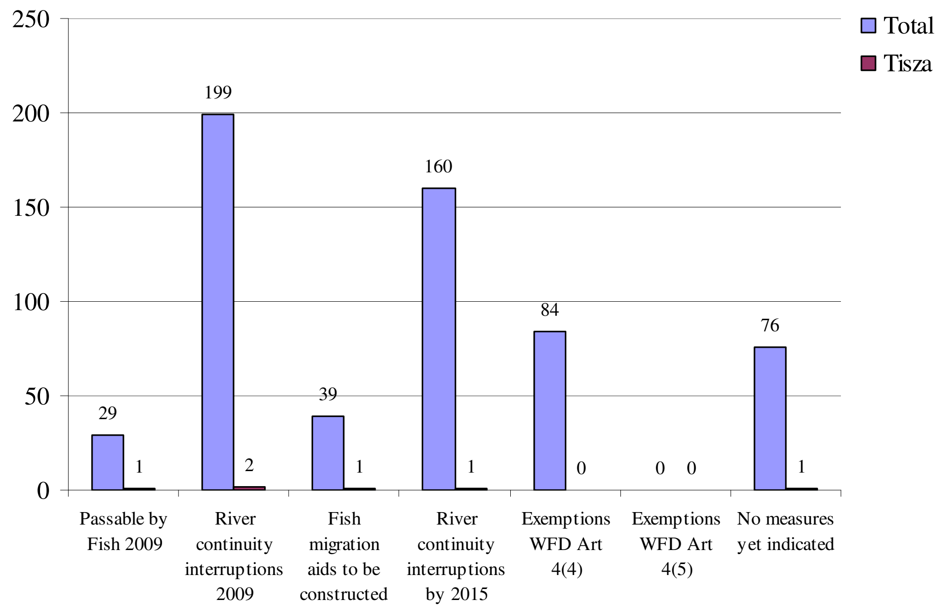

Figure VII.10.: Interruption of river continuity in the Tisza River Basin as of 2015 (including the number of exemptions according to the WFD Article 4(4) and 4(5) (see also Map 26).

Table VII.3: Overview for each Tisza country on the number of river continuity interruptions 2009 and 2015 restoration measures and exemptions according to the WFD Article 4(4) and 4(5).

Country	Barriers 2009	Passable by Fish 2009	River continuity interruptions 2009	Fish migration aids to be constructed	River continuity interruptions by 2015	Exemptions WFD Art 4(4)	Exemptions WFD Art 4(5)	No measures yet indicated
Ukraine	1	0	1	0	1	0	0	1
Romania	100	13	87	1	86	23	0	66[42]
Slovakia	60	5	55	13	42	42	0	0
Hungary	55	11	44	25	19	19	0	0
Serbia	12	0	12	0	12	0	0	12
Total	228	29	199	39	160	84	-	76
Tisza	3	1	2	1	1	-	-	1

7.1.4.2.2. Estimated effect of national measures on the basin-wide scale

Figure VII.10 indicates the water bodies with fish migration barriers (interruption of river continuity in the Tisza River Basin) as of 2009 and 2015, including the number of exemptions according to the WFD Article 4(4) and 4(5). By 2015, 39 measures will be implemented, and 84measures are subject to exemptions according to WFD Article 4(4). There were no measures indicated at all for 76 interruptions. However, for 44 river continuity interruptions in Romania, no measures are needed at water body level, because these water bodies (where 1 or more interruptions are located) already achieve their environmental objectives (good ecological potential for HMWB and good ecological status for natural ones).

Based on the approach developed by the ICPDR for the ecological prioritisation of measures to restore river and habitat continuity in the Danube River Basin (also including Tisza River and its tributaries with catchment area larger than 4,000 km^2), Map 28 of the Danube River Basin Management Plan illustrates where priority measures could be implemented to achieve the highest effectiveness of measures for WFD environmental objectives on the Danube Basin scale. On the Tisza River, three barriers have been indicated: the Kiskörei Barrage and the Tiszalöki Barrage in Hungary, and Novi Becej in Serbia. The Tiszalöki Barrage is passable by fishes and fish bypass are planned for the Kiskörei Barrage by 2015. No measures have been indicated for Novi Becej (**Map 26**).

The WFD environmental objectives for river and habitat continuity interruption will not be achieved by 2015 on the basin-wide scale, but it is likely that these objectives can be achieved after 2015 in the Tisza River Basin. The tributaries and the Tisza River itself in the upper section of the Tisza River Basin run free of dams and other considerable human impacts, which contribute to the survival of ‘zonations’ and natural assets, which are unique in Europe. The conservation of these natural assets is of common interest.

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[42] For 44 river continuity interruptions in Romania, no measures are needed at water body level, because these water bodies (where 1 or more interruptions are located) already achieve their environmental objectives.

7.1.4.3. Hydromorphological alterations (2) - Disconnection of adjacent floodplains/wetlands

7.1.4.4. Vision and management objectives

The ICPDR's *Tisza* basin-wide vision is that floodplains/wetlands in the entire Tisza River Basin are reconnected and restored. The integrated functions of these riverine systems ensure the development of self-sustaining aquatic populations, flood protection and reduction of pollution in the Tisza River Basin.

The vision will be achieved through the implementation of the following **management objectives by 2015:**

EU Member States and Non EU Member States:

- Protection, conservation and restoration of wetlands/floodplains to ensure biodiversity, the good status in the connected river by 2015, flood protection and pollution reduction;
- Development and introduction of a priority ranking (including flood retention, nutrient reduction and wetland/floodplain reconnection potential) and
- Implementation of the no net-loss principle.

7.1.4.4.1. JPM approach toward the management objectives by 2015

Floodplains/wetlands play an important part of the ecological integrity of riverine ecosystems and are of significant importance when it comes to ensuring/achieving the *good ecological status* of adjacent water bodies. As the majority of the former wetlands in the Tisza River Basin are disconnected, major restoration efforts and measures are needed to achieve reconnection of floodplains/wetlands in the entire basin (although some restoration projects have already been undertaken by the Tisza countries in recent years).

The approach chosen for the JPM to protect, conserve and restore wetlands is a pragmatic one, taking into account a background of 80% wetland loss. The Tisza countries have provided information on:

- national floodplains/wetlands >100 ha with a potential to be reconnected to the adjacent river (see **Map 6**);
- reconnection measures to be undertaken by 2015 or beyond, regarding WFD Article 4 (4).

The analysis shows the area of floodplains/wetlands to be reconnected for the Tisza River and its tributaries by 2015. The inter-linkage with national river basin management plans is vital for wetland reconnection as significant areas are expected to be reconnected to rivers with catchment areas <1,000 km^2 and with surface areas <100 ha, which will nevertheless have positive effects on the water status of larger rivers.

The approach will be further developed during the second river basin management cycle as improvements in knowledge are needed and expected. Current activities on the production of flood risk maps, for example, will significantly contribute to the compilation of an inventory of connected and disconnected floodplains/wetlands and therefore increase the knowledge on reconnection potential.

7.1.4.4.2. Summary of measures of basin-wide importance

The analysis shows the area of floodplains/wetlands to be reconnected by 2015 for both the Tisza River and its tributaries. The inter-linkage with national RBM Plans is vital for wetland reconnection as significant areas are expected to be reconnected to rivers with catchment areas <1,000 km^2 and with surface areas <100 ha having nevertheless positive effects on the water status of larger rivers.

By 2015, 2,651 ha, along with 17,306 ha of wetland areas identified in 2009 with potential for reconnection, are expected to be reconnected to the Tisza Basin Rivers. According to the application of the Article 4(4), 10 wetlands (1,662 ha) will be reconnected in Slovakia and an additional 12,993 ha in Ukraine after 2015 (within the second and third river basin management cycles) (see **Figure VII.11).**

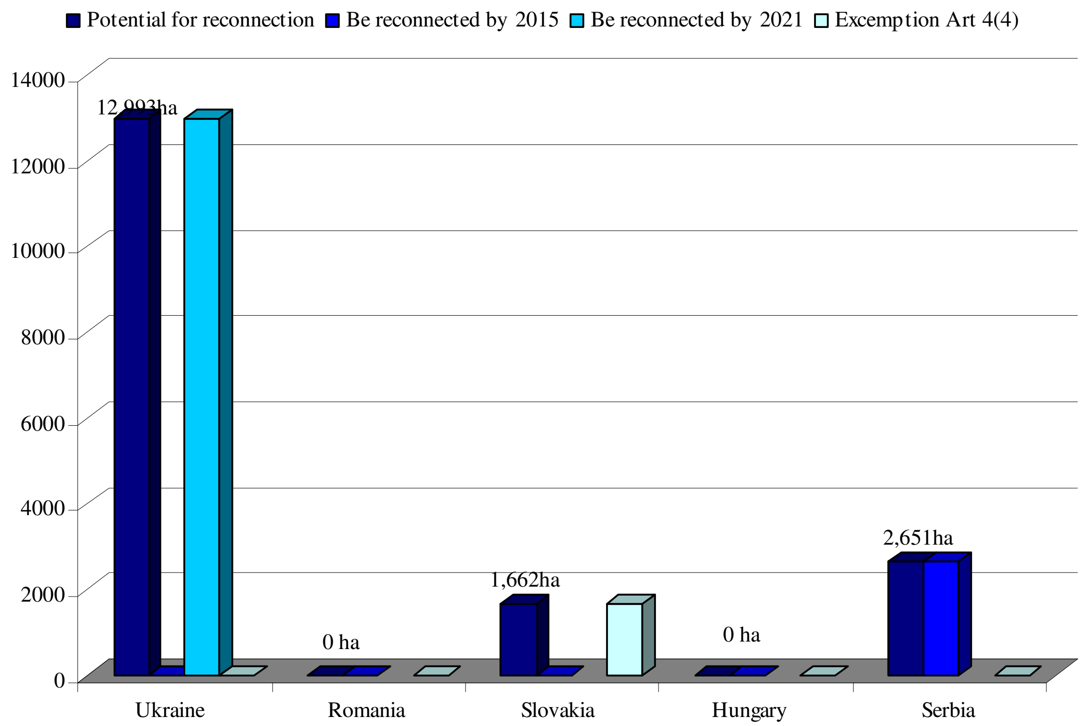

Figure VII.11.: Wetlands with reconnection potential, and wetland reconnection measures by 2015 and 2021 (including exemptions according to Article 4(4).

7.1.4.4.3. Estimated effects of national measures on the basin-wide scale

Based on the JPM results, measures have been identified to reconnect of wetlands/floodplains where good ecological status/ecological potential will not be achieved or to maintain good ecological status/ecological potential.

Reconnecting wetlands can play a significant role given the impacts of wetlands on nutrient reduction and flood mitigation.

It is also important to emphasise that measures related to wetlands (e.g. wetlands reconnection) can be considered integrated measures with positive impacts on flood risk mitigation, land use management and other water quantity aspects of the basin.

Compared to the Danube River Basin, the Tisza countries have more potential to 'give space to the rivers', thus restoring unique environments. Parameters such as water discharges, water quality, land uses and economic needs have to be taken into account during the planning process (see **Chapter 8**).

7.1.4.5. Hydromorphological alterations (3) - Hydrological alteration

7.1.4.5.1. Visions and management objectives

Vision: The ICPDR's *Tisza* basin-wide vision is that hydrological alterations are managed in a way to minimise impacts on ecosystem development and distribution.

To implement this vision, the same approach will be followed as that for the Danube River Basin Management Plan, i.e. focusing on impoundments and water abstractions.

Chapter 8 gives additional details on hydrological alteration and specific pressures from water abstractions, as well as visions and management objectives for integrating water quantity and quality issues (especially for water abstractions) of which there is a strong overlap.

7.1.4.5.2. JPM approach toward the management objectives by 2015 – hydrological alteration

As shown by the pressures analysis and status assessment, hydrological alterations impact the status of water bodies. Impoundments, water abstraction are key pressures that require measures on the basin-wide scale.

EU Member States, Accession countries and Non EU Member States:

Impoundments: Most of the impounded water bodies are designated as heavily modified and good ecological potential has to be achieved. Due to this fact, the ***management objective*** foresees measures on the national level to improve the hydromorphological situation in order to achieve and ensure this potential.

Water abstractions: The ***management objective*** foresees the ***discharge of a minimum ecological flow,*** ensuring that the biological quality elements are in good ecological status or good ecological potential.

Hydropeaking: In case water bodies affected by hydropeaking (in DRB scale) are designated as heavily modified and good ecological potential has to be achieved. Therefore, the ***management objective*** foresees measures on the national level to improve the situation to achieve and ensure this potential. Hydropeaking and its effect on water status is a very complex issue, and further respective investigations and scientific studies are needed.

7.1.4.5.3. Summary of measures of basin-wide importance 2015 – hydrological alteration

Overall 39 measures are expected to take place by 2015 to improve impacts on water bodies caused by hydrological alterations. Some 27 measures are subject to WFD Article 4(4) and will therefore be implemented after 2015. **(Figure VII.12)**

Out of the total 76 impoundments, no measures have been indicated for 30 cases, and 26 impoundments are subject to exemption according to Art 4(4). Improvement is expected for 20 impoundments by 2015.
Of the identified 26 water abstractions, improvement is planned for 14 cases by 2015 and 8 water abstractions are subject to exemption according to Art 4(4). No measures have been indicated for two cases.

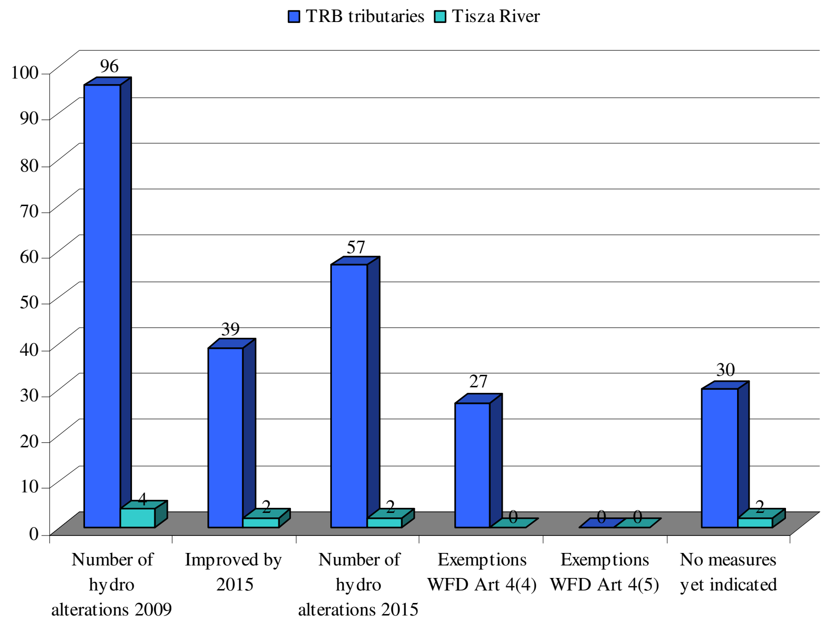

Figure VII.12: Measures for hydrological alterations by 2015 and exemptions according to Article 4(4) and 4(5) (see also Map 27).

7.1.4.5.4. Estimated effect of national measures on the basin-wide scale

The measures of basin-wide importance to restore hydrological alterations have been identified based on the results of the JPM. Their implementation will be crucial in order to achieve the WFD environmental objectives by 2015 and partly beyond (2021/2027). It is difficult at this stage to indicate the exact effect of such measures at the basin-wide scale, as is also the case for the Danube River Basin. Installing and applying appropriate control mechanisms at the national level for measure implementation will be important to achieve this basin-wide aim. A feedback mechanism between the national and international level and vice versa will enable further estimation of the basin-wide effect of implemented national measures.

7.1.4.6. Hydromorphological alterations (4) - Future infrastructure projects

7.1.4.6.1. Visions and management objectives

The ICPDR's *Tisza* basin-wide vision for future infrastructure projects is that they are conducted transparently using best environmental practices and best available techniques throughout the Tisza River Basin, so that impacts on or deterioration of the good status and negative transboundary effects are fully prevented, mitigated or compensated.

The vision will be achieved through the implementation of the following **management objectives by 2015:**

EU Member States and Non EU Member States:

- Completion of Environmental Impact Assessments and/or a Strategic Environment Assessment in conjunction with the WFD Article 4(7) during the planning phase of the future infrastructure project if needed.
- Fulfilment of the conditions set out in WFD Article 4, in particular the provisions for new modifications specified in Article 4, Paragraph 7.
- Recommendations for stakeholders to implement best environmental practices and best available techniques.

7.1.4.6.2. JPM approach toward the management objectives by 2015 – future infrastructure projects

Many future infrastructure projects in the Tisza River Basin may have negative impacts on water status and need to be addressed accordingly by 2015.

The Tisza River Basin management objectives include precautionary measures that should be implemented to reduce and/or prevent impacts on *good ecological status/ecological potential*.

Romania and Hungary provided information on future infrastructure projects to the DanubeGIS database; however no information is available from Slovakia, Serbia or Ukraine. There are 28 projects officially planned or in preparation, and 3 projects are ongoing. The types of projects include a flood protection levee built to design flood level plus security height; construction of a flood level mitigation reservoir at the middle Tisza Valley (Nagykúnság); construction and rehabilitation of an emergency reservoir for Tisza River floodplain between Szolnok and Kisköre. Of the future infrastructure project, 91% are for flood protection. Projects are also planned for water supply and hydropower issues, as well as for other reasons to a small extent.

Out of the 28 projects in Hungary, 7 cases of transboundary impacts were indicated.

7.1.4.6.3. Summary of measures of basin-wide importance

At the moment, it is not clear whether the reported future infrastructure projects will deteriorate water status, or what mitigation measures will be taken. These issues and their importance on the basin-wide scale will be followed-up in the preparations for the second ITRBM Plan. Further considerations for such follow-up, particularly for flood protection infrastructure projects, are indicated in **Chapter 8**.

Specifics of ITRBM Plan compared to DRBM Plan

For hydromorphological alterations, the following specific conclusions for the Tisza can be drawn in comparison to the Danube Basin level:

- Some 91% of future infrastructure projects are intended to improve the flood protection systems (mainly in Hungary). Many of the future infrastructure projects are subject to Article 4(7) and/or Strategic Environment Assessment / Environmental Impact Assessments assessment. In comparison to the Danube Basin, where the future infrastructure projects are mainly focused on navigation, flood protection is a significant issue in the Tisza River Basin and the needs of the WFD need to be harmonised with flood protection measures. The main integrated management objective is to facilitate this harmonisation process and to highlight measures that have positive impacts on both water quality and quantity and the aquatic ecosystem.

7.2. Groundwater

7.2.1. Introduction

Detailed information on the relevant measures for each groundwater body were collected and this chapter summarises the measures that are planned for the 85 groundwater bodies of basin-wide importance.

7.2.1.1. Groundwater quality - Visions and management objectives

Vision: The ICPDR's *Tisza* basin-wide vision is that the emissions of polluting substances do not cause any deterioration of groundwater quality in the Tisza River Basin. Where groundwater is already polluted, restoration to good quality will be the ambition.

The vision will be achieved through the implementation of the following **management objectives**:

EU Member States and Non EU Member States:

- Elimination/reduction of the amount of hazardous substances and nitrates entering the groundwater bodies in the Tisza River Basin to prevent deterioration of groundwater quality and to prevent any significant and sustained upward trends in the concentrations of pollutants in groundwater.
- Implementation of the management objectives described for organic and nutrient pollution of surface waters (see above).
- Increase in the level and efficiency of wastewater treatment.
- Implementation of BAT and BEP.
- Reduction of pesticide/biocides emissions in the Tisza River Basin.

In addition, for EU Member States:

- Implementation of the principle concerning prevention/limitation of pollutants inputs to groundwater according to the EU Groundwater Directive (GWD, 2006/118/EC).
- Implementation of the EU Nitrates Directive (91/676/EEC).
- Implementation of the Plant Protection Directive (91/414/EEC) and the Biocides Directive (98/8/EC).
- Implementation of Urban Wastewater Treatment Directive (91/271/EEC).
- Implementation of the Integrated Pollution Prevention Control Directive (96/61/EC), which also relates to the Dangerous Substances Directive 76/464/EEC, Priority Substances Directive [43], Mining Waste Directive (2006/21/EC) and Waste Directive (94/62/EC).

7.2.1.2. Groundwater quantity – Visions and management objectives

Vision: The ICPDR's *Tisza* basin-wide vision is that water use is appropriately balanced and does not exceed the available groundwater resources in the Tisza River Basin, considering future impacts of climate change.

Management objectives
EU Member State and Non EU Member States:

- Over-abstraction of groundwater bodies within the Tisza River Basin is avoided by sound groundwater management.

In addition, for EU Member States:

- Implementation of WFD requirements that the available groundwater resource is not exceeded by the long-term annual average rate of abstraction.

7.2.2. Groundwater quality - Summary of measures

Results of the status assessment clearly show that contamination by NO_3 and NH_4^+ from diffuse sources is the main reason groundwater bodies have poor status in the Tisza River Basin. These substances have therefore been identified as target substances to improve groundwater quality, through the reduction of the load to underground sources. Basic measures, listed in WFD Annex VI (Part A), are seen as key instruments to achieve good chemical status and reverse of any significant and sustained upward trends in the concentrations of nitrates in groundwater in the Tisza River Basin. Depending on the origin of the pollution load, this should primarily be done through implementation of the EU Nitrates Directive and also the UWWTD. Where drinking water sources are endangered, basic measures through the implementation of Drinking Water Directive (80/778/EEC), as amended by Directive (98/83/EC), should provide improvement of quality of groundwater.

Additional measures have to be taken for the presence of hazardous substances in the groundwater aquifers, as required under the following Directives:

1 Drinking Water Directive (80/778/EEC), as amended by Directive (98/83/EC)

2. Plant Protection Products Directive (91/414/EEC)
3. Habitats Directive (92/43/EEC)
4. IPPC Directive (96/61/EC)

43 Hungarian comment: 2008/105/EC

In specific cases (for example in urban areas), supplementary measures such as management of urban run-off and control of diffuse pollution in urban areas must be implemented, in addition to basic measures.

To prevent pollution of groundwater bodies by hazardous substances from point source discharges liable to cause pollution, an effective regulatory framework has to be put in place prohibiting direct discharge of pollutants into groundwater and setting all necessary measures required to prevent significant losses of pollutants from technical installations and reduce the impact of accidental pollution incidents.

While there is a strong connection between the status of surface water bodies and groundwater bodies, specific actions have to be taken to reduce or eliminate the presence of polluting substances in surface water bodies.

7.2.3. Groundwater quantity - Summary of measures

Available groundwater resources must not be exceeded by the long-term annual average rate of abstraction to maintain good quantitative status according to WFD Annex V (2). Furthermore, any damage to groundwater-dependent terrestrial ecosystems must be prevented.

The vision for the groundwater quantity defined by the ICPDR stipulates that water use in the Danube River Basin has to be appropriately balanced considering the conceptual models for the particular groundwater bodies and should not exceed the available groundwater resources in the basin. In line with this vision, the over-abstraction of groundwater bodies within the Tisza River Basin should be avoided by effective groundwater management.

Most measures addressing poor quantitative status of groundwater bodies in the Tisza River Basin are based on the implementation of appropriate controls for the abstraction of fresh surface and groundwater, as well as impoundment of fresh surface water, including a register of water abstractions. Additionally, other measures should also be applied to improve the water balance, such as changes in drainage systems, cessation of illegal abstractions and use of crops with low water demand and as well as the application of water-saving irrigation technology. Slow and insufficiently recharging deep aquifers in some parts of the Tisza River Basin, followed by several decades of intensive public water supply, have resulted in over-abstraction. Sustainable solutions for future water supplies in such cases include measures to investigate alternative water sources.

8. Integration of water quality and water quantity issues

8.1. Introduction

In most cases, problems of water quality and quantity cannot be separated, as nearly every water management problem has a quantitative and qualitative component. Hydromorphological alterations, identified as a significant water management issue for both the Danube and Tisza Basins, have already emphasised the relevance of water quantity management pressures/impacts and their effect in water status. Impacts from hydromorphological alterations are already bringing to the surface the need to further investigate water quantity management pressures/impacts and to examine the linkage between water quality and water quantity management.

As the main conclusion of the Tisza Analysis Report 2007 (TAR), the Tisza Group identified that integration of water quality and quantity in land and water planning is an essential issue to be considered during the preparation of the Integrated Tisza River Basin Management Plan (ITRBM Plan).

In the TAR, the Tisza Group defined water quantity as a relevant water management issue: expert judgement was developed related to water uses and demands (present status and scenario analysis), characterisation of flood and drought management and relevance of extreme climate conditions. Furthermore in the frame of the UNDP/GEF Tisza project national reports were developed on integration for all five Tisza River Basin countries to introduce key pressures and impacts on water quality derived from water quantity alterations. Based on the outcomes of those reports the Tisza Group outlined the main objective of integration measures and determined the definition of integrated management relevant for the Tisza River Basin.

It is therefore of key importance that the definition of integrated management is used for the development of the ITRBM Plan: the plan aims to identify measures which will have positive impacts both on water quality and quantity and on aquatic ecosystems in the Tisza River Basin.

The following water quantity related management aspects were considered in the assessment of integration of water quality and quantity management in the Tisza River Basin:

- Key water quantity management issues (see also **Box 1**)
    - Flood and excess water events
    - Drought and water scarcity
    - Climate change scenarios

Box 1 introduces the key water quantity management issues as well as water quantity pressures which can have direct impact on water quality in the Tisza River Basin.

Box 1. Key issues of integrated water management connected to water quantity management.

Key integrated water management issues of quantity are divided into the following categories:

A) Floods and excess water

B) Droughts and water scarcity

C) Climate change

The following priority pressures and impacts are identified in connection to integrating water quality and water quantity in the Tisza River Basin. These pressures and impacts play a role in two or more Tisza countries:

- Hydromorphological pressures from flood protection measures
- Accidental pollution due to flooding
- Loss of wetlands
- Solid waste
- Groundwater depletion due to over-abstraction
- Increased irrigation and related surface water abstraction

- Impacts of climate change on low water flow

This issue is of particular of importance in river basins with a relatively small amount of water flow compared to the size of the basin, such as the Tisza River Basin.

The water resources of the Tisza River Basin are mainly used for public water supply, irrigation and industrial purposes, but also for other uses, such as agriculture, fishing and recreation.

Based the '*average total water quantities annually used by the given users'* and the '*percentage of the estimated consumptive use*[44]*'*, calculations in the analysis report estimated consumptive uses by the various water users (million m^3) with the average value for three years (2002-2004). Then a scenario for 2015 was created estimating the uses of various water users. From data on planned water uses, the total annual water demand for the Tisza River Basin in 2015 is estimated at approximately 1.5 billion m^3 – or 5.5% to 6% of the total annual runoff. Water use for irrigation will increase significantly as all Tisza countries plan to upgrade existing irrigation systems and build new ones. The increases in water use in the Tisza River Basin will be an additional pressure on already endangered aquatic ecosystems, particularly in the summer low-water period when planned irrigation can go beyond available water quantities.

Water scarcity and droughts and flood and excess water events are major challenges in the Tisza River Basin and climate change is expected to further influence the current situation.

Droughts and floods have broader impacts on natural resources through negative side-effects on biodiversity, water quality, soil impoverishment and soil erosion. But these phenomena are not just a concern for water managers. As natural phenomena they have a direct impact on economic sectors which depend on water (such as agriculture, industry, energy, transport, tourism and related land uses/spatial development), and a social impact (such as famine or unemployment) at the same time.

Water scarcity, droughts and floods affect land uses, but at the same time land use can also influence water quality and quantity aspects of ecosystems. Proper and sustainable land use management can offer integrated water management solutions, and therefore the linkages between the two management sectors must be examined.

In river basins, sub-basins or the recharge areas of groundwater, various water uses may compete or even conflict with each other creating management problems, particularly if water is scarce or quality is deteriorating. Knowledge about economic development patterns is important to understand how water management problems may worsen in the future[45]. To manage water scarcity, droughts and floods, the first priority is to move towards a water-efficient and water-saving economy. It is essential to improve water demand management in the Tisza River Basin, and a wide range of policy options therefore need to be considered.[53]

8.1.1. Structure of this chapter

This chapter on integration emphasises the fact that measures of water quantity and land use management can be highly beneficial from a water status point of view, if there are coordinated measures from the relevant sectors.

Sub-chapter 8.2. stresses the pressures and impacts related to the key water quantity management issues (flood/excess water, drought/water scarcity and climate changes) for Tisza countries. Sub-chapter 8.3. also introduces national experiences while outlining the linkage between land use management and water management.

To manage droughts, floods and climate changes, the first priority is to move towards a water-efficient and water-saving economy and to improve water demand management in the Tisza River Basin in line with the planning process of land uses/spatial development. Sub-chapter 8.4. highlights a range of innovative financing mechanisms.

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[44] **Consumptive use:** Water abstracted which is no longer available for use because it has evaporated, transpired, been incorporated into products and crops or consumed by man or livestock. Water losses due to leakages during the transport of water between the point or points of abstraction and the point or points of use are excluded. Definition source: Joint OECD/Eurostat questionnaire 2002 on the state of the environment, section on inland waters.

[45] UNECE, 2007, Recommendations on payments for Ecosystem services in integrated Water resources management New York and Geneva, 2007

Sub-chapter 8.5. introduces visions and management objectives to better integrate water quality, quantity and land use management given the priority roles of economic measures.

Sub-chapter 8.6. proposes further development of integrated management by outlining integrated measures with positive impacts on both water quality and quantity.

8.2. Pressures and impacts related to key water quantity management issues

8.2.1. Floods and excess water

Floods in the Tisza River Basin can develop at any season as a result of rainstorm, snowmelt or the combination of the two. Snowmelt without rainfall rarely occurs in the Tisza Basin and floods resulting from this account for no more than 10-12% of the total amount. A rise in temperature is almost always accompanied or introduced by some rain, and therefore large flood waves are generated more frequently in late winter and early spring.

Inundation in the lowland areas of the Tisza River Basin originates from unfavourable meteorological, hydrological and morphological conditions on saturated or frozen surface layers as a result of sudden melting snow or heavy precipitation, or as a result of groundwater flooding. This runoff or excess water cannot be evacuated from the affected area by gravity and may cause significant damage to agriculture or even to traffic infrastructure and settlements.

The analysis report provided an overview on historical floods events from 1879 to 2006, and indicated 24 extreme flood events with serious damage in the Tisza River Basin during this period.

Following a relatively dry decade, a succession of abnormal floods has set new record water levels on several gauges annually over the last few years. Over 28 months between November 1998 and March 2001, 4 extreme floods travelled down the Tisza River. Large areas were simultaneously inundated by runoff and rapid floods of abnormal height on several minor streams. The extreme Tisza flood in April 2006 was preceded by several floods in February and March generated by melting snow and precipitation.

Floods generated in Ukraine, Romania and the Slovakia are mainly rapid short-duration floods and last 2-20 days, with flooded areas situated on superior Tisza courses or on the tributaries. Large floods on the Tisza in Hungary and in Serbia, in contrast, can last for as long as 100 days or more (the 1970 flood lasted for 180 days). This is due to the very flat characteristic of the river in this region and multi-peak waves which may catch up on the Middle Tisza causing long flood situations. Also characteristic of the Middle Tisza region is that the Tisza floods often coincide with floods on the Danube and on its tributaries, which is especially dangerous in the case of the Someş/Szamos, Crasna/Kraszna Bodrog, Criş/Körös and Mureş/Maros Rivers.

Recent severe floods have highlighted the problem of the inundation of landfills, dump sites and storage facilities where harmful substances are deposited and toxic substances can be transferred into the water posing a clear threat to the environment. Such potential threats were recognised by the ICPDR (Potential Accident Risk Sites in the Danube River Basin, 2002), and an inventory of old contaminated sites in potentially flooded areas in the Danube River Basin was compiled in 2002-2003.

8.2.1.1. Priority pressures end related impacts in connection to floods and excess water

Hydromorphological alterations due to flood protection measures

Hydromorphological pressures from flood protection measures are significant in all Tisza countries (see **Chapter 2.1.7.1.** for the exact numbers of modifications). Flood protection is one of the key driving forces causing river and habitat continuity interruption for 25% of the Tisza River Basin. Out of the 228 barriers listed (ramps/sills as well as dams/weirs), flood protection is the primary use for 58 barriers .

According to DanubeGIS data, Hungary and Romania listed a total of 31 future infrastructure projects (see **Annex 7**) and 28 of these are for flood protection.

As part of flood action plans for Tisza countries, the Ukraine and Romania plan to implement measures for technical flood defence (construction of new dikes and consolidation of the banks along the Tisza River and its tributaries). New flood protection measures with possible effects on the Tisza aquatic ecosystems are also underway in Hungary, and reconstruction of levees/dikes in Serbia is almost finished (**Annex 16** indicates flood protection measures introduced by the Tisza Countries in 2009).

At the moment, limited efforts have been undertaken to restore river and habitat continuity interruptions in the Tisza Basin. In addition, several new technical flood defence measures or infrastructure projects are planned with a high potential for negative impacts on water ecosystems. However, additional regulations on land uses and spatial planning are planned for flood protection in the Tisza River Basin (e.g. limitations related to land use in flood prone areas) with the potential for positive impacts.

Chapter 8.6 indicates how restoration measures, new flood infrastructure projects or land use and spatial planning will/can contribute to the achievement of the related management objective (see Chapter 8.5. and 8.6.).

Accidental pollution due to flooding

Accidental pollution due to flooding is an important issue in most Tisza countries, except Slovakia and Serbia. Accidental pollution can originate from operating industrial facilities, but also from pollution from sites contaminated by former industrial activities or waste disposal. Flood events should be managed in such a way that water surplus-related pollution is reduced via suitable preventive measures considering the land use management of floodplain/wetlands.

A survey in 2002 identified 261 potential risk sites in the Danube River Basin, and as a consequence, a methodology was developed to screen their risk potential. It was agreed upon by the Danube countries that sites with a high risk potential should be investigated further to create a more concrete risk estimation and ranking. In the Tisza River Basin 92 risk spots have been reported in 2009.

Disconnection of adjacent wetlands/floodplains

Wetlands can play an important role in flood and drought mitigation as well as in nutrient reduction. They act as sponges, soaking up rain and storing floodwater and runoff. Wetlands slowly release flood waters back into streams, lakes and groundwater, making the impact of flooding less damaging.

Due to the regulations of the Tisza and its tributaries, wetlands with shallow water important for fish spawning have been reduced significantly, and water-dependent wild ecosystems have vanished. Today disconnected floodplains are used for intensive farming.

In Tisza countries, efforts have already been undertaken to restore wetlands (e.g. EU-LIFE floodplain rehabilitation project – SUMAR[46], UNDP/GEF Tisza MSP[47]) and there is more potential to reconnect former floodplains (see **Chapter 2.1.7.2**).

Based on preliminary results, the extent the restoration of wetlands may help combating flood and drought impacts still has to be assessed. It is clear, however, that reconnected wetlands will considerably improve the hydromorphological situation of the Tisza River Basin. Until now, no quantitative estimate can be given for such effects.

Solid waste

Despite national regulations, solid waste remains a problem in the Tisza River Basin, mainly due to illegal waste disposal in the mountainous area in the Upper Tisza Basin. A high-level roundtable conference on 25 March 2009 about 'Solid communal waste treatment and preventing transboundary water pollution' called attention to the importance of this problem, and the problem is further investigated under the UNDP/GEF Tisza MSP demonstration projects, and possible solutions will be discussed in 2010. As a follow-up action to this the roundtable conference, two demonstration projects for plastic waste recycling are in progress under the frame of the ICPDR facilitating actions in Ukraine and Romania.[48]/[49]

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46 Sustainable use and management rehabilitation of flood plain in the Middle Tisza District (2004-2006)

47 Integrating multiple benefits of wetlands and floodplains into improved transboundary management of the Tisza River Basin (2008-2011)

48 UNDP/GEF Tisza MSP project - demonstration project: Selected Measures Towards Integrated Land and Water Management in Upper Tisza – Activity 1 Communal waste management system for Velyky Bychkiv and Bocicoiu Mare is improved

49 Coca-Cola /ICPDR/WWF - Recycling of plastic waste from Tisza floodplains

8.2.2. Drought and water scarcity

The Tisza River Basin runoff is highly variable – there are alternate periods of drought and flooding that are difficult to forecast and manage effectively. The droughts of recent years, such as the drought of August 2003, had severe effects in the region, particularly on agriculture on the Hungarian Plain. The lack of water not only reduces agricultural activity, but also the development of industry and urbanisation. Cities and other communities demand more water than the quantity available from rainfall and it has always been difficult to get enough water for settlements far away from rivers.

According to the Working Group on Water Scarcity and Drought at the Water Directors, water scarcity refers to long-term water imbalances, combining an arid or semi-arid climate (low water availability) with a level of water demand exceeding the supply capacity of the natural system.

In **Ukraine** the term 'drought management' has never been applied to the country's part of the Upper Tisza River Basin due to the fact that in Transcarpathia the annual surface water resources potential per capita is three times as much (3,130 m^3) as the same index for the whole country (1,000 m^3). 'Water scarcity' or 'water deficit' are the only terms relevant there. There have been dry years (1961, 1963) which didn't result in water shortage.

High drought risk areas were identified in **Romania** based on the correlation of the aridity index calculated through the reporting of precipitations to the potential evapotranspiration with the Palfay aridity index (PAI) which takes into consideration the frequency of the dry years. Affected areas consist of the territories in which the aridity index has values under 0.65 and the ones with sensitivity to drought for which the PAI is between 4 and 8**.** For the basins that drain into the Tisza River tributaries, the areas with PAI values between 4 and 6 (moderate sensibility) and 6 and 8 (high sensibility) are only encountered in the Sãlaj Hills (Dealurile Sãlajului)and on the Western Plain (Cãmpia de Vest) at the border with Hungary and Serbia. These areas are fragmented and comprise a relatively small surface.

For the **Slovak** part of the Tisza River Basin, the PAI index was used to evaluate drought and showed that the most unfavourable year was 2003. Most of the Slovak part of the Tisza River Basin was classified as having 'moderate draught', with the exception of the Somotor station (in the vicinity of the Bodrog River), with a value of 10.4 or 'severe draught', and the Michalovce station (Laborec Valley) with a value of 8.41 or 'medium draught'. Return periods were not calculated.

A short overview follows of the drought situation of the **Hungarian** part of the Tisza River Basin, as recent years were not included in the analysis report:

Hungary is often threatened by droughts and floods. According to past experiences, a damaging water shortage occurs four out of every ten years on average – three droughts occurred between 1976 and 1985, and seven between 1986 and 1995. These numbers confirm that Hungary must be prepared to avoid and prevent damage caused during periods of water shortage. To prevent damage caused by drought, it is necessary to create and operate systems ensuring water importation between areas, as well as to create water retention areas and preserve water resources.

Farmers in the area can protect themselves against damage to vegetation with melioration, irrigation and initiation of the irrigation management. The drought forecast introduced in the beginning of 1990s helps significantly in preparing for irrigation.

The last two decades experienced extreme droughts in 1990, 1992, 1993, 1994, 2000 and 2001, and a period of extreme water shortage occurred in 2002 which affected the Alföld (Hungarian Great Plains). Flood and drought can occur shortly after each other in the Tisza River Basin, and management plans should deal with both aspects in the basin.

The data analysed in **Serbia** indicate a large concentration of dry years during the last two decades.

Of all droughts occurring during vegetation periods and calendar years, the two driest seasons were in 2000 (the SPI <-2.0 on average for all of Serbia, but for between -3 and -4 for the Tisza catchment) and 1990 (the drought assumed extreme characteristics in a wide area northeast of the Tisza catchment at Kikinda). However, based on the extent of impact, the years 1961, 1993 and 2003 can also be included in this category. The study of SPI series indicate an increasing frequency of droughts in Serbia over the last 20 years (1981-2000), with concentrations of severe droughts near the end of the period including an extreme drought in 2000**.** (Spasov et al. 2002)

According to the USDA Report for 2003, the areas most seriously affected by drought conditions in Serbia were north and central Banat, all of Bačka, and east and central Srem. All these regions are in Vojvodina, the so-called "bread basket of Serbia". Instead of an average rainfall of 40 l/m^2 in April and May 2003, those regions received only 12 l/m^2 in total.

8.2.2.1. Priority pressures and related impacts in connection to drought and water scarcity

Decreasing groundwater level due to over abstraction (e.g. Nyírség) or problem related to water scarcity due to inadequate water resource management in basin wide scale (e.g. Maros and Körös rivers) already well-known problems, which has to be dealt with in the Tisza River Basin. The following subchapters are highlighting specific problems due to over-abstraction of GWs and expected increase of irrigation and related surface water abstraction.

Over-abstraction of groundwater

As indicated in the pressures analysis in Chapter 2.1.4, over-abstraction of groundwater prevents the achievement of good quantitative status for 21 groundwater bodies (mainly in Hungary) of the 85 assessed in the Tisza River Basin.

Compared to 2007, consumptive uses between water users are estimated to nearly double by, mainly due to the significant increase of irrigation and will result in an increase in water demand in the near future. It is unknown to what extent effective measures (such as appropriate abstraction controls, registers of water abstractions, change in drainage system, cessation of illegal abstractions and the use of crops with low water demand as well as application of water-saving irrigation technology) will be applied throughout the Tisza River Basin to solve over-abstraction.

Increased irrigation and related surface water abstraction

A significant increase can be expected in most Tisza countries in the future for irrigated area and related amount of water (average water quantity annually used for irrigation (m^3 per ha), average total water quantities annually used for irrigation (10^6 m^3) and consumption uses).

It is clear that sustainable balance needs to be established between water resources availability and water demands, and that water pricing policies should be put into place to provide adequate incentives to use water resources efficiently.

8.2.3. Climate change in the Tisza River Basin

Climate change, including changes in temperature, precipitation and snow cover, is intensifying the hydrological cycle. At the same time, other factors such as land-use changes, water management practices and extensive water withdrawals have considerably changed the natural flow of water, making it difficult to detect climate change-induced trends in hydrological variables. However it is already clear that extreme events such as floods and droughts are likely to occur more frequently and with greater intensity. The impacts on low water flow may be particularly problematic, and naturally a healthy aquatic ecosystem is more resilient to climate change impacts.

8.2.3.1. Reasons for integrating climate change adaptation issues into river basin planning

The European Commission's White Paper 'Adapting to climate change: Towards a European framework for action' (2009) calls for the promotion of "strategies which increase the resilience to climate change of health, property and the productive functions of land, inter alia by improving the management of water resources and ecosystems". It also sees the need to investigate the potential for policies and measures to boost ecosystem storage capacity for water and for the development of guidance to ensure that river basin management plans are climate proof in 2015.

To prepare the Danube River Basin Management Plan, an international conference on Climate Change in the Tisza River Basin was held in Vienna in December 2007, with conclusions also relevant for the Tisza River Basin (see **Annex 15**).

The results of the first climate change scenarios for the Tisza River Basin were reported by the end of 2009 **presenting in short the results of the main European projects concerning climate changes with reference for the Tisza River Basin**

Annex 15 of the Plan introduces additional climate change relevant information also including short description of European projects on climate change.

8.2.3.2. Responses to climate change

Climate changes strategies at the national level in the Tisza River Basin

HUNGARY: Hungary adopted a climate change law in June 2007. On the basis of the provisions of this act, Hungary is preparing a National Climate Change Strategy for 2008-2025. The new element in this strategy compared to other climate change strategies is that it attempts to deal with the goal of emission reduction and adaptation in a balanced and integrated manner. The strategy can provide methodological tools for other countries as well as lessons in preparing an integrated climate change strategy.

In spring 2008, Hungary – among the very first internationally – passed a middle-term National Climate Change Strategy, which determines both the national tasks to reduce greenhouse gas emissions, and sectorial tasks to adapt to the ongoing climate change for 2008–2025.

ROMANIA: In July 2005, Romania adopted the first National Strategy for Climate Change (NSCC), by Governmental Decision no. 645/2005. By means of this Strategy, Romania took the first steps towards a concerted and coordinated national effort to implement policies in the field to limit greenhouse gas emissions and prepare measures to adapt to the potential impacts of climate change for 2005-2007.

According to the provisions of the NSCC, a National Action Plan on Climate Change (NAPCC) was developed. The NAPCC includes concrete actions meant to ensure attainment of the general and specific objectives presented in the NSCC during 2005- 2007.

SERBIA: In Serbia there is no adopted National Climate Strategies Document yet, however it is planned for 2011. Some principles on this issue are included in the National Sustainable Development Strategy adopted on 9 May 2008.

SLOVAKIA: The Republic of Slovakia does not have a national strategy concerning climate changes yet; however some strategic steps on this issue were included in the National Strategy on Sustainable Development (2001). Activities in the field of emission reduction have intensified since March 2007, raising the reduction goal to 20% that of the EU level by 2020. In addition, a preparation and approval process of legislative tools to achieve the goal has been launched.

A coordination body for climate change and renewable energy resources was established at the higher political level together with the Commission for Climate-Energy Measures to prepare national policy. Development of permanent monitoring of climate systems was supported by the Act on State Hydrological and Meteorological Service issued in 2009. The recent vision and strategy document also reacts to climate change up to 2020.

UKRAINE: There is no National Climate Strategies Document adopted in Ukraine, but in December 1999 the Climate Change Initiative (CCI) established a project management and information centre in Kyiv. The CCI Centre provides information and links to international climate change programs and organisations, and maintains a database of all climate change activities in Ukraine. The CCI focuses on institutional strengthening, development of climate change policy, investment in green house gases mitigation projects, and increased involvement of non-governmental organisations and industry in climate change activities.

Integration of the strategies in the joint programme of measures has not been achieved yet and will be task for the 2nd cycle of the WFD implementation.

8.3. Link between land use management and river basin management

Land uses in the Tisza River Basin include: agriculture, forestry, pastures, nature reserves as well as urbanised areas. Land uses can influence the water quality and water quantity aspects of water related ecosystems. The impacts of land uses can cause nutrient, hazardous substances and organic pollution.

Intensive agriculture is still practiced in the Pannonian Plain, which includes both the Middle and Lower Tisza regions. This has been made possible after many rivers were canalised for irrigation purpose, and wetlands were drained, resulting in repeated severe flood damage in the Hungarian part of the Tisza Basin. This has also led to an increase in soil pollution and erosion, a loss of the absorptive capacity during floods, additional agricultural runoff and surface and groundwater pollution. Flora and fauna diversity are also affected by the disconnection and drainage of floodplains along the Tisza and its tributaries. The situation is exacerbated by the use of agrochemicals, which run off into rivers and groundwater bodies.[50]

Forest logging is one of the main economic activities in the uplands of the basin. The TAR describes that forest logging activities can have a significant influence during flood periods. Moreover soil erosion and related pollution is also relevant concerns in connection to forest management.

Among flood protection measures the significant role of sustainable forest management has also to be taken into account. Cooperation with relevant organisations such as UNEP-Carpathian Convention is a good potential for further investigating in this issue.

The document on '*Flood risk assessment and management strategy for the development of flood action plans in the Tisza River Basin'*[51] highlights the importance of measures related to preventive land uses which can be an important step toward suitable flood risk management and can also influence water quality of rivers and water-related ecosystems. Adequate land-use is a key interlinking factor for flood risk management and river basin management. Those land use patterns which serve to reduce runoff are equally advantageous for the environmental objectives of river basin management since they also contribute to the reduction of diffuse pollution, e.g. nutrient and pesticide input into rivers. In addition to flood mitigation, reactivation of former wetlands and floodplains where feasible can contribute to ecological benefits in the form of maintaining biodiversity, frequent recharging of underground aquifers and the availability of cleaner water.

Inadequate water allocation between economic sectors results in imbalances between water needs and existing water resources. A pragmatic shift is required to change policy-making patterns and to move forward effective land-use planning at the appropriate levels.

Measures listed in this chapter should serve as further messages to land use planners and should be further considered in land development processes. Therefore one of the main elements/objectives of the ITRBM Plan is to facilitate and develop suitable communication between the competent/responsible policy level of river basin/water management planning and land use planning.

The integration chapter focuses on water quantity management pressures and impacts. When visions, management objectives and related measures are outlined, land use management must also be taken into account.

8.4. Visions and management objectives relevant for integration of water quality and quantity management in the Tisza River Basin

For the integration of water quality and water quantity management, the following sectorial planning has to be considered:

- Flood and drought management – taking climate change scenarios into account
- Water demand management – taking climate change scenarios into account
- Regional spatial development/land use management – taking climate change scenarios into account
- Economic planning – alternative economic tools/ecosystem services – taking climate change scenarios into account

Visions and management objectives were outlined considering the sectors listed above. Based on the management objectives, the ITRBM Plan aims to identify measures which will have positive impacts both on water quality and quantity in the Tisza River Basin.

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50 Tisza Analysis Report – 2007 (pp 29.)

51 (version January 2008, chapter 4.2.1. Measures related to preventive land use – included in the Tisza Analysis report as Annex 16) – see references

8.4.1. ICPDR Visions agreed in the ICPDR Tisza Group

- Hydrological alterations are managed in a way to minimise impacts on ecosystem development and distribution.
- Land is managed in such a way that the negative impacts as a consequence of floods and droughts on good water status (e.g. pollution from contaminated sites or agricultural impacts) are minimised.
- Floodplains/wetlands in the entire Tisza River Basin are reconnected and restored. The integrated function of these riverine systems ensures the development of self-sustaining aquatic populations, flood protection and reduction of pollution in the Tisza River Basin.
- Future infrastructure projects are conducted transparently using BEP and BAT in the entire Tisza River Basin. Impacts on or deterioration of the good status and negative transboundary effects are fully prevented, mitigated or compensated.
- Water scarcity is managed in such a way, that water resources are used efficiently, that resource availability, demand and supply is balanced and that water-related ecosystems are not influenced in their natural development and distribution.
- Flood management follows the entire cycle of risk assessment (prevention, protection, mitigation and restoration) and performed in an integrated way to ensure both flood protection and the good status of water bodies.
- The negative effects of the natural phenomena (floods, flash floods, drought, soil erosion) on life, property and human activities as well as on water quality are reduced or mitigated.
- Climate change and its hydrological impacts (droughts, floods and flash floods) are fully addressed in decision-making to ensure the sustainability of ecosystems.

8.4.2. Management objectives

- Ensure that all adverse effects linked to any additional water supply/water quantity infrastructure (like dams or reservoirs) are fully taken into account in the environmental assessments for such infrastructure.
- Protect, conserve and restore wetlands/floodplains to ensure biodiversity, pollution reduction in relation to the achieving of good status in the connected river and flood protection.
- Progress towards a harmonised implementation of the WFD and the Floods Directive.
- Design land-use development measures (e.g. agriculture, future irrigation projects) and overall flood management measures in such a way that they contribute to reaching good ecological status and good ecological potential.
- Put in place water tariffs based on a consistent economic assessment of water uses and water value, with adequate incentives to use water resources efficiently and an adequate contribution of the different water uses to the recovery of the costs of water services, in compliance with WFD requirements.
- Set up appropriate coordinated measures to restore sustainable balance between water resource availability, water demands and supply.
- Set up appropriate coordinated measures to ensure good groundwater quantity.
- Identify climate change impacts at the Tisza Basin-wide scale and assess whether and how these impacts affect the Tisza Programme of Measures and vice versa (e.g. are certain measures effective or can certain measures be considered as no-regret measures in relation to climate change adaptation).

8.5. Measures towards integrated river basin management in the Tisza River Basin

As a general principle of integrated river basin management, measures should only be implemented that will have positive impacts both on water quality and quantity in the Tisza River Basin and minimal negative impacts or neutral impact on the ecosystem or on related sectors. Whilst this may be considered an ideal situation it is important that this ITRBM Plan identify situations where measures can have detrimental impacts and suggest approaches to minimise such impacts by fully considering the integration of water quality and quantity issues together with the needs of society and other sectors. Many such measures have already been implemented within Tisza countries. It is also crucial that integration fully take place at the international level. This chapter gives recommendations for measures which have to be taken to address the most urgent water management issues relevant for both water quality and quantity. These measures have to be further elaborated and implemented in the Tisza Basin.

8.5.1. Horizontal measures related to integration of water quantity and quality

For all issues related to the integration of water quantity and quality issues, there are common elements relevant for measures related to floods and excess water, droughts and water scarcity and climate change.

International coordination: For most measures related to integrated water management, particularly those with a spatial dimension, local action alone is not an option. In most cases the impacts (both positive and negative) will materialise on a larger geographical scale, and even for similar measures in the same basin, it is likely that there are cumulative impacts. Therefore, the international dimension of measures related to integrated water management has to be identified and there should be action to solve the issue in an internationally coordinated way. The ICPDR, particularly the Tisza Group, and the bilateral commissions should play a further role in that. The work under the Carpathian Convention as well as in other relevant international frameworks in the region should also be expanded as much as possible.

The Tisza Group recommends and requests further engagement with the bilateral commissions addressing water management in the Tisza River Basin, specifically by requesting that the issues of the ITRBM Plan is discussed at regular meetings of bilateral commissions ensuring that the ITRBM Plan is a recurring item on meeting agendas.

These measures could be developed within the existing structures of the ICPDR, but additional higher-level political commitment and funds are required to facilitate integration issues at bilateral and Tisza River Basin levels.

Communication and consultation: To identify measures that are integrating different objectives and benefits, it is necessary that the relevant competent authorities are working together from the early stages of development onwards. Therefore, inter-ministerial (and/or inter-sectorial) committees or work groups could be established that prepare decisions and coordinate implementation.

Measures that address multiple benefits of integrated water management often have a spatial dimension. This often means that existing land uses have to change, and that land owners and users have to be involved from the early stages. Communication on the benefits of changing land use, such as less erosion, a higher level of flood protection for a large community, etc, is crucial in preparing such spatial measures.

Once spatial measures have been taken, it is also crucial to train the owners and users, such as farmers and forest owners, on the sustainable management of the area, such as selective logging.

For all the above issues, it is recommended to develop an overall communication strategy for the Tisza Basin specific for integrated water management. This communication strategy (including education and general awareness-raising) should target different levels of authorities, land owners and users. It should also include the aspect of climate change and how climate change could lead to the need for further actions on the long-term. An appropriate communication and consultation strategy should be developed by the Tisza Group with support from the ICPDR's Public Participation Expert Group.

Incentives: Spatial changes are often needed to improve integrated water management. Therefore, appropriate long-term compensation schemes may need to be developed for land owners in the event that their land is used for wider water management purposes, such as flood protection, improving natural values, water retention, etc.

The UNDP/GEF Tisza `Upper Tisza project ` demonstration project ` (See Box 1) was investigating water and land management practices in the Upper Tisza which cause significant flood risk and environmental problems.

BOX 1 - UNDP/GEF Tisza demonstration Project - Upper Tisza Project

Title: Selected measures towards integrated land and water management on Upper Tisza, Ukraine

Problem description: The unsustainable water and land management practices in the Upper Tisza cause significant flood risk and result in organic, nutrient as well as solid waste pollution and have negative impacts on both the environment and the quality of life of the citizens in the transboundary section of the Tisza River in Ukraine and Romania.

Project area: The project included two villages in Ukraine and Romania, separated by the Tisza river– Velyky Bychkiv village in Rakhiv rayon, Zakarpattya Oblast (UA) and Bocicoiu Mare village in Maramureş County (RO)

Main activities of the project: The project was aiming at to identify cost effective practical solutions to the most typical problems of the Upper Tisza region including active cross border cooperation at communal level. The following measures and their implementation were developed in close cooperation with local governments, village councils and regional management units of water and forest sectors:

1. Improvement of communal waste utilization system for Velyky Bychkiv and Bocicoiu Mare is improved
2. Management plan of streams within Velyky Bychkiv with practical measures on flood mitigation and reduction of nutrient and organic pollution is developed and implemented
3. Restoration of riverbed, floodplain and habitat at selected mountainous stream in Ukraine
4. Re opening of water gauging station in Dilove village at the Tisza river
5. Construction and design of waste water facilities for district of Velyky Bychkiv

Lessons learned:

The project involved wide range of stakeholders (environmental scientist, flood experts, waste management expert as well as local citizens) initiating cooperation between the different fields of integrated river basin management and demonstrating in practice the often abstract `terms` of "transboundary river basin management", "ecosystem rehabilitation" as well as "waste management" in relation to river basin management. The project brought solutions in local level with the intention to further disseminate those results and practical solutions in the whole Tisza River Basin.

8.5.2. Measures related to flood and excess water

Flood protection measures

General issues related to the hydromorphological impacts of flood protection are raised in **Chapter 7.1.4**. It is clear that there will be many future infrastructure projects related to flood protection. To be able to define the hydromorphological impacts of future flood protection measures, there is a clear need to get a precise insight into the exact measures that will be taken and their hydraulic and ecological effects on the Tisza Basin scale.

The implementation of the EU Floods Directive will be a major step for getting this better insight, e.g. with the establishment of the preliminary flood risk assessment in 2011 and flood hazard and risk maps in 2013.

Among flood protection measures the significant role of sustainable forest management has also be taken into account. Cooperation with relevant organisations such as UNEP-Carpathian Convention is a good potential for further investigating in this issue.

Space for rivers should be the overarching strategy for sustainable flood protection measures within the Tisza Basin, but it is clear that in some cases, structural solutions like dyke and bank reinforcements are needed to protect urban settlements. Identifying measures that have benefits for both flood protection and nature protection (win-win measures) are part of such 'space for the river' strategies.

Execution of demonstration projects of non-structural measures, and wide dissemination of the results of such projects (for example the UNDP/GEF demonstration project on the Bodrog River) may support implementation of other similar measures along the Tisza.

In case of the UNDP/GEF Tisza `Bodrog ` demonstration project ` (See Box 2) the focus was on flood risk mitigation also setting the target to have environmental benefits from flood management/flood protection measures. Space for rivers should be the overarching strategy for sustainable flood protection measures within the Tisza Basin, but it is clear that in some cases, structural solutions like dyke and bank reinforcements are needed to protect urban settlements. Identifying measures that have benefits for both flood protection and nature protection (win-win measures) are part of such 'space for the river' strategies.

BOX 2- UNDP/GEF Tisza demonstration Project -Bodrog Project

Title: Making space for water in the Bodrog River Basin

Problem description: The Bodrog river sub-basin, which is part of the Tisza catchment area, is frequently affected by major flood events in all countries sharing its territory (in Slovakia, Hungary and Ukraine). In some cases floodplain restoration based flood mitigation and flood protection approaches can have lower investment costs and can be considered as win-win solutions in achieving objectives of the Water Framework Directive. This approaches, however, must be tested. Therefore, the project intended to implement pilot investments to demonstrate advantages of the mentioned approaches.

Project area: Bodrog River Basin by demonstrating practical solutions in three specific areas in Slovakia, Hungary and Ukarine: Viss-Oxbow / Vissi Holtág (HU), Senné depression bisected by the Čierna Voda River (SK), Tova River (UA)

Main activities of the project: The main project objective was to mitigate consequences of floods through achieving consistent and holistic management of flood risk in the Bodrog river basin by implementing the following activities:

1. Formulation of the "*Strategy for mitigation of floods for Bodrog River Basin countries*".

2. Improvement of conditions of original floodplains and wetlands affected by current land uses and environmentally inappropriate flood protection measures

3. Dissemination of project results to achieve replication on national levels and to other basins.

Lessons learned: The interventions of the pilot demonstration projects serves as a good example of floodplain restoration and originates better flood control conditions by creating temporary "space" for water during flood events. In the same time these measures are improving habitat conditions (e.g. water regime) and creating new opportunities in connection to agricultural use. Such "simple" solutions can be implemented in other sub-river basins as well. The stakeholder workshops and meetings enabled to strengthen understanding of linkages between the Bodrog project and the ITRBM Plan. Experiences showed that early involvement of local stakeholders in the design process helped to find consensus among the partners and helped the designer to submit the plan for license in time. Other experiences highlighted, however, that willingness of farmers to cooperate is highly depending on ownership situation and agro-environment subsidies which, in several cases are de-motivating farmers to change arable land to grass land or wetlands.

Reconnection of wetlands and floodplains

As mentioned in **Chapter 7.1.4.3**, there is a large potential for reconnecting former floodplains and wetlands in the Tisza Basin, and some measures have been identified that will be implemented by 2015. However, to increase the surface of reconnected wetlands and floodplains, the following measures need to be elaborated on the short term for the Tisza Basin:

- There is the need to get better insight into the specific benefits of wetlands in the various regions of the Tisza Basin. These benefits could consist of providing ecological services, reducing flood risks, water supply for dryer periods, erosion prevention, soil retention, nutrient reduction, etc.
- Guidelines need to be developed for developing wetlands in the Tisza Basin. These guidelines should include the issue of obtaining land, and costs and benefits of wetlands.
- Experience with pilot projects or demonstration projects should be shared and further pilot projects could be prepared. The results of these projects should be widely disseminated.
- Improving the linkages and integration with planned flood protection measures is needed to ensure that regional and local measures can be implemented with minimal competition between the needs to protect property and lives from flood events with alternative approaches to mitigating peak floods whilst ensuring maximum benefit to the riverine ecosystems.
- Specific guidelines should be developed for cases when wetlands are established on the sustainable management of wetlands.

In case of the UNDP/GEF Tisza `ILD` (See Box 3) demonstration project the focus was on sustainable land use management - reconnection of floodplains/wetlands to have better water resource management of the given territory/agricultural area also setting the target to have benefits of flood management/flood prevention from land use alterations/development.

Restoration of value of natural systems should be ensured and an appropriate long-term compensation schemes should be developed for land owners in the event that their land is used for wider water management purposes, such as flood prevention, improving natural values, water retention, etc.

Based on the ecosystem service approach, the potential benefits of wetlands in the Tisza River Basin should be assessed against the costs of ‘conventional’ flood protection measures and against the costs and ecosystem benefits that can be achieved through floodplains and wetlands.

BOX 3 - UNDP/GEF Tisza demonstration Project - ILD Project

Title: Integrating multiple benefits of wetlands and floodplains into improved trans-boundary management for the Tisza River Basin

Problem description: Since the beginning of the 1990s the Tisza river region suffers from over-fragmentation of parcels and unclear ownership. The problem occurs mostly at rural areas suffering from high flood risk at former floodplains. The lessons learned from the UNDP/GEF Tisza Biodiversity (2005-2008) project highlighted the need for integrated land management – landscape planning, utilization programming, land consolidation, property exchange. The previous works have revealed that any real progress can only be made when water management approaches are fully integrated with a complete paradigm shift in land use practices and patterns, mostly on agricultural land.

Project area: Pilot demonstration are is situated in Nagykörü (HU) and additional possibilities for integrated land development (ILD) were seeking in Romania and Serbia.

Main activities of the project:

1. Elaborating the legal situation related to ILD and provide useful recommendation on base of 5 Tisza country survey;
2. Practical demonstration of ILD at one pilot, to develop further pilots in Serbia and Romania
3. Dissemination of the experience and the lessons

Lessons learned: The ILD demonstration project in Nagykörű provides a comprehensive, system oriented and holistic approach to simultaneously tackle the priority pressures of extreme floods, sustained drought and occasional excess water within the Tisza floodplain. Hydromorphological alterations of the last two or three hundred years prevented the river from building and eroding its own environment in a dynamic equilibrium which allows for ecosystem services to be taken advantage of. Integrated land management and development would offer an alternative water steering regime where the original – and sometimes still functional – morphological features of the now disconnected, inactive ("protected") floodplain could be used to skim floods, mitigate drought and manage stagnating excess surface water within large areas of the Holocene meander belt. Such an alternative, fragmented and diverse land use pattern would offer possibilities to a more resilient agriculture and husbandry scheme including the growing of industrial plants such as reed, hemp or biofuel plantations, boost extensive, free ranging livestock production or woodlots for timber and firewood. Also, the system is expected to adapt more readily to much of the expected climate change scenarios. With appropriate changes, the approach can be used at different stages and under various geographical conditions of the Tisza river basin, as demonstrated by the international partners in the upper catchment section in Romania and in the river flats in Serbia.

Accidental pollution prevention

The ICPDR has successfully implemented and operated an Accidental Pollution Early Warning System (AEWS) that has been recently strengthened in Ukraine. Whilst this system functions and has alerted countries to potential and real incidents, there is a need for continual review of both the risks in the basin and the operation of the AEWS at the Tisza Basin scale.

There is the need to harmonise and update the inventories addressing accidental pollution from mining and other industrial sites in flood risk regions. This update could include an extension of sites that are not only prone to flood risks, but also sites that are vulnerable to the impacts of extreme weather events such as heavy precipitation. Other potential risk sites should also be included where pollutants may have a path to the water course not necessarily linked to flood events.

A next step is then to agree on a common approach to establishing threshold values, agreeing on priorities for measures and concrete targets to manage relevant sites at the Tisza Basin scale. This step should include updating the accident risk spot identification and a harmonised approach to cataloguing.

The actions described above should be supported by dissemination of examples and good practices, which are available within the Tisza Basin, and existing guidelines (e.g. ICPDR checklists and safety requirements for industrial sites, and the UNECE Safety Guidelines and Good Practices for Tailing Management Facilities) need to be widely disseminated and applied.

Solid waste-related measures

Inappropriate disposal of solid waste on river banks is a global issue that is a particular problem in the Upper Tisza River Basin resulting in the need to remove hundreds of tons of waste plastic bottles from the main river per year. Measures ranging from education and awareness, river clean-up actions to installing collection and recycling facilities are available and lessons learned replicated and taken into account.

Practical demonstration projects (funded by the UNDP/GEF Tisza MSP and Coca Cola) addressing solid waste (specifically plastic bottles) are being implemented in Ukraine and Romania to highlight sustainable means to reduce waste deposited on the river floodplains. The expectation is that these demonstration actions will also identify financial options (e.g. selling the waste plastic) to facilitate replication and sustainability of the collection and recycling approaches applicable throughout the Tisza River Basin.

The ICPDR/WWF-DE `Plastic waste` project ` (See Box 4) was focusing on the development of sustainable waste management to reduce pollution from plastic waste in the Upper Tisza River Basin. The project has highlighted the significance of the dialog between separate management sectors (such as water management and waste management sectors) as well as the need of proper public communication process in smaller agglomerations to reach good water status in the overall basin.

BOX 4 - ICPDR/WWF - DE - Plastic waste project

Title: Recycling of plastic waste from Tisza floodplains – Drotyntsi/UA

Problem description: Floating plastic waste from upstream sections in Upper Tisza basin pollute visibly all downstream floodplains during frequent floods, create problems with grazing cattle and even caused complete logging of Tisza and Latorica rivers at the border sections to Hungary and Slovakia. At the communal level in the downstream sections of Tisza river in Ukraine the necessity to act against further pollution is generally agreed but concrete action often lacks initiative and means.

In the frame of the international conference on `*Solid communal waste treatment and preventing transboundary water pollution*`- held in Nyíregyháza (Hungary) on 25th March 2009, participants representing water management authorities/organizations environmental protection authorities, as well as competent territorial authorities and municipalities from Hungary, Romania, Slovakia and Ukraine adopted a conclusion concerning the prevention of the transboundary floating waste during high water events.

The representatives expressed their common interest to support the measures for restraining transboundary floating waste and the implementation of projects and investments serving joint interest.

Project area: Upper Tisza Basin, Drotyntsi (UA)

Main activities of the project:

The project aimed at reduction of plastic waste pollution accumulating after floods on the Tisza river floodplain by clean-up, recycling and awareness building activities.

Lessons learned: The project helped to establish a waste separation system in Drotyntsi village and to mitigate plastic waste pollution and its transboundary effects. However, ensuring long-term yield of plastic and economic viability of plant operation (income by products sold, depreciation, maintenance costs) has to be taken into account when replicating project activities.

8.5.3. Measures related to drought and water scarcity

There is an indication that current water use in the Tisza Basin will increase in the near future, with a very significant increase in water use for irrigation. However, there is a need for better knowledge of the spatial distribution of water use and future demands relevant to the Tisza River Basin. One element is the establishment of common indices to define droughts and to get a better insight of water scarcity across the Tisza Basin. Maps with water scarce areas identified would be a helpful tool and should be developed for the Tisza Basin.

Irrigation and groundwater depletion is a major problem, but more precise information is needed on the future uses.

Possible measures to address these problems are changes in agricultural practices, improving irrigation efficiency, reduction of leakage rates, development of an agreed upon groundwater model to assess depletion, a coordinated approach to water allocation and the application of economic incentives or tools such as water pricing. These measures need to be targeted towards the specific local situation in the Tisza Basin.

In addition, an overview of the methodologies used to establish national minimum ecological flows should be prepared that could lead to agreement on comparable limits and approaches to managing low-flow situations.

To ensure the better management and regulation of groundwater resources, there is a need to establish comparable national approaches to monitor and report groundwater abstraction.

8.5.4. Measures related to climate changes

While there is enough scientific evidence that climate change may pose a significant threat to the environment in the Tisza River Basin, scientific models might never be able to predict accurately changes in precipitation extremes, variability or tipping points. As a first step, better insight into possible impacts of climate change on the Tisza region is needed, initially achievable through a review and analysis of the many previous and ongoing projects that could lead to the need for any future (demonstration) projects addressing the specific needs of the Tisza River Basin.

Another priority is to ensure that future measures implemented in the Tisza River Basin that might have additional negative impacts on water status, are climate-proof or no/low regret measures. Particularly for large infrastructure projects with a long lifetime, possible climate scenarios have to be taken into account.

Another priority is to speed up implementation of some measures of the ITRBM Plan that increase ecosystem resilience. Examples are floodplain restoration to recreate wetlands that can serve as water buffers in times of floods and droughts and fish by-passes that allow fish species to freely adjust their feeding or spawning range when environmental conditions change.

To meet the goal of making the river basin management plans ‘climate-proof/checked’ by 2015 in the Danube as well as Tisza River Basin, the following steps are proposed to be taken within this water management cycle:

- Investigate the effects of climate changes on ecoregions, typologies and reference sites as well as proposals for solutions;
- Ensure that monitoring systems used in the Tisza River Basin have the ability to detect climate change impacts on ecological and chemical water status as well as the effects of climate change adaptation measures;
- Implementation of pilot projects to define practical solutions at the local level for up-scaling to larger regions in the Tisza River Basin;
- Foster the improvement of models (climate and hydrological aspects) and of scenarios for the Tisza River Basin as well as ensure the improvement regarding the presentation on climate fluctuations;
- Investigate the effects of climate change on the various sectors active in the Tisza River Basin and the evaluation of indirect increases in impacts on water status;
- Conduct a climate vulnerability assessment of basin ecosystems;
- Promote and apply methodologies and standards for climate-proofing infrastructure projects and integrating climate considerations into EIA and SEA procedures;
- Enhance the sharing of research information on climate change in the Tisza River Basin;
- Ensure that scientific information is ‘translated’ to water managers;
- Integrate all knowledge, results and lessons learnt related to climate change threats in the next ITRBM Plan;
- Agree on a sustainable Danube Basin Development Strategy that outlines climate-resilient economic development options also highlighting the role of the ongoing activities in the Tisza River Basin with integrated measures outlined in the current plan.

Future management cycles will have to be based on the evaluation of activities and new knowledge gained during the coming five years.

Conclusions

Following the methodology of the ICPDR river basin management process, the key conclusions focus on aspects of water quality management according to the implementation of the EU Water Framework Directive (WFD) at the basin-wide scale. The preparation process of the Integrated Tisza River Basin Management Plan (ITRBM Plan) in connection to status assessment, pressures and joint programme of measures, has been based on the provisions of the WFD Annex 7.

For water quality management, the ITRBM Plan addresses the same significant water management issues (SWMI) as the Danube River Basin Management Plan (organic, nutrient, hazardous substances pollution and hydromorphological alterations) but the assessments are targeted to specific elements for the Tisza.

Additionally, the Tisza Group identified water quantity as a relevant water management issue in the Tisza River Basin, and three issues of concern for the integration of water quality and water quantity are floods and excess water, droughts and water scarcity and climate change. Conclusions on these topics are included in this chapter.

The ITRBM Plan represents a sub-basin plan (B level) based on contribution from all the Tisza countries and assesses the water management issues at a more detailed scale than the Danube RBM Plan[52].

Complementary information on the considerable and important work taking place at the national level can be obtained from the national river basin management plans.

This Plan is based on data provided by September 2010 (reference year 2007) and contributions from all Tisza countries. In specific cases, such as for groundwater monitoring stations, data were uploaded in 2010. Data introduced in this document are based on DanubeGIS information delivered by Ukraine, Romania, Slovakia, Hungary and Serbia.

The ITRBM Plan was introduced to interested parties and stakeholders of the Tisza River Basin with the intention that a final plan will be presented to the ICPDR Heads of Delegation for their endorsement by the end of 2010 and will be adopted by the Ministers of Countries from the Tisza River Basin.

In the below conclusions, it is clear that there are many elements for which further work has to take place. The ICPDR Tisza Group can already follow up with some immediate actions in 2011.

[52] The ITRBM Plan took into account rivers with catchment size larger than 1,000 km^2 instead of 4,000 km^2; natural lakes >10 km^2 instead of 100 km^2; main canals; groundwater bodies >1,000 km^2 and of basin-wide importance. This means that in comparison to the 11 identified transboundary groundwater bodies or groups of Danube Basin-wide importance, the Tisza countries have collected and evaluated information related to 85 groundwater bodies – all the national and transboundary groundwater bodies of importance to the Tisza River Basin.

Pressures assessment

From the updated pressures analysis for **organic, nutrient and hazardous substances pollution**, the following specific conclusions for the Tisza can be drawn:

- The surface water quality in the Tisza River Basin is mainly affected by municipal and industrial pollution, agricultural run-off and accidental pollution.
- The major cause of organic pollution is insufficient or lack of treatment of wastewaters discharged by agglomerations, industrial and agriculture point sources.
- Hazardous substances from mining cause a significant pressure due to existing abandoned tailing deposits and the accidental pollution risk from the operational mines. The significance of accidental pollution due to mining is much higher in the Tisza River Basin as compared with the Danube River Basin.
- The level of treatment of urban wastewater is relatively low, and more than half of existing agglomerations in the Tisza River Basin lack collection and treatment of wastewater.
- There are 894 agglomerations (3.9 million PE) in the 2,000 -10,000 PE class and 194 agglomerations can be classified with PE >10,000 (8.5 million PE). There is still a high number of agglomerations ≥2,000 PE that are neither connected to a sewage collecting system nor to a wastewater treatment plant. In total, wastewater is not collected at all in more than 590 agglomerations.
- Intensive agriculture is still practiced in the Middle and Lower Tisza regions. This has also led to an increase in soil pollution, erosion and agricultural run-off which has contributed to surface and groundwater pollution.

From the updated pressures analysis for **hydromorphological alterations,** the following specific conclusions for the Tisza can be drawn:

- The key driving forces causing river and habitat continuity interruption in the Tisza River Basin are mainly water supply and flood protection.
- As of 2009, 199 continuity interruptions remain a hindrance for fish migration in the Tisza River Basin.
- Until the middle of 19^{th} century, the Tisza and its tributaries repeatedly inundated some of 26,000 km^2 along their courses in the lowland. Compared to the 19^{th} century small proportion of the former floodplains, wetlands remain in the entire Tisza River Basin.
- The main pressure types in the Tisza River Basin causing hydrological alterations are impoundments, as found on the Danube River Basin level.
- In the Tisza River Basin, the key water use causing significant alterations through water abstractions is mainly agriculture, forestry and fishing, while in the Danube River Basin it is hydropower generation.
- The main purpose of future infrastructure projects in the Tisza River Basin is flood protection (91%). In the Danube River Basin the main purpose of future infrastructure projects is navigation (57%), and only 28% relate to flood protection. No future infrastructure projects were indicated in the Tisza River Basin related to navigation purposes.
- It should be highlighted that the Tisza River and its tributaries in the upper section of the basin are free of dams and other considerable human impacts, contributing to the survival of natural assets, which are unique in Europe.

From the updated pressures analysis for **groundwater bodies**, the following specific conclusions for the Tisza can be drawn in comparison to the Danube Basin level:

- The main reasons for pollution in the Tisza River Basin are similar to the Danube River Basin, though with the addition of mine water discharges as well as with quantity issues such as over-abstraction.
- Illegal water abstraction and indirect abstraction by drainage may be a significant and specific problem in the Tisza River Basin.

Status assessment

- Based on the DanubeGIS data, approximately 39% of the river water bodies reached good or better ecological status or ecological potential and around 44% have moderate or worse ecological status or ecological potential in the Tisza River Basin. Out of 223 river water bodies, 107 (48%) reached good chemical status and 43 (19%) fail to reach good chemical status. The chemical status is unknown for 73 (33%) river water bodies.
- The results of chemical status assessment show that out of 85 groundwater bodies of basin-wide importance, good chemical status was observed in 74 water bodies (87%). Out of this number, there are 49 transboundary and 25 national groundwater bodies. Eight groundwater bodies have poor chemical status. There are no data about chemical status for three groundwater bodies from Ukraine.
- The results of quantitative status assessment show that out of 85 groundwater bodies of basin-wide importance, good quantitative status was observed in 63 water bodies (74%), out of which 39 are transboundary and 24 national groundwater bodies. Poor quantitative status was observed in 19 groundwater bodies (7 national and 12 transboundary). There is no data on quantitative status for three groundwater bodies from Ukraine.
- To enable meaningful assessments of status in time and space, a three-level confidence assessment system was agreed upon for water bodies regarding both ecological and chemical status.
- Regarding the confidence of the ecological status assessment, almost all Tisza countries reported some cases of a preliminary assessment using the risk assessment data or insufficient monitoring data requiring further investigations and/or monitoring.
- The percentage of surface water bodies designated a heavily modified water body (HMWB) in the Tisza River Basin is 34%. This is less in comparison with the Danube River Basin (where it is 40%), but still significant. Approximately 36% of the Tisza River water bodies are designated as HMWB or provisional HMWB (for the Danube River, approximately 57% of the water bodies are designated HMWB or provisional HMWB).
- The assessment of the ecological status according to the WFD was a challenge for all EU Tisza Countries, and there are still several gaps and uncertainties to be dealt with in the future. There are also significant data gaps for chemical status.
- Conclusions identified for status assessment in the Tisza River Basin scale are in line with the those of Danube River Basin:
    - The status assessment of water bodies is not yet directly linked to the measures and the effects of the measures at the basin-wide scale. Additional work is required to better understand the linkage between the effects of the measures and the water status.
    - The assessment of biological quality elements will be further improved to enable complete intercalibration as well as assessment of the ecological status and potential.

Organic pollution

- The reduction of BOD and COD in all calculated future scenarios is significantly higher than for the Danube River Basin as many agglomerations will have constructed secondary treatment. In addition, the effect of the implementation of urban wastewater treatment measures is more visible on a smaller scale in the Tisza River Basin than for the Danube River Basin.

Nutrient pollution

- Reducing emissions from urban systems has a strong reduction potential particularly for phosphorus, but it very much depends on the specific situation in the countries. Connecting remote villages to wastewater treatment plants is very cost intensive and may require a long time before these households can be connected to a central system. For the coming years decentralised systems seem to be more favourable and faster to be implemented.

- Taking the baseline scenario for nutrients in 2015 at the outlet of the Tisza River Basin, the Total Nitrogen loads would be reduced by 12% and the Total Phosphorus loads by 26%.
- As in the Danube River Basin, the reduction goals for TN will probably not been met for the Tisza River Basin. The Baseline Scenario-Agriculture 2015 shows only a very limited potential to reduce the TN emissions, as agricultural practices are expected to intensify moderately for some countries.
- According to the other agricultural scenarios (Agricultural Scenario-Nutrients 1 2015 and Agricultural Scenario-Nutrients 2 2015) there is a strong potential for an increase of TN emissions from agriculture. This could finally also lead to an overall increase of TN emissions in Tisza River Basin.
- The reduction goals for phosphorus could be reached by implementing the phosphate ban alone. This relatively cost effective and easily implemented measure could be one of the first solutions to be realised. Although the Tisza River Basin countries would reach reduction goals, it would be necessary to implement other measures, *especially* the improvement of wastewater treatment in order to reach the reductions goals for the Danube River Basin.
- Regarding the effects of wetland reconnection in the Tisza River Basin, further work is needed on nutrient reduction.

Hazardous substances pollution

- Considering the high environmental significance of pollution due to accidents, especially in the mining areas, the relevance of preventive measures is much higher in the Tisza Basin than in the Danube Basin. Special attention is needed to update accidental risk spots inventories, including industrial sites, on-going mining activities and solid waste disposal and abandoned tailing deposits.
- There is a need to investigate options for emergency management procedures in relation to accidental pollution events in a transboundary context (such as mutual assistance and contingency planning).

Hydromorphological alterations

River and habitat continuity interruption

- By 2015, measures will be implemented to improve river continuity for 39 river continuity interruptions. For another 84 barriers, measures will be implemented after 2015. No measures were indicated for 76 interruptions. The numbers indicate that most restoration measures will not be taken until the second and third WFD cycle (2021 or 2027).
- Consequently 160 interruptions of river continuity will remain impassable for fish migration by 2015 and good ecological status and good ecological potential may not be ensured.
- For river and habitat continuity interruption, the WFD environmental objectives on the basin-wide scale will not be achieved by 2015 but further work is needed to achieve these objectives after 2015 in the Tisza River Basin.

Disconnection of adjacent floodplains/wetlands

- In the Tisza River Basin, 17,306 ha of wetland areas were identified in 2009 with the potential for reconnection. By 2015, 2,651 ha are expected to be reconnected to the Tisza Rivers and according to the application of WFD Article 4(4), 10 wetlands (1,662 ha) will be reconnected in Slovakia after 2015. An additional 12,993 ha are expected to be reconnected to the Tisza Rivers in Ukraine by 2021.
- It is important to emphasise that measures related to wetlands (e.g. wetlands reconnection) can be considered as an integrated measure with positive impacts on flood risk mitigation, land use management and on other water quantity aspects of the basin.
- Compared to the Danube River Basin, the Tisza countries have more potential to 'give space to the rivers', thus restoring unique environments. Parameters such as water discharges, water quality, land uses or economic needs have to be taken into account during the planning process for reconnecting floodplains/wetlands.

Restoration of hydrological alterations

- Of the total 76 impoundments, no measures are indicated for 30 cases, and 26 impoundments are subject to exemption according to WFD Article 4(4). Improvements are expected for 20 impoundments by 2015.
- Conclusions from the Danube River Basin also apply for the Tisza River Basin:
    - Measures will be taken to improve the ecological status of water bodies impacted by significant hydrological alterations on the basin-wide scale.
    - A part of the significant pressures will be reduced as a consequence of measures implemented by 2015, but a larger part will only be addressed by 2021 or 2027.
    - Although data gaps on hydrological alterations still exist, it is quite likely that more measures need to be taken to ensure the achievement of WFD environmental objectives, taking into account eventual future effects of climate changes and related adaptation measures.

Future infrastructure projects

- Some 91% of future infrastructure projects in the Tisza River Basin are intended to improve the flood protection in the Tisza countries (mainly in Hungary). Some of the future infrastructure projects are subject to an assessment according to WFD Article 4(7) and/or Strategic Environmental Assessment/Environmental Impact Assessment. In comparison to the Danube River Basin where the future infrastructure projects are mainly focused on navigation, flood protection is a significant issue in the Tisza River Basin and harmonisation of the flood protection measures with the needs of the WFD has to be taken into account.

Groundwater

Groundwater quality

- Results of the status assessment clearly show that contamination by nitrate and ammonium from diffuse sources is the main reason for the poor status of groundwater bodies in the Tisza River Basin.
- The basic measures listed in WFD Annex VI Part A, are key instruments in achieving good chemical status and reversing any significant and sustained upward trends in the concentrations of nitrates in groundwater in the Tisza River Basin.
- In specific cases (for example in urban areas), supplementary measures such as management of urban run-off and control of diffuse pollution in urban areas must be implemented, in addition to basic measures.
- To prevent pollution of groundwater bodies by hazardous substances from point source discharges liable to cause pollution, an effective regulatory framework has to be put in place prohibiting direct discharge of pollutants into groundwater and setting all necessary measures required to prevent significant losses of pollutants from technical installations. It is also necessary to prevent and/or reduce the impact of accidental pollution incidents.

Groundwater quantity

- Most measures addressing poor quantitative status of groundwater bodies in the Tisza River Basin are based on implementation of appropriate controls of the abstraction of fresh surface water and groundwater and impoundment of fresh surface waters including a register or registers of water abstractions.
- Additionally, other measures such as a change in drainage system, cessation of illegal abstractions and the use of crops with low water demand, as well as the application of water-saving irrigation technology should also be applied in order to improve the water balance.
- Slow and insufficiently recharging deep aquifers in some parts of Tisza River Basin, followed by several decades of intensive public water supply, have resulted in over-abstraction. Sustainable solutions for future water supply in such cases include measures on investigations for alternative water sources.

Integration of water quality and quantity

In the Tisza River Basin it was identified that A) Flood and excess water, B) Drought and water scarcity as well as C) Climate changes can play an important role reaching good water status in the Tisza River Basin. Integration of water quality and water quantity aspects therefore has crucial importance in the Tisza River Basin. The role of spatial development – especially land use management – agriculture and forestry has to be integrated in such an integration process.

Priority pressures and impacts were identified in connection to integrating water quality and water quantity in the Tisza River Basin. These pressures and impacts play a role in two or more Tisza countries:

- Hydromorphological pressures from flood protection measures
- Accidental pollution due to flooding
- Loss of wetlands
- Solid waste
- Groundwater depletion because of over-abstraction
- Increased irrigation and related surface water abstraction
- Impacts of climate change on low water flow

Since there are common elements which are relevant for measures related to floods and excess water, droughts and water scarcity and climate change, the following horizontal measures were identified relevant to the three water quantity issues:

- International coordination
- Communication and consultation (including education and awareness-raising)
- Incentives (e.g. related to land uses)

Flood and excess water

Measures leading to hydromorphological pressures

- Some 91% of future infrastructure projects are intended to improve the flood protection systems in the countries in the Tisza River Basin. Some of the future infrastructure projects are subject to an assessment according to WFD Article 4(7) and/or Strategic Environmental Assessment/Environmental Impact Assessment. The proposed measures aim to reduce flood damage and risk, however realising these types of measures often leads to severe hydromorphological impacts. It is recommended that these possible pressures are taken into consideration in further elaboration and mitigated through appropriate or adapted measures.
- Some tributaries, and the Tisza River itself, in the upper section of the basin run free of dams and other significant human impacts, contributing to the values of these natural assets which are considered unique in Europe. Conservation of these natural assets is of common interest and the implementation of future infrastructure projects has to be managed in such a way to preserve these natural assets.
- The implementation of the EU Floods Directive will provide better insight to the threats and pressures from hydromorphological facilities, such as through the preparation of flood-risk maps for the Tisza River Basin in 2013.
- Demonstration projects of non-structural measures, such as the concept of 'making space for rivers' (e.g. UNDP/GEF Tisza Project in the Bodrog basin[53] and ILD project[54]), will help to illustrate both the environmental benefits and economic benefits of such approaches whilst still achieving the overall objectives of reducing the detrimental impacts of floods.

Wetland related measures

- The Tisza River Basin has lost most of its former wetlands through flood protection schemes and other hydromorphological interventions. There is a potential to restore former wetlands and floodplains to provide multiple benefits to the riverine ecosystem by buffering to floods waters, retaining nutrients and recharging groundwater.

[53] Making Space for Water in the Bodrog River Basin (Hungary, Slovakia, Ukraine)

[54] Integrated land development (ILD) programme to improve land use and water management efficiency in the Tisza Basin

- By 2015, 2,651 ha wetland areas are expected to be reconnected to the Tisza Rivers. According to the application of WFD Article 4(4), 10 wetlands (1,662 ha) will be reconnected in Slovakia after 2015 and an additional 12,993 ha are expected to be reconnected to Ukraine by 2021 within the second and third river basin management cycles (2021 or 2027). The measures in Ukraine are mainly for flood protection in the Upper Tisza. Further possibilities to 'give space to the river' and reconnect wetlands should be considered.
- Guidelines should be developed for future wetland restoration and reconnection programmes throughout the Tisza River Basin. These guidelines should address both the technical issues associated with sustainable management of wetlands functions and the issues of land ownership, as well as address public concerns on alternative approaches to flood mitigation while raising awareness of the full range of benefits that are attributed to wetlands.
- Based on the ecosystem service approach, the potential benefits of wetlands in the Tisza River Basin should be assessed against the costs of 'conventional' flood protection measures and against the costs and ecosystem benefits that can be achieved through floodplains and wetlands.
- Experiences from pilot or demonstration projects should be widely shared and the lessons from these disseminated.

Accidental pollution related measures

- Recent severe floods have highlighted the problem of the inundation of landfills, dump sites and storage facilities where harmful substances are deposited and toxic substances can be transferred into the water posing a clear threat to the environment. Such potential threats were recognised by the ICPDR (accidental risk spots inventory), and an inventory of old contaminated sites in potentially flooded areas in the Danube River Basin was compiled in 2002-2003.
- Accidental pollution due to flooding was identified as an important issue in most of the Tisza countries, except Slovakia and Serbia. Accidental pollution can originate from operating industrial facilities, but also as pollution from sites contaminated by former industrial activities or waste disposal.
- The existing inventories should be updated to reflect both the remediation that has taken place (especially at old mines in Romania) and to ensure all significant sites (both within and outside flood-risk regions) are documented. Initial steps to update the inventories of accident risk spots include a common approach to establishing threshold values, agreeing priorities for measures and concrete targets.
- The ICPDR Tisza Group should identify and support the dissemination of examples of good practices from within the Tisza River Basin (and more widely) and assist in ensuring that these are applied as required.

Solid waste related measures

- Despite national regulations, solid waste remains a problem in the Tisza River Basin, mainly due to illegal waste disposal in the mountainous area in the Upper Tisza Basin.
- A range of measures to address the sources of the solid waste problems (specifically plastic bottles) is being tested e.g. under the UNDP/GEF Tisza MSP and the ICPDR/Coca Cola support in Ukraine with the active support of local authorities. These measures range from education and awareness-raising on the appropriate disposal of plastic bottles to provision of collection and recycling activities that will potentially lead to an income stream to assist with sustainability. The lessons learned will be applicable throughout the Tisza River Basin.

Drought and water scarcity

Overall management of drought in the Tisza River Basin

- Water demand is expected to increase in the near future (the analysis report estimated that consumptive use will nearly double by 2015 in comparison to 2007, mainly due to the significant increase of irrigation).
- Although appropriate abstraction controls, registers of water abstractions, change in drainage system, cessation of illegal abstractions, use of crops with low water demand and as well as application of water-saving irrigation technology are effective measures, it is not known to what extent these will be applied throughout the Tisza River Basin to solve over-abstraction. These measures need to be targeted towards specific local situations within the basin.

- There is a need for better knowledge of the spatial distribution of use and future demands. This knowledge, supported by a need for the development of common indices to define droughts and water scarcity resulting in appropriate maps, will enable better planning and management of limited resources. Special attention should also be given to the equitable allocation of water resources in a transboundary context.
- Irrigation and groundwater depletion are major problems but more information is needed. Specifically there is a need to establish comparable national approaches to monitor and record groundwater abstractions.
- An overview of the methodologies used to establish national minimum ecological flows should also be undertaken that could lead to comparable limits and approaches to managing low-flow situations in a transboundary context.

Water pricing and irrigation related measures

- In the future, a significant increase can be expected in most of the Tisza countries in the irrigated area and related amount of water (average water quantity annually used for irrigation (m3 per ha), average total water quantities annually used for irrigation (106 m^3) and consumption uses).
- A sustainable balance needs to be established between water resources availability and water demands, and that water pricing policies are one option to provide adequate incentives to use water resources efficiently.

Climate changes

- Currently, studies are being done to predict the possible impacts of climate change in the Tisza River Basin.
- However, it is already estimated that in the long term extreme events such as floods and droughts will likely occur more frequently and with greater intensity. The impacts on low water flow may be particularly problematic.
- A healthy aquatic ecosystem is more resilient to climate change impacts, and working towards more resilient ecosystems is a 'no-regret' measure. In addition, long-term, costly infrastructure works could be developed with different climate scenarios in mind. In the future it will be crucial to follow-up on the ongoing results of scientific projects related to possible climate changes in the Tisza River Basin and to identify adaptive measures considering specific phenomenon of the area (such as flood and drought and its impacts on climate changes)

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