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Report on significant pressures relevant for the Tisza River Basin

Deliverable 3.2.1 Report on significant pressures relevant for the TRB

Version Final,
Date August 2018

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

Interreg
Danube Transnational Programme
JOINTISZA

Acknowledgements

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Disclaimer

This Report is based on data delivered by the Tisza River Basin countries as of July 2018. Data were incorporated in to the Danube GIS database as well as into questionnaires send out in December 2017.

Sources other than project partners have been clearly identified in this report.

This report has been elaborated in line with the methodology for the Danube River Basin Management Plan – Update 2015. A more detail level of information is presented in the national river basin management plans in the Tisza River Basin countries.

Data in this report has been dealt with, and is presented, to the best of our knowledge. Nevertheless, cannot be ruled out.

Contents

Chapter 1 Role of Significant Water Management Issues

The Significant Water Management Issues represent the key issues of the water environment which consider DPSIR framework (Driving forces-Pressures-State-Impact-response), those pressures which determine the risk of failure to achieve the environmental objectives of the EU Water Framework Directive. Issues may arise from:

- On-going human activity (e.g. farming, industry);
- Historic human activity and natural background);
- New development (e.g. future infrastructure projects).

Four Significant Water Management Issues (SWMI) have been identified for the Tisza River Basin, in the ITRBMP (2011) as well as in DRBMP (2015) which can directly or indirectly affect the status of surface water bodies:

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

Those SWMIs were included also into the national RBMPs of the Tisza River Basin countries.
Additional relevant issues in the Tisza River Basin are:

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

The role of SWMIs can be defined on two levels:

- 1st - The collection and processing the actual information for evaluation of pressures from urban agglomerations, industry, agriculture and hydromorphological pressures for each significant management issue. The assessment of organic, nutrient and hazardous substances pollution and hydromorphological pressures assessment follow the similar approach as in the case of Danube River Basin Management Plan – Update 2015. The evolution between the first and second cycles of river basin management planning is assessed.
- 2nd - Evaluation of the SWMIs and proposal of effective measures with respect to expected development in the future: State of the SWMIs and their previous development, described in the report of an Activity 3.2, as well the status assessment in the report of Activity 3.1, with regard to information from national programmes of measures serve as base for selection of measures and their prioritization. Estimation of development SWMIs in the future is considered. The Joint Programme of Measures is structured according to the SWMIs under the activity 3.5.1 of the JOINTISZA Project.

This report addresses each of the significant pressures on surface waters issues and includes revised information since the 1st ITRBM Plan. As it was previously mentioned the organic, nutrient and hazardous substances pollution and hydromorphological pressures assessment are following the similar approach as in the case of Danube River Basin Management Plan. The evolution between the first and second cycles of river basin management planning is assessed. The share of individual sources/sectors and pathways (if relevant) is estimated via modelling, using the same models used in the elaboration of the Danube RBM Plan in the frame of the ICPDR.

Some activities with only local effects are not discussed in this report and are subject to National Reports. Further, the country specific emissions regarding organic, nutrient and hazardous substance pollution in this report and hydromorphological alteration should in general be seen in relation to the respective countries share in the TRB.

Chapter 2 Significant pressures

2.1 Surface waters - rivers

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' sharing 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 of the Tisza River with catchment areas larger than 1,000 km^2.

For the development of the ITRBM Plan update, the pressure assessment followed a similar approach and methodology as for the Danube River Basin Management Plan update 2015. When addressing pressures on the TRB at the basin-wide scale, it is clear that cumulative effects may occur and this the reason why the basin-wide perspective is needed. Effects can occur both in downstream direction (e.g. pollutant concentrations) and/or a downstream to upstream direction (e.g. river continuity). Addressing these issues effectively requires a basin-wide perspective and cooperation between the countries.

2.1.1 Organic pollution

Key findings and progress

At the basin scale, the urban waste water sector generates about 19,750 tons per year BOD and 46,000 tons per year COD discharges into the surface water bodies of the Tisza Basin (reference year: 2011/2012). The direct industrial emissions of organic substances total up to ca. 2,000 tons per year COD for the reference year (2012). This means overall COD emissions of approximately 48,000 tons per year, out of which 96% are released by the urban waste water sector. 22% of the BOD surface water emissions via urban waste water stem from agglomerations with existing sewer systems but without treatment. Taking into account that these agglomerations represent only 3% of the total PE of the basin, implementation of measures for a relatively small proportion of the agglomerations can result in substantial progress. However, about 40% of the agglomerations (representing 26% of the PE) have no collection systems which should be constructed together with appropriate treatment in the future.

The assessment of the 1st ITRMP showed that 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. The COD and BOD emissions to the environment (water and soil) from agglomerations (≥2,000 PE) in the Tisza River Basin were 230 kt/y and 129 kt/y respectively (reference year 2005/2006).
Due to significantly differed basic data concerning number of agglomerations in the basin it is problematic to compare those data with actual figures presented based on data reported by the Tisza River countries (reference year: 2011/2012), since the differences concerning the number of agglomerations present 103 agglomerations more assessed in previous plan. Therefore, achieved progress is difficult to be quantified.

In spite of that it is possible to conclude that since the reference year 2011/2012 important progress were made after 2015 regarding the improvement of the level for urban waste water treatment in agglomerations with more than 2,000 PE in the TRB countries mainly in the EU MS countries.

The major cause of organic pollution (non-toxic organic substances) is insufficient or lack of treatment of wastewaters discharged by municipalities, industrial point sources and partly also agricultural point sources (animal breeding farms, manure depots, etc.). The primary impact of organic pollution on the aquatic environment is the influence on the dissolved oxygen balance of the water bodies. Significant oxygen depletion can be experienced downstream of pollution sources mainly due to biochemical decomposition of organic matter. Microorganisms consume oxygen available in the water bodies for the breakdown of organic compounds to simple molecules. However, dissolved oxygen concentrations are increasing again once the oxygen enrichment rate via diffusion from the atmosphere and photosynthesis ensured by algae and macrophytes is higher compared to the consumption rate.

In the most severe cases of oxygen depletion anaerobic conditions might occur, to which only some specific organism can accommodate. Additional impacts of anaerobic conditions could be the formation of methane and hydrogen sulphide gases and dissolution of some toxic elements. Organic pollution can be associated with the health hazard due to possible microbiological contamination. The usual indicators of organic pollution are biochemical oxygen demand (BOD), chemical oxygen demand (COD), total organic carbon, Kjeldahl-nitrogen (organic and ammonium-nitrogen) and coliform bacteria. Usually, secondary (biological) waste water treatment and runoff management practices provide adequate solutions to the organic pollution problem.

Diffuse organic pollution is less relevant in comparison to that of point sources and related to polluted surface run-off from agricultural fields (manure application and storage) and urban areas (e.g. litter scattering, gardens, animal wastes). A specific case of diffuse organic pollution is the emission from combined sewer overflows that represent a mixture of polluted run-off water and untreated waste water. Background emissions of organic substances are related to sediment input arising from soil erosion, surface run-off from naturally covered land and groundwater flow.

The pressure assessment for point and diffuse source pollution in the TRB follows the same approach as for the development of the DRBMP (2015). Significant water pollution problems still persist at present throughout a large part of the basin despite ongoing implementation of EU and national policies in most of the Tisza River Basin countries[1].

2.1.1.1 Organic pollution from urban waste water

One fraction of the anthropogenic pressures is wastewater emissions from municipal sources that include significant loads of organic pollutants: BOD5 (5-day biochemical oxygen demand) and COD (chemical oxygen demand) and nutrients (nitrogen (N) and phosphorus (P)).

Based on reporting of the TRB countries on the status of waste water treatment (for the EU MS this is in line with the obligatory data submission for the reference year 2011/2012 to the European Commission under the Urban Waste Water Treatment Directive, UWWTD) there are 985 agglomerations with a population equivalent (PE, the ratio of the total daily amount of BOD produced in an agglomeration to the amount generated by one person per day) more than 2,000 PE in the basin (Table II.1, II.2 and Map II.1). Urban waste water load presents **11,568,886 PE.** 783 of these agglomerations are small-sized settlements having a PE between 2,000 and 10,000, 185 are middle-sized agglomerations (between 10,000 and 100,000 PE) whilst only 17 have a PE higher than 100,000.

[1] ICPDR: The Danube River Basin District Management Plan –Update 2015 *http://www.icpdr.org/main/sites/default/files/nodes/documents/drbmp-update2015.pdf*

Table II. 1: Number of agglomerations in the Tisza River Basin

Size class (PE)	Ukraine	Romania	Slovakia	Hungary	Serbia	Total
2000 - 10,000	147	371	70	146	49	**783**
10,000 - 100,000	7	54	17	88	19	**185**
> 100,000	1	8	1	6	1	**17**
Total	**155**	**433**	**88**	**240**	**69**	**985**

Source: ICPDR database

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

Size class (PE)	Ukraine	Romania	Slovakia	Hungary	Serbia	Total
2000 - 10,000	581,800	1,419,159	279,233	798,129	232,906	**3,311,227**
10,000 - 100,000	209,554	1,369,144	487,147	2,141,366	445,713	**4,652,924**
> 100,000	115,947	1,759,730	155,000	1,422,040	152,018	**3,604,735**
Total	**907,301**	**4,548,033**	**921,380**	**4,361,535**	**830,637**	**11,568,886**

Source: ICPDR database

The proportion of the agglomerations without appropriate collection system is still relatively high 40% (394 agglomerations). These are mainly small-sized settlements between 2,000 and 10,000 PE. Seven percent of the agglomerations have constructed public sewerage but are not connected to urban waste water treatment plants at all. At additional 7% of the agglomerations waste water collection is addressed by individual and other appropriate systems where waste water is collected in appropriate storage tanks and then transported to treatment plants or treated locally. On basin-wide level, 53% (521) of the agglomerations with higher than 2,000 PE have connection to operating waste water treatment plants (tertiary, secondary, primary treatment and the treatment addressed through individual and other appropriate systems).

Regarding the treatment stages 3% of the agglomerations are only served by primary (mechanical) treatment. The proportion of the secondary (biological) treatment is 25%. At 17% of the settlements waste water undergoes tertiary treatment aiming to remove nutrients besides organic matter see Table II.3.

Table II.3: Number of agglomerations and generated urban waste water loads in the Tisza River Basin

Type of collection and treatment system*	Proportion of the connected PE	Number of agglomerations	Urban waste water load (PE)
Collected and tertiary treatment	≥80%	77	3,302,211
	<80%	94	1,144,758
Collected and secondary treatment	≥80%	62	2,340,617
	<80%	186	2,174,133
Collected and primary treatment	≥80%	4	44,483
	<80%	29	282,757
Addressed through individual and other appropriate systems	≥80%	18	60,881
	<80%	51	189,983
Collected and no treatment	≥80%	1	71,547
	<80%	69	479,370
Not collected and not treated	100%	394	1,478,146
Total		**985**	**11,568,886**

**Categorisation is based on the highest technologic level that is available for the agglomeration*

Share of the collection and treatment stages in agglomerations more than 100,000 PE in the TRB is presented in Figure III.1. Out of 17 agglomerations in 9 agglomerations waste water partially undergoes tertiary treatment aiming to remove nutrients but only in one agglomeration is fully implemented tertiary treatment aiming to remove nutrients for all amount of produced waste water. In one case is ensured the Nitrogen removal. Secondary treatment of waste water is partially used in 7 agglomerations, in one case all produced water are treated. There are 5 agglomerations with some portion of waste water addressed through individual and other appropriate systems and 10 agglomerations with some portion of waste water without collection and treatment in UWWT.

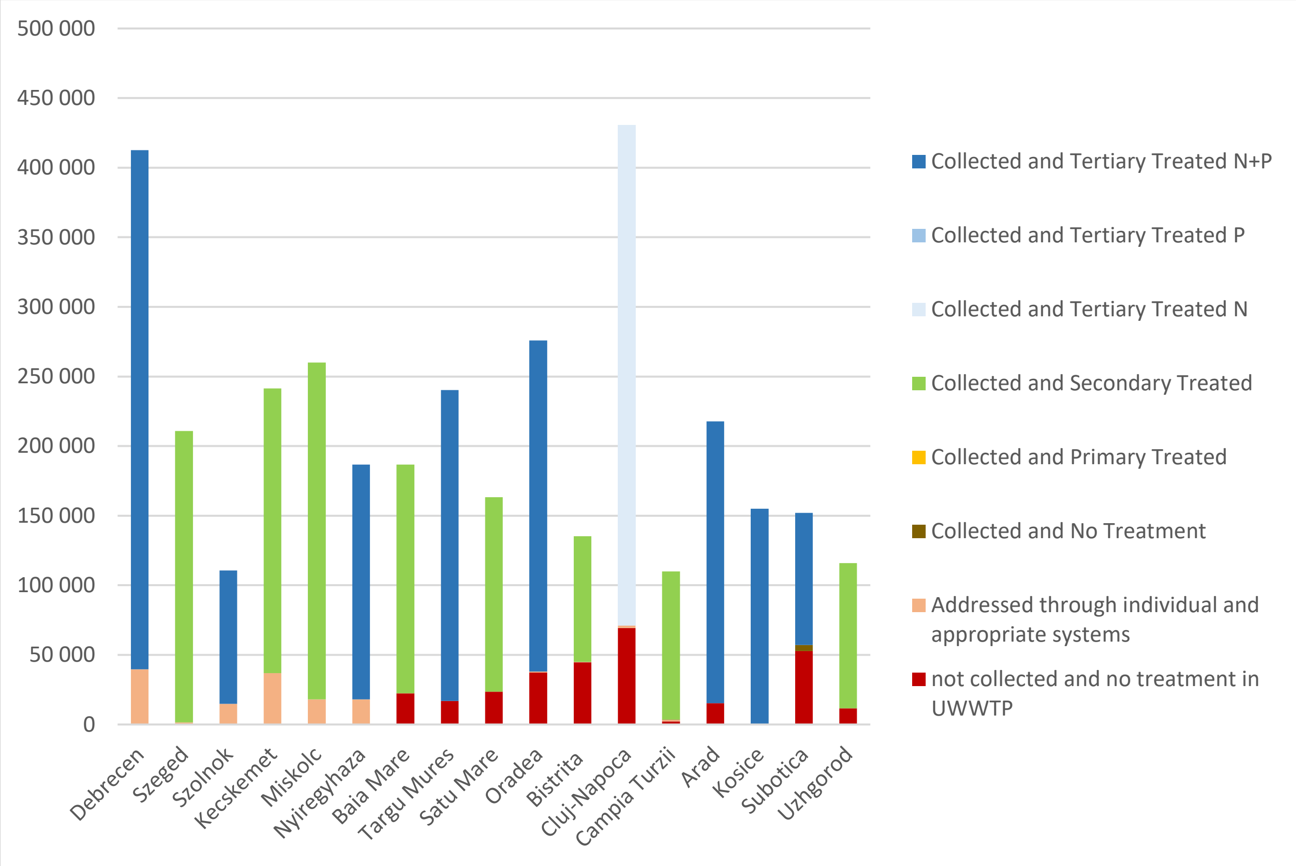

Figure II.1 Agglomerations ≥ 100,000 PE in Tisza Basin

In total, a waste water load of about 11.5 million PE is generated in the basin. Despite the high number (783) of small agglomerations (2,000 – 10,000 p.e.), they contribute only about 29% to the total loads (p.e.), whilst middle-sized agglomerations (agglomeration with 10,000 – 100,000 p.e.) produce about 40% and 31% of the generated total waste water load stems from the big agglomerations with more than 100,000 p.e.; this indicates the necessity to install appropriate treatment technologies in these cities.
The distribution of the agglomerations according to their size and connection rates to collecting systems and treatment plants clearly influences that of the generated loads. Only 26% of the generated loads arise from agglomerations having no sewerage. Additional 3% can be linked to collection systems without treatment, whilst 10% of the total loads are addressed through individual systems. The majority (61%) of the loads are conveyed via sewers to urban waste water treatment plants. The loads are mainly transported to either secondary (28%) or tertiary (32%) phases and only one percent of the loads are transported to primary treatment, (Figure II.2 and II.3).

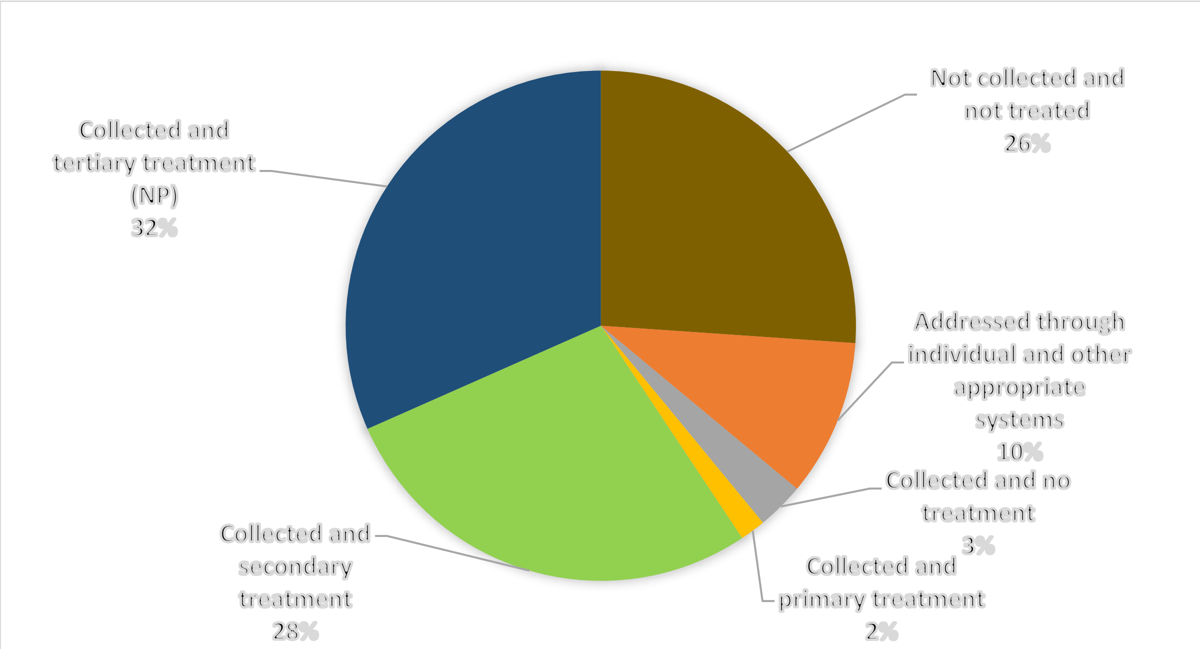

Figure II.2: Share of the collection and treatment stages in the total population equivalents in the Tisza River Basin (reference year: 2011/2012)

Country contributions to the basin-wide generated loads are presented in Figure II.3.

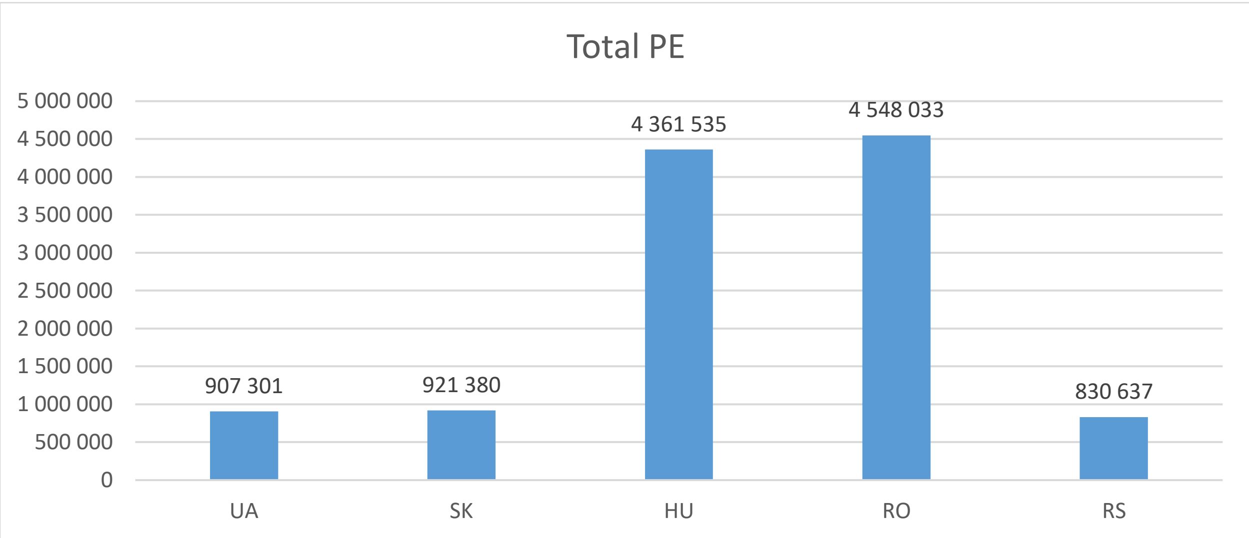

Figure II.3 Generated waste water load of the Tisza River Basin countries (expressed in population equivalents, reference year: 2011/2012)

Proportions of the connection of generated urban waste water load (PE) to the collection systems and treatment stages are presented in Figure II.4. Collection and treatment of waste water are in an enhanced status in Slovakia and Hungary whilst significant proportions of the generated loads are not collected or collected but not treated in Ukraine, Romania and Serbia.

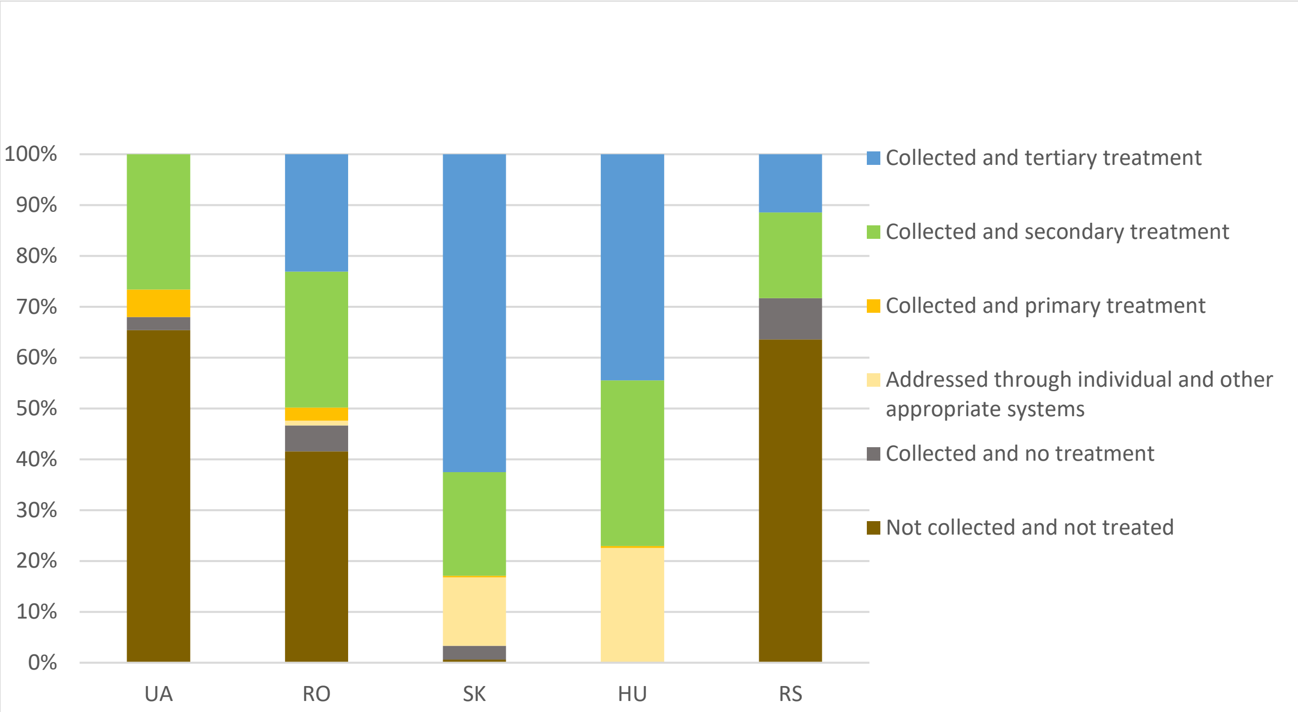

Figure II.4 Share of the collection and treatment stages in the total population equivalents in the Tisza River Basin countries (reference year: 2011/2012).

Regarding the discharges of the organic substances via urban sewerage systems into the surface waters, about 19,750 tons per year BOD and 45,936 tons per year COD are released from the agglomerations with more than 2,000 PE throughout the basin (Table II.4). The ratio of COD to BOD of about 2.3 indicates a considerable fraction of biodegradable organic matter being still released. Fractions of the total discharges (BOD: 22%, COD: 20%) stem from the collected but untreated waste water amounts (Table II.4 and Figure II.5). Despite the smaller waste water amounts subject to primary treatment, its share in the discharges are higher (BOD: 4%, COD: 3%) due to the limited treatment efficiency. The UWWTPs equipped with secondary treatment 39% of the BOD and 40% of the COD discharges. Plants with tertiary treatment emit 35% (BOD) and 37% (COD) of the total releases.

Table II. 4: BOD and COD discharges via urban waste water in the Tisza Basin - without discharges not collected and not treated (reference year: 2011/2012)

Type of treatment	Collected and treated load PE	Discharge BOD (tons per year)	Discharge COD (tons per year)
Tertiary treatment	3,658,566	6,839	17,052
Secondary treatment	3,207,203	7,634	18,234
Primary treatment	186,466	860	1,459
Collected but not treated	347,392	4,418	9,191
Total	7,399,628	19,750	45,936

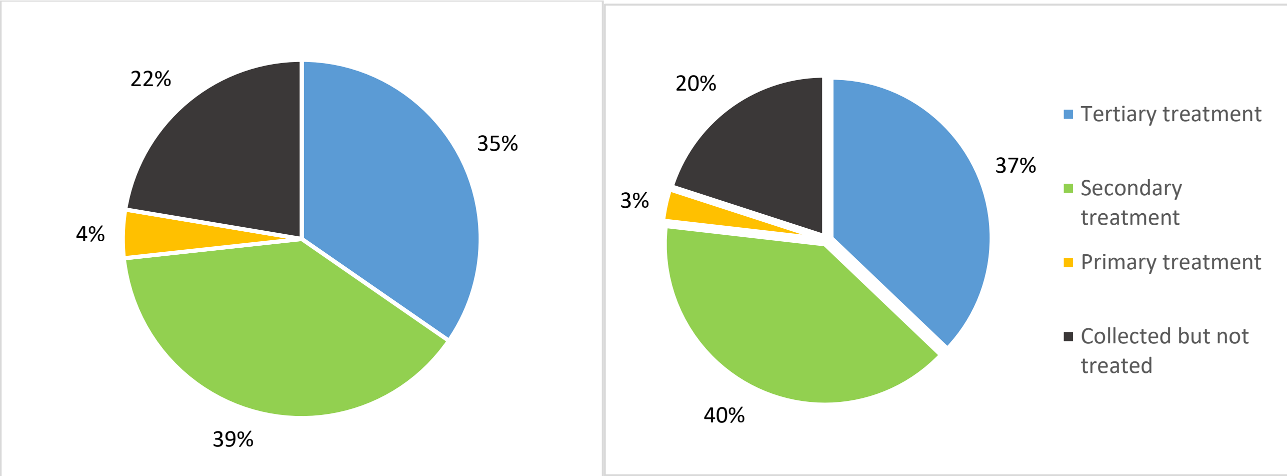

Figure II. 5 Share of the collection and treatment stages in the total organic pollution of surface waters via urban wastewater collected by the public sewerage systems in the Tisza Basin (reference year: 2011/2012) left: BOD discharge, right: COD discharge

BOD discharges via wastewater sector per country are shown in Figure II.6 and Figure II. 7 according to different treatment systems. It reflects that the less developed waste water infrastructures are substantially determined by untreated waste water releases. All countries except Hungary and Slovakia have still great potential to reduce organic pollution of their national surface water bodies by introducing at least biological treatment technology. In particular, Serbia, can significantly diminish organic pollution via waste water treatment since PE-specific emissions are still high. Ukraine, Romania and Serbia have relatively the highest total discharges indicating that further improvement of the waste water sector in these countries would substantially reduce the basin-wide emissions. It should be pointed out that the reference year of the assessment (2012) is differing from the end of the recent management cycle (2015), therefore further improvements can be expected by 2015. For many EU MS the transitional period for the compliance ended by 2014 or 2015 (Slovakia, Hungary), whilst for Romania the transitional period for the implementation of the UWWTD will terminate in 2018.

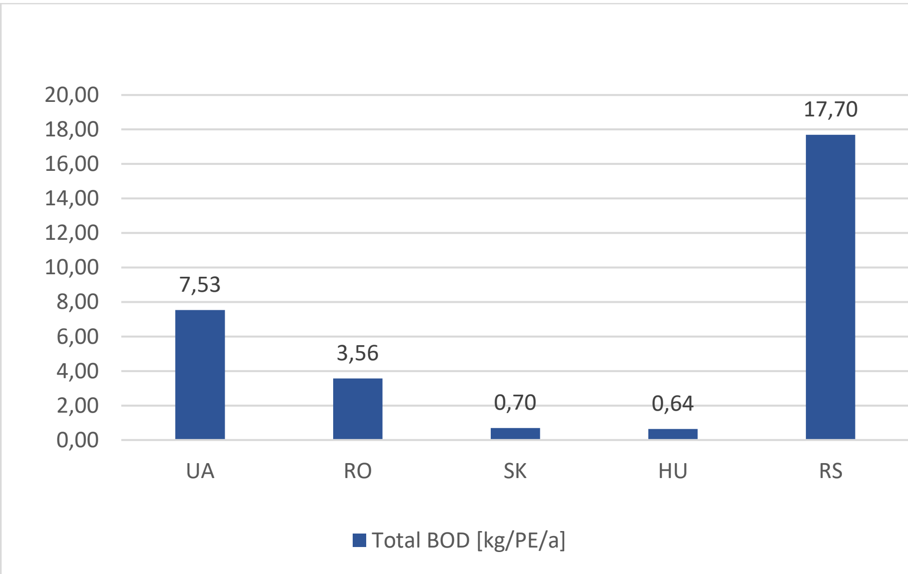

Figure II. 6 Specific organic pollution of the surface waters via urban waste water collected by the public sewerage systems in the Tisza countries (expressed in kg BOD per PE and year, reference year: 2011/2012)

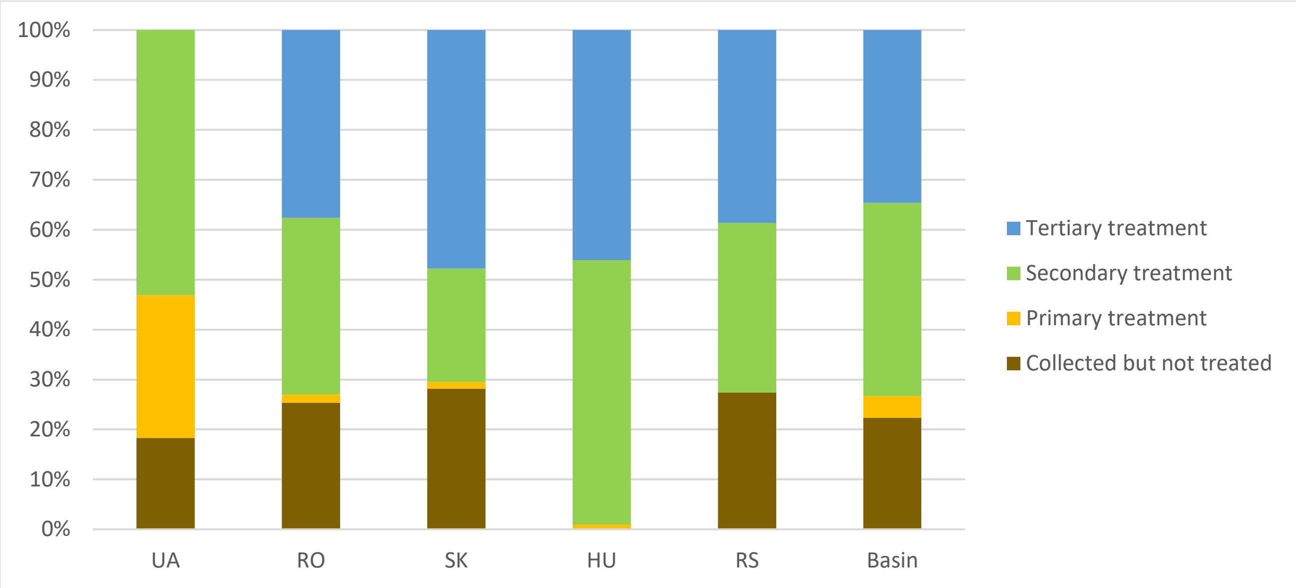

Figure II. 7 Share of the collection and treatment stages in the total organic pollution of the surface waters via urban waste water collected by the public sewerage systems in the Tisza countries (reference year: 2011/2012, refer to tons BOD per year

2.1.1.2 Organic pollution from industry and agricultural point sources

Data for the industrial direct dischargers derived from the European Pollutant Release and Transfer Register (E-PRTR) database which contains the main industrial facilities and their discharges above certain capacity and emission levels (Map 2, showing all industrial facilities reported to E-PRTR). In total, 14 installations from 3 main industrial sectors were reported by the countries which have significant direct organic substance discharges (above a threshold of 50 tons TOC per year). Agricultural operations were not found in E-PRTR database. [2]

Out of these, waste and industrial wastewater management sector (mainly waste recycling and disposal sites and specific industrial waste water treatment plants, excluding urban waste water treatment plants), paper and wood processing (50%), chemical industry (30%) and production and processing of metals (20%) are the most important fields in terms of organic pollution (Figure II. 8 last column). In the reference year (2012) some 1 929 tons per year organic substances (expressed in COD) were released (Table II.5). The type of activities, their total releases and proportions are differing among the countries. Slovakia and Hungary contribute the highest COD discharges via industrial activities (Figure II.8). Ukraine, Romania and Serbia have no facilities reported over the given release threshold.

Table II.5: Organic pollution via direct industrial discharges in the Tisza River Basin according to different industrial sectors (reference year: 2012)

Activities	Releases to water, COD (tons per year)
Paper and wood production and processing	993
Production and processing of metals	363
Chemical industry	573.3
Total	1,929.3

2 ICPDR: The Danube River Basin District Management Plan –Update 2015 http://www.icpdr.org/main/sites/default/files/nodes/documents/drbmp-update2015.pdf

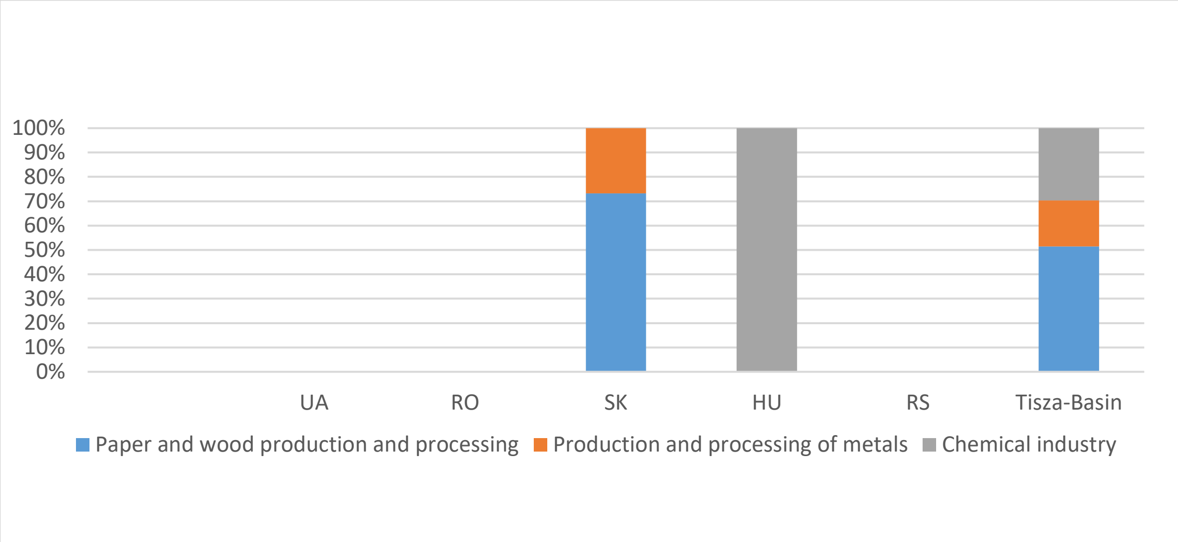

Figure II.8 Share of the industrial sectors in the total organic pollution via direct industrial discharges in the Tisza River Basin countries.

2.1.2 Nutrient pollution

Key findings and progress

Based on the updated database of the former MONERIS setup (2nd DRBMP) for the Tisza river basin resulted in a higher TN emission. TP emissions remained almost constant. Although spatial patterns of nutrient emissions remained similar, in certain regions differences were identified due to the updated datasets of land use, soil loss and N surplus. The updated database and the new modelling approaches resulted in predicted (modelled) average total emissions of 95 t/yr TN and 4.7 kt/yr TP for the Tisza catchment.

Major pathway of TN emissions represents groundwater (66.1%) followed by surface run-off (11.4%) and most important source of TN is the arable land and grasslands (together 52.6% of total) followed by forest and urban area (23.8 and 21.7% of total, respectively). In the case of TP emissions, the situation is different. To the major pathway of TP emissions belong point sources (28%), groundwater (23.9%) and erosion (22.7%) and most important sources of TP are urban areas (46.7% of total) and arable land and grasslands (together 37.2% of total).

Regarding the sources, agriculture and urban water management are responsible for the majority of the nutrient emissions indicating the necessity of appropriate measures to be implemented in these sectors. Similarly, to organic pollution, total point source emissions are influenced by collected and untreated waste water discharges being responsible for 11% (TN) and 12% (TP) of the total point source emissions. Besides this, enhanced treatment by the existing plants at agglomerations above 10,000 PE (202 agglomerations) has great potential to reduce nutrient emissions concerning more than 8 million PE in total.

Nutrient pollution is caused by significant releases of nitrogen (N) and phosphorus (P) into the aquatic environment. Nutrient emissions can originate from both point and diffuse sources.

Point sources of nutrient discharges are highly interlinked to those of the organic pollution. Municipal waste water treatment plants with inappropriate technology, untreated waste water, industrial enterprises, and possibly animal husbandry can discharge considerable amounts of nutrients into the surface waters besides organic matter.

Diffuse pathways, however, have higher importance considering nutrients. Direct atmospheric deposition, overland flow (surface run-off), sediment transport (erosion), tile drainage flow and groundwater flow can remarkably contribute to the emissions into rivers, conveying nutrients from agriculture, urban areas, atmosphere and even from naturally covered areas.

The importance of the pathways for diffuse pollution is different for N and P. For N, groundwater flow and urban run-off are the most relevant diffuse pathways. In case of P, groundwater is usually replaced by sediment transport generated by soil erosion. Regarding the sources, agriculture can play a key role in nutrient pollution. Surface waters can receive significant nutrient emissions from agricultural fields due to the elevated nutrient surpluses of the cultivated soils and/or inappropriate agricultural practices. Agglomerations with sewer systems but without connection to treatment plant having nutrient removal technology and combined sewer overflows are important urban sources. Deposition from the atmosphere is especially relevant for N as many combustion processes and agricultural activities produce N gases and aerosols that can be subject to deposition. The role of background fluxes is often overlooked even though they might have significant regional contribution especially from poorly covered areas or mountainous catchments.
Impacts on water status caused by nutrient pollution can be detected through substantial changes in water ecosystems. The natural aquatic ecosystem is sensitive to the amount of the available nutrients which are limiting factors. In case of nutrient enrichment, the growth of aquatic algae and macrophytes can be accelerated and water bodies can be overpopulated by specific species. Lakes and water reservoirs have been suffering from eutrophication that severely impairs water quality and ecosystem functioning (substantial algae growth and consequently, oxygen depletion, toxicity, pH variations, accumulation of organic and toxic substances, change in species composition and in number of individuals). Eutrophication might limit or even hinder human water uses as well (recreation, tourism, fisheries, drinking water supply). Even though river systems, floodplains and reservoirs can retain nutrients during in-stream transport (e.g. denitrification, uptake, settling), significant nutrient loads can reach lakes transposing water quality impacts far downstream from the sources[3].

2.1.2.1 Nutrient pollution from urban waste water

In total, 171 agglomerations with a PE of about 4 million are equipped (at least partially) with tertiary treatment aiming at nutrient removal in the basin (Maps 5, reference year: 2011/2012). A majority of them (75%) addresses the elimination of both nutrients. The 202 agglomerations with a size over 10,000 PE in terms of PE presents the overall load generation is about 8 million PE, 46% of this load (3.7 million PE) is effectively subject to tertiary treatment.

At the basin-wide scale 8,862 tons per year TN and 1,224 tons per year TP are emitted into the surface waters from the waste water collection and treatment facilities (Table II. 6). 11% (TN) and 12% (TP) of the emissions can be linked to untreated waste water discharged directly into the recipients (Figure II. 9). This figure also shows that about 3% of the nutrient releases stem from plants having mechanical treatment, whilst the proportion of the waste water treatment plants with secondary treatment is 45% (TN) and 52% (TP). Some 14% (TN) and 12% (TP) of the nutrient emissions are discharged from plants with stringent technologies.

3 ICPDR: The Danube River Basin District Management Plan –Update 2015 *http://www.icpdr.org/main/sites/default/files/nodes/documents/drbmp-update2015.pdf*

Table II.6: Nutrient pollution of surface waters via urban waste water collected by the sewerage systems in the Tisza Basin (reference year: 2011/2012)

Type of treatment	Collected and treated load PE	Discharge TN (tons per year)	Discharge TP (tons per year)
Tertiary treatment (NP removal)	3,025,748	2,327	254
Tertiary treatment (N removal)	545,880	1,267	145
Tertiary treatment (P removal)	86,937	62	5
Secondary treatment	3,207,203	4,019	632
Primary treatment	186,466	222	38
Collected but not treated	347,392	965	149
Total	**7,399,627**	**8,862**	**1,224**

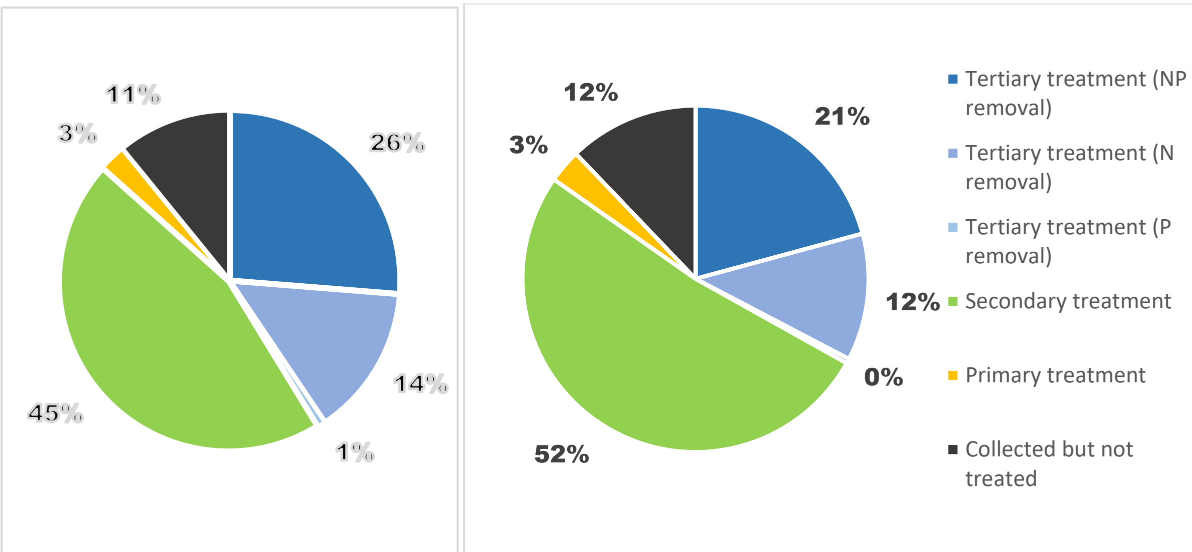

Figure II.9 Share of the treatment stages in the total nutrient pollution of surface waters via urban waste water collected by the sewerage systems in the Tisza Basin (reference year: 2011/2012); left: TN discharge, right: TP discharge

Country performances are presented in Figure II.10 and Figure II.11. The variation at country level is similar to the situation discussed by the organic pollution.

Non-EU countries have only limited possibilities to install nutrient removal devices at the vast majority of the agglomerations, even for the smaller sized of the agglomerations due to insufficient implementation of the EU relevant legislation as well as lack of financial sources. Other countries, EU MSs can, however, remarkably enhance the overall treatment status of the plants, particularly at the agglomerations over 10,000 PE, where the introduction of the tertiary treatment technologies is lagging behind.

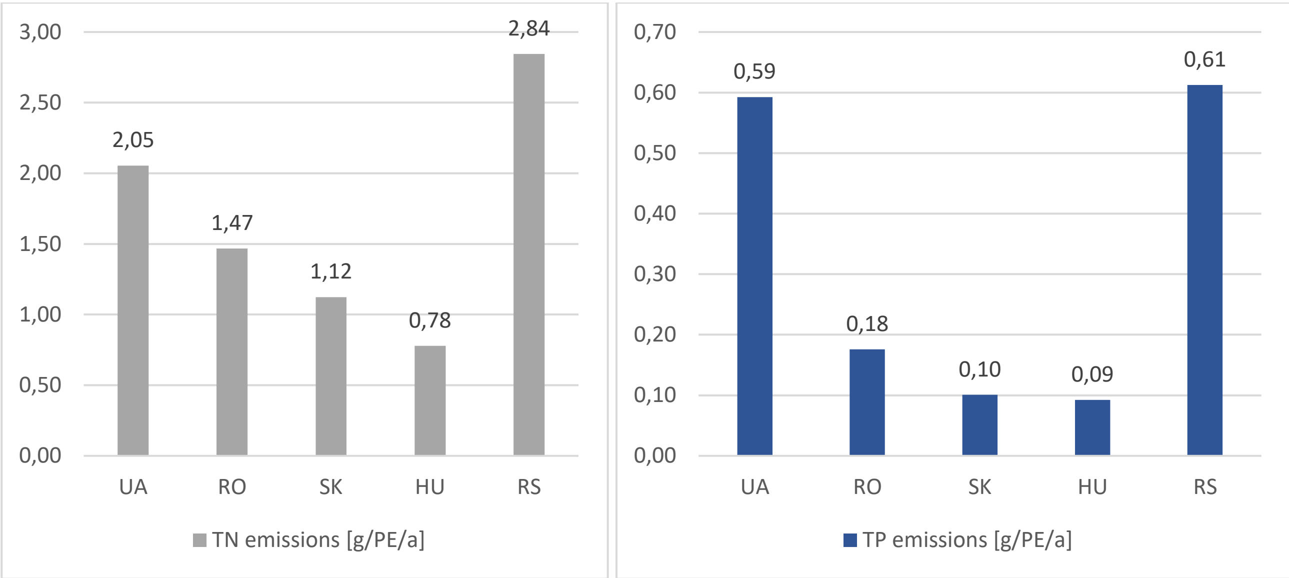

Figure II.10 Specific nutrient pollution via urban waste water collected by the sewerage systems in the Tisza countries (reference year: 2011/2012); on the left: TN, on the right: TP N and TP per PE and per year.

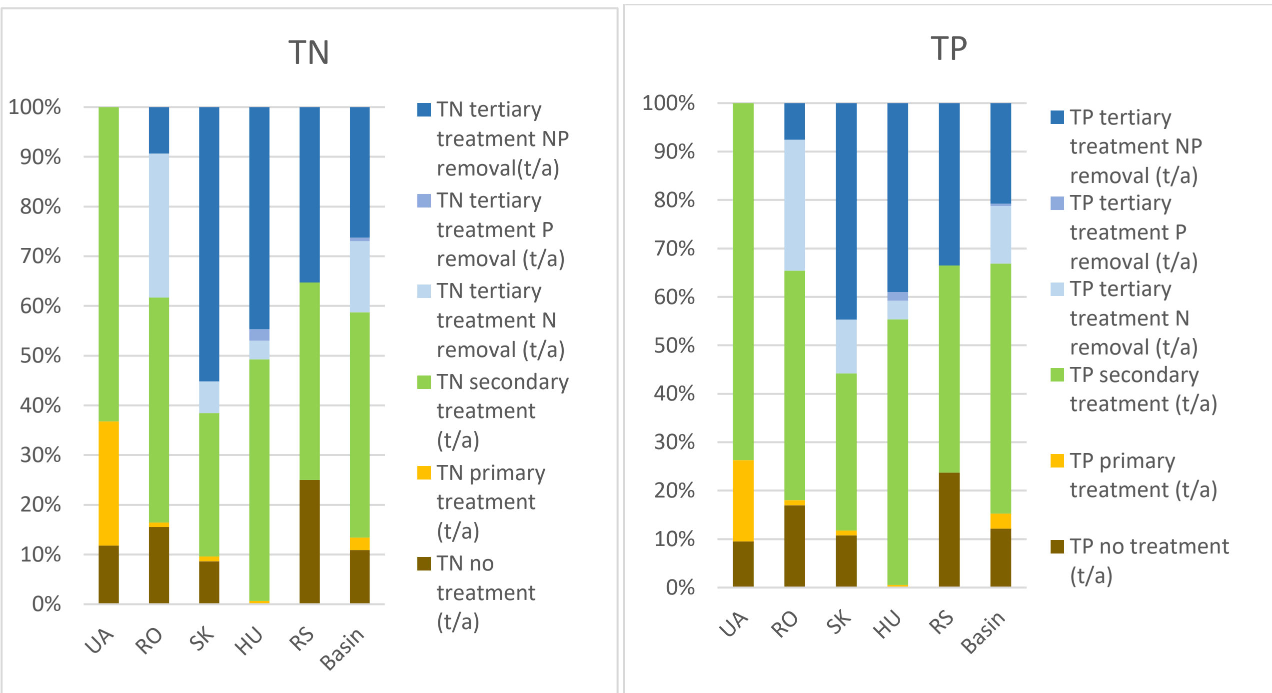

Figure II.11 Share of the treatment stages in the total nutrient pollution via urban waste water collected by sewerage systems in the Tisza countries (reference year: 2011/2012); on the left: TN, on the right: TP (absolute numbers on the top refer to tons TN and TP per year)

2.1.2.2 Nutrient pollution from industry and agricultural point sources

Regarding the industrial discharges, the main sectors with nutrient pollution reported by the countries are the same as those of the organic pollution (reference year: 2012). In total, 683.7 nitrogen tons per year were released in the reference year (Table II.7). Regarding the nitrogen, the chemical industry has the highest importance emitting almost 70% of the total discharges by Romania (388 TN tons per year) with small contribution from Hungary (Figure II.12). Besides this, production and processing of metals sector contributing with 22.5% to the total discharges (Slovakia 154 TN tons per year). Rest of emitted TN discharges is originated in the food and beverage sector (Serbia about 51 TN tons per year). In case of phosphorus, no discharges were reported by countries. The reported industrial emissions are relatively small in comparison to those of the urban waste water, only 8% TN of the waste water discharges are emitted via industrial facilities. No TN discharges were reported by Ukraine.

Table II.7: Nutrient Pollution of surface waters via direct industrial waste water discharges in the Tisza River Basin

Activities	Releases to water, TN (tons per year)
Production and processing of metals	154.0
Products from food and beverage sector	51.3
Chemical industry	478.4
Total	**683.7**

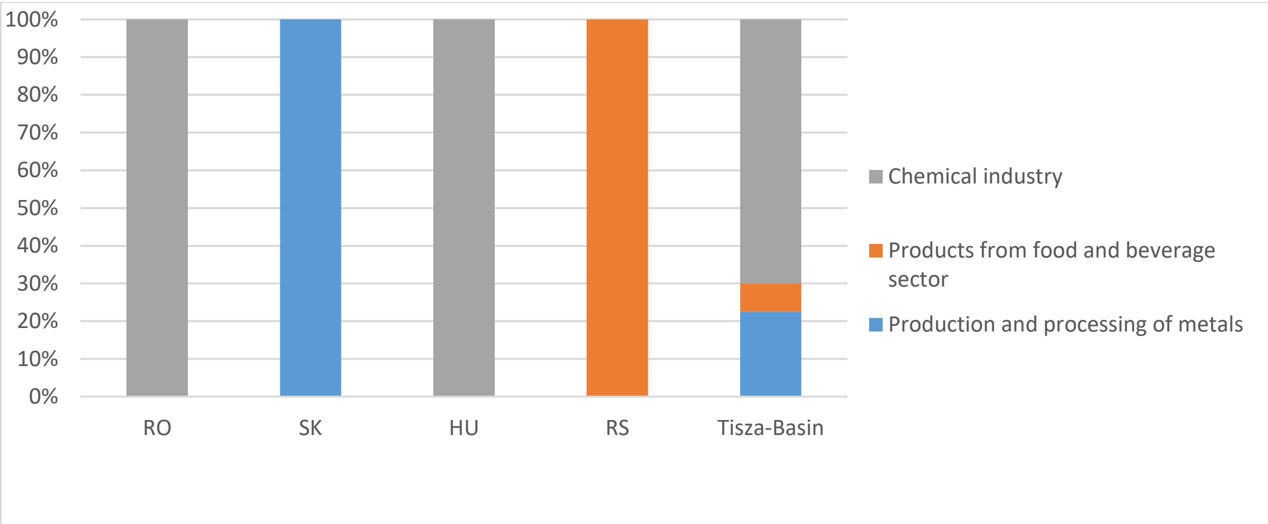

Figure II.12 Share of the industrial activities in the total nutrient (TN) pollution via direct industrial waste water discharges in the Tisza countries (reference year: 2012)

2.1.2.3 Diffuse nutrient pollution

To estimate the spatial patterns of the nutrient emissions in the basin and assess the different pathways contributing to the total emissions, the MONERIS model (Venohr et al., 2011), was applied by Leibniz-Institute for Freshwater Ecology and Inland Fisheries (April 2018) for the entire basin and for current hydrological conditions (2009–2012). The model is an empirical, catchment-scale, lumped parameter and long-term average approach which can supply decision making to facilitate the elaboration of larger scale watershed management strategies. It can reasonably estimate the regional distribution of the nutrient emissions entering the surface waters within the basin at sub-catchment scale and determine their most important sources and pathways. Moreover, taking into account the main in-stream retention processes the river loads at the catchment outlets can be calculated that can be used for model calibration and validation (Annex 1).
The updated database and the new modelling approaches resulted in average total emissions of 95 kt/yr TN and 4.7 kt/yr TP for the Tisza catchment (see Figure II.13 and Table II.8).

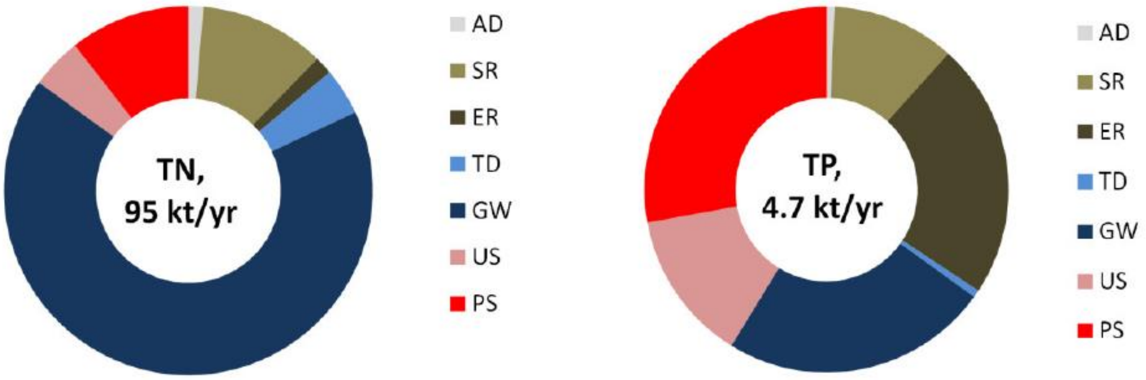

Figure II.13 Mean share of the pathways on the total nutrient emissions in the Tisza catchment during 2009-2012 *(AD = atmospheric deposition, SR = surface runoff, ER = erosion, TD = tile drainage, GW = groundwater, US = urban systems, PS = point sources)*

According to Table II.8, a major pathway of TN emissions is groundwater (66.1%) followed by surface run-off (11.5%) and point sources (10.5%). The most important source of TN is the arable land and grasslands (together 52.6% of total) followed by forest and urban areas (23.8% and 21.7% of total, respectively). In the case of TP emissions, the situation is different. The major pathways of TP emissions are point sources (28.0%), groundwater (23.9%) and soil erosion (22.7%), the most important sources of TP are urban areas (46.7% of total) and arable land with grassland (together 37.2% of total). Significance of pathways on national level illustrates Figure II.15.

Table II.8: Relative share of nitrogen and phosphorus emissions (relative values in %) from different land-use types and via considered pathways for the reference status (long-term 2012)

Pathway	Land-use type						
	Water surface area	Arable land	Grassland	Forest	Urban area	Other areas	Total
Nitrogen							
Atmospheric deposition	1.3	-	-	-	-	-	1.3
Surface run-off	-	6.2	0.9	4.3	-	0.0	11.5
Soil erosion	-	1.1	0.0	0.4	-	0.0	1.6
Tile drainage	-	4.6	0.1	-	-	-	4.7
Groundwater	-	33.3	6.3	19.0	6.9	0.6	66.1
Urban systems	-	-	-	-	4.3	-	4.3
Point sources	-	-	-	-	10.5	-	10.5
Total	1.3	45.2	7.4	23.8	21.7	0.6	100.0
Phosphorus							
Atmospheric deposition	0.7	-	-	-	-	-	0.7
Surface run-off	-	5.9	1.0	3.8	-	0.0	10.8
Soil erosion	-	16.6	0.7	5.5	-	0.0	22.7
Tile drainage	-	0.6	0.1	-	-	-	0.7
Groundwater	-	10.4	2.0	6.0	5.4	0.1	23.9
Urban systems	-	-	-	-	13.2	-	13.2
Point sources	-	-	-	-	28.0	-	28.0
Total	0.7	33.4	3.8	15.3	46.7	0.1	100.0

As it is presented in figure II.14, more than half of both total TN and total TP emissions come from the Hungarian and Romanian part of the catchment (64% and 66% for TN and TP respectively). But area specific emissions in both countries are on average comparatively low (see Figure 17 and Maps 3 and 6). These area-specific emissions of TN, especially in rural areas, are substantially higher in the northern part of the basin, where the specific runoff is also highest. In Serbia area-specific emissions of TN and TP are more scattered, and urban areas are dominating.

Figure II.14 Share of nutrient emissions from the Tisza countries on overall TP and TN emissions (2009-2012)

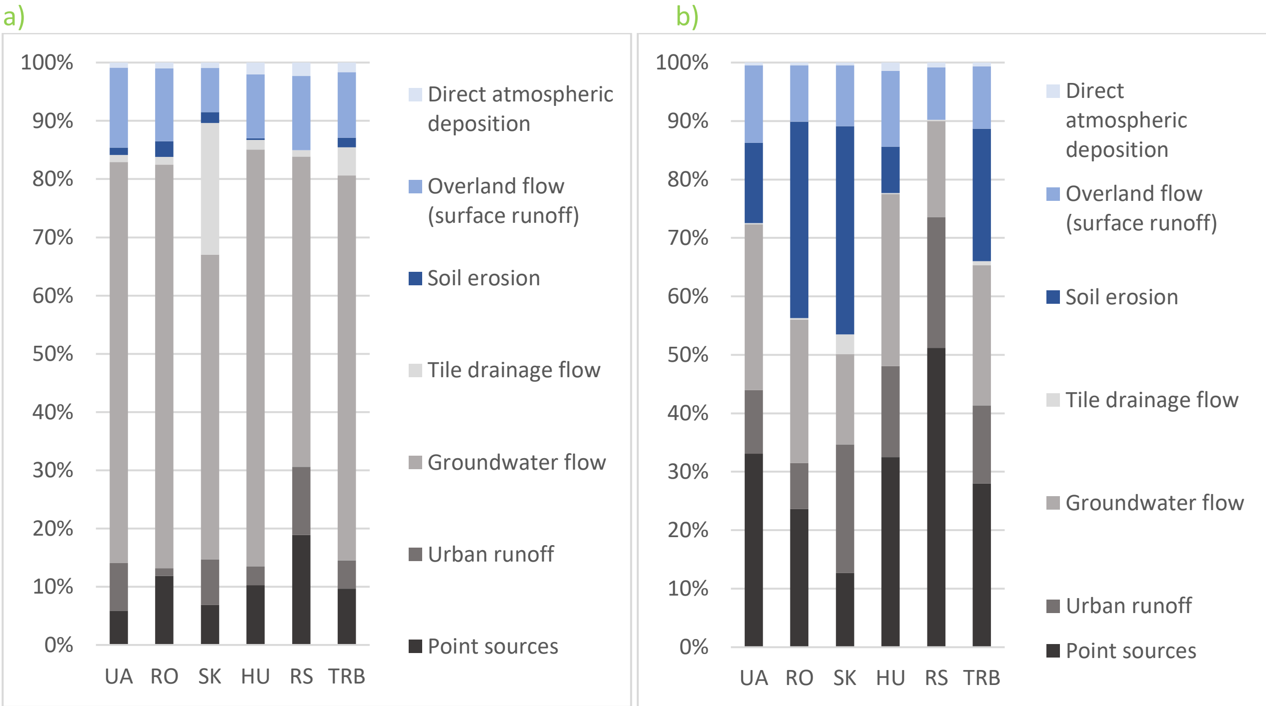

Figure II.15 Share of the in the overall a) TN and b) TP emissions in the Tisza countries (2009-2012)

The distribution of the sources (land uses) in the overall TN and TP emissions in the Tisza countries (see figure 16) shows that the highest share of TN emissions comes from arable land (HU 64.3%, RS 51.9%, SK 51.8%, RO 34.8% and UA % 21.0%). Urban areas represent the second most important source of TN emissions (RS 39.7%, UA 26.6%, RO 22.5%, SK 18.5% and HU 15.9%). Forest area is significant especially in the case of Ukraine

(51.0%), Romania (30.6%), and Slovakia (24.4%). In the case of TP, the highest emissions come from urban area (RS 78.0%, UA 53.7%, HU 50.8%, SK 37.8% and RO 37.7%) followed by arable land (SK 42.8%, RO 37.4%, RO 37.4%, RS 19.7% and UA 16.7%). Forest area, similarly as in the case of TN emissions, is significant especially in Ukraine (28.8%), Romania (18.2%) and Slovakia (16.4%).

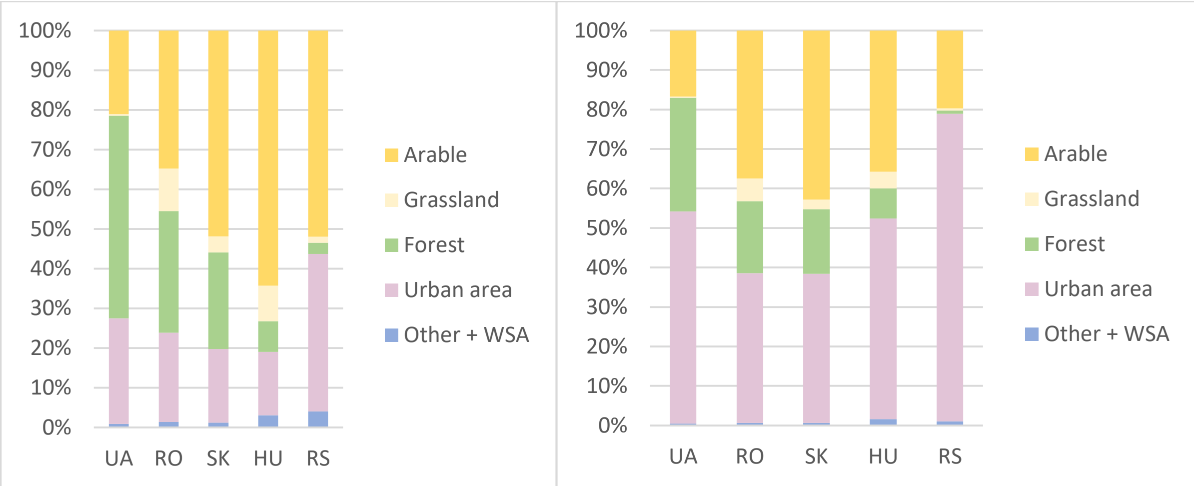

Figure II.16: Share of the sources (land uses) in the overall TN (left) and TP (right) emissions in the Tisza countries

Specific nutrient TN and TP per analytical unit and land use is illustrated on following maps (figure 17).

a) *b)*

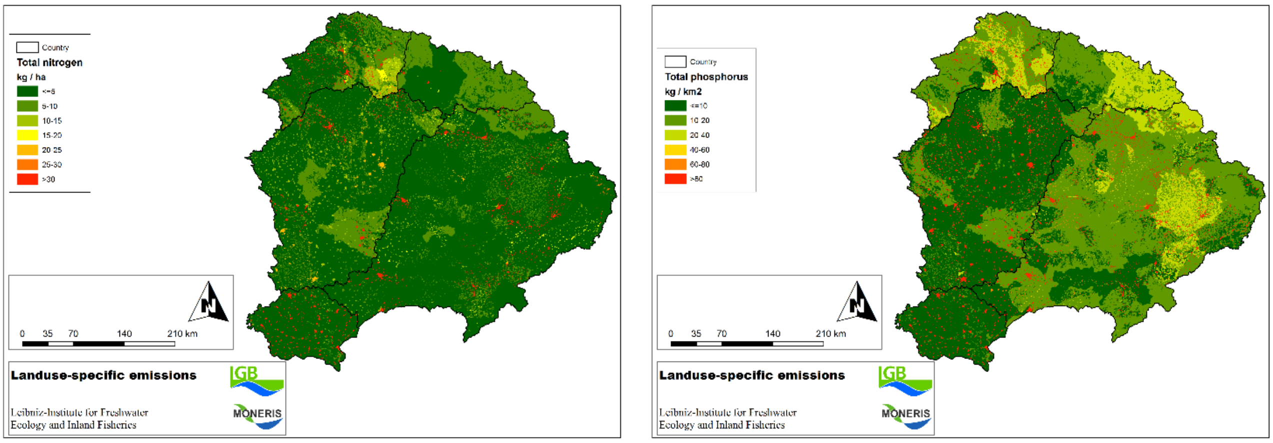

Figure II.17 a) TN and b) TP emissions per land use (average 2009-2012); label classes are presented as used in Vernohr et al. 2018

Specific nutrient per analytical unit and land use are higher in comparison with the DRBMP - Update 2015 results in the case of TN and TP. While changes in Romania are mainly caused by the revision of the former N surplus, in the case of Slovakia and Hungary increase of TN emissions is caused by the re-calibration of run-off according to new national hydrological data. In the case of TP emissions, the increase was caused by the change of spatial pattern change, as well as by new implemented data of soil loss and hydrology. So, direct comparison of above mentioned values of TP and TN emissions with those in 1st ITRBMP cannot offer accurate information on mitigation effort within individual landscape type or sectors.

For receiving more objective picture, it is suitable to compare the Tisza catchment emissions with rest of Europe (see Annex 1 - Assessment of nutrients emissions with MONERIS model - *Results of IGB* Figure II.17). Label classes and their distribution (great share of green classes indicate that TN and TP emissions can be considered acceptable in many areas and the problem has often local or subnational nature.

Nutrient emissions in the Tisza catchment were compared with emissions calculated for Europe. The comparison shows that for both, TN and TP, the Tisza has a higher share of specific emissions between 5-10 and 20-40 kg/ha/yr of TN and between 20 to 40 $kg/km^2/yr$ of TP. In contrast, high specific emissions (TN: >12.5 kg/ha/yr and TP: 50 kg/km/yr) have a significantly lower share than the European wide average. This is also reflected in the area weighted mean specific TN and TP emissions, amounting 6.5 kg/ha/yr and 31.4 kg/km/yr in the Tisza compared to 10.8 kg/ha/yr and 47.7 kg/km/yr in Europe, respectively.

2.1.3 Hazardous substances pollution

Key findings and progress

Tisza countries have taken important steps to fill the existing data gaps in the field of hazardous substances pollution. The recent investigations on the priority and other hazardous substances have provided essential information on the relevance of these substances resulting in a much clearer picture on the pollution problem (relevant substances and their magnitude) than ever before. The elaboration of an inventory of emissions, discharges and losses of the priority substances can help to close information gaps on the sources. TRB countries are collecting data on the existing industrial and contaminated sites that might be at potential risk to cause accidental pollution triggered by operation failures or natural disasters like floods.

Hazardous substances pollution involves contamination with priority substances laid down in Annex X of the WFD and other specific pollutants listed in Annex VIII of the WFD that might be toxic, heavily degradable or accumulative and have local/regional relevance. They include both inorganic and organic micro-pollutants such as heavy metals, arsenic, cyanides, oil and its compounds, trihalomethanes, polycyclic aromatic hydrocarbons, biphenyls, phenols, pesticides, haloalkanes, endocrine disruptors, pharmaceuticals, etc. Hazardous substances can be emitted from point and diffuse sources. Households and public buildings connected to sewerage can contribute to water pollution by emitting chemicals used in the course of daily routine. Industrial facilities that process, utilise, produce or store hazardous substances can release them with waste water discharges. Indirect dischargers are connected to public sewer systems and can transport contaminated industrial waste water to the treatment plants if their own treatment system is not sufficient. Direct dischargers without specific removal technology for hazardous substances can potentially deteriorate water status[4].

2.1.3.1 Sources of 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.

[4] ICPDR: The Danube River Basin District Management Plan –Update 2015 http://www.icpdr.org/main/sites/default/files/nodes/documents/drbmp-update2015.pdf

Generally, there is a significant knowledge gap on the sources of emissions mainly due to the less sensitive monitoring devices available. Moreover, estimation of diffuse emissions is a challenge for many countries as data on field application is hardly available. Another common problem regarding surface water monitoring is the insufficient sampling frequency in surface waters which does not allow to reasonably determine annual river loads. Besides this, monitoring programs usually focus on the dissolved phase which is not sufficient for analysing emission-immission relationships for which whole sample is needed.

In order to obtain an overview concerning the current situation in field of Inventories on priority substances emission, discharges and losses the TRB countries provided following information:

Ukraine:
All legal entities which discharge wastewaters are considered as point sources. The emissions are quantified as difference between the maximum admissible concentrations and real values. Diffuse pollution is not addressed at the moment. No modelling is applied as well. Following substances are analysed: nitrogen group (nitrogen total, nitrogen ammonia, nitrates and nitrites), phosphorus group (phosphates, total phosphorus), organic pollution (BOD, COD), general physical-chemical parameters (dry residue, suspended solids, chlorides and sulphates), specific substances (synthetic surface-active substances, oil products, heavy metals). In total, 56 pollution substances can be identified. But at present Tisza Basin authority laboratory cannot provide required analysis. Particular substances of national importance were not identified.

Romania:
The first Priority Substances EDL inventory has been achieved in 2013 based on data for the period 2009-2011, followed by the second PS EDL inventory in 2014 with data from 2012-2013, according to the EQS Directive and the WFD CIS Guidance Document no. 28 requirements. Romania is presently in process to update it with new data and information. All monitored point sources of pollution discharges are considered in assessment. The emissions are quantified according to the national methodology. The methodology is developed based on the WFD CIS Guidance Document no. 28 recommendations. The diffuse emissions are assessed according to the Guidance Document no 28 on the Preparation of an Inventory of Emissions, Discharges and Losses of Priority and Priority Hazardous Substances recommendation. The diffuse load was estimated as the difference between the total riverine load and the load discharged from point sources. All priority substances according to Annex 1, Part A of the EQS Directive 2008/105/EU for which monitoring data were available have been involved to the emission assessments. The inventory was developed for 33 priority substances, except brominated diphenylethers, chloroalkanes, tributyltin compounds and pentachlorophenol (which are included in monitoring programme since 2016), where monitoring data were available. The used data resulted from the surveillance and operational monitoring, depending on the status of water bodies, with frequency according to the WFD. The following substances have been identified as relevant at the national level: Cd, Pb, Hg, Ni.

Slovakia:
Elaboration of the 1st PS EDL inventory has been completed in 2013 based on data for the period 2009-2011. Into assessment industrial facilities, E-PRTR were involved. Concerning UWWTD data there is lack of information on pollution by priority substances. Point sources emissions were quantified on the base of effluent measurements. Priority substance diffuse pollution was addressed. Diffuse loads were calculated by formula: Ldif = Ly (total riverine load) – Dp (total point source discharge) – Lb (natural background load).
The quantification of emissions, discharges and losses was carried out by calculating of the riverine load (by OSPAR, 2004 equation - recommended by technical guidance) and then by linking results with existing information on the pollution sources or eventually with natural background. For metals the natural background concentrations - developed for each of the water bodies, were taken into account. In case of synthetic substances - for level of background concentration, half of the limit of quantification of analytical method have been used. Relevance substances for RBD and sub-basins were identified on the base of following criteria:

- The substance causing the failure state of at least one water bodies;
- The average concentration of the substance is over half EQS in more than one water body;
- Data from E-PRTR and national Central water database (SEV) confirm the release, which could lead to a concentration corresponding to the above criteria;
- There are known sources and activities causing inputs to the basin that could lead to a concentration corresponding to the above criteria.

Priority substances and substances relevant for Slovakia are monitored in the frame of surveillance and operational monitoring. All priority substances are measured for assessment of chemical status with frequencies 12 times per year. The river basin specific pollutants are measured in the relevant water bodies, where are discharged 12 times per year as well. Following the requirements of the WFD, a process of selecting relevant dangerous substances and developing a related Pollution Reduction Programme (PRP) has started in the Slovak Republic in 2001. Based on the results of a three years investigative screening campaign, 59 chemical substances were identified as relevant dangerous substances in 2004 and included in the national PRP. From this list of 59 chemical substances, 33 priority substances were already included in the EQS Directive (2008/105/EC). The remaining 26 relevant dangerous substances were assigned as river basin specific pollutants (Annex VIII substances of the WFD) for the Slovak Republic. Priority substances significant for Slovakia in the part of the Tisza River Basin are: atrazine, p.p. DDT, dichloromethane, DEHP, PAHs, trichlomethane, octylphenols, hexachlorcyklohexane, cadmium and its compounds, mercury and its compounds. From the list of Slovak relevant substances (identified in 2008) significant for Slovak part of the Tisza River Basin are: MCPA, 4-methyl-2,6-di-terc butylphenol, cyanides, dibutylphtalate, PCB (congeners 28, 52, 101, 118, 138, 153,180), arsenic and its compounds, cuprum and its compounds, zinc and its compounds.

Hungary:
1st EDL Inventory had been published in the 2nd River Basin Management Plan of Hungary by the end of 2015. Results are public and available: http://www.vizugy.hu/vizstrategia/documents/988BF7DB-B869-46C6-9463-E9E4BFC81D2A/3_6_Hatteranyag_Veszelyesanyagok.zip
Point sources involved into the assessments are UWWTPs, industrial and other facilities (every facility with above 15 m^3 waste water discharge/operative days, not just E-PRTR). Emission quantification was based on influent-effluent measures and emission factors in case of UWWTPs, in case of industrial facilities only effluent measures were addressed.
In general, diffuse emissions were calculated according to riverine load approach. Based on available data we addressed different pathways of hazardous substances: air deposition, groundwater and transportation. Air deposition loads were calculated based on data of European Monitoring and Evaluation Programme and CORINE Land Cover.
Hazardous substance groundwater loads were estimated based on interflow data and concentrations of the infiltration area. HS loads from transportation were estimated based on the following data: number of motor vehicles and emission factors of toxic metal loads from break wear, tire wear and exhaust gases. The estimation method was developed in 2011.
Involved pollutants in the Tisza River Basin are specific pollutants (Zn, Cr, Cu, As), heavy metals (Pb, Ni, Hg, Cd), PAHs (anthracene, flouranthene, total benzo(b)fluor-anthene + benzo(k)fluor-anthene, benzo(a)pyrene), pesticides (atrazine, hexachlorobenzene), other industrial pollutants (dichloroethane, phenols, AOX). All parameters of Directive 2008/105/EC were measured (at least by one of the stations) except of tributyltin-cations, chloroalkanes, total cyclodiene pesticides, brominated diphenylethers. Data of surveillance monitoring stations on the national border was used in the Tisza River Basin (12 samples/year). Riverine load approach cannot be applied properly in Hungary, increase of sampling frequency may not give more accurate results or may not be economical.

Serbia:

EQS Directive is not fully transposed in national legislation. For Serbia the issue of HS is currently under evaluation and no reliable data is available on emissions and sources. Surface and ground water monitoring data indicate that HS pollution is currently not a serious issue in Serbia. The relevant registers and inventories are under development.
More detailed information on the national inventories is presented in Annex 2.

2.1.3.2 Hazardous substances pollution from accidental risk spots and contaminated sites

Accidental pollution events represent a specific and generally dangerous form of water contamination by hazardous substances. Industrial facilities, mining areas and contaminated sites that store, process or produce such substances in substantial amounts pose hazard (potential risk) to water by having a certain potential to cause serious pollution, even though they might not have any release in their regular operation. However, in case of emergency situations (natural hazard events like floods, earthquakes or landslides and operation failures) and without appropriate safety measures in place they can represent a real water pollution risk. Depending on the type and mixture of the hazardous substances, their released amount, the temporal variability of the pollution and the local circumstances, the accidental spills can adversely impact the receiving environmental media and the ecosystems, population, economic activities, goods and properties of the affected surrounding areas but even those of the regions far downstream if contaminants are further transported by streams.

Besides a few, mainly local accidental pollution events, two major accidents happened in the TRB in the last two decades, which had serious negative impacts on the aquatic ecosystems. The main lesson learnt from these events is that despite of several quick and effective technical solutions was found during the emergency and remediation phases of the spills, the costs of any remediation activities are always likely to be far higher than introducing appropriate safety and prevention measures. Implementing appropriate safety measures at the accident risk hot spots is a strong prerequisite for an effective risk mitigation and contingency management.

Cyanide spill at Baia Mare & heavy metal spill at Baia Borsa

The cyanide spill at Baia Mare and the heavy metal spill at Baia Borsa in 2000 were one of the reasons that starting the transboundary cooperation on environmental risk management in the Tisza river basin. The risk of accidental pollution due to mining and industry still exists (see Ajka red mud accident in Hungary on the Danube River Basin, in 2010, or the environmental risks of mining areas). Further national and international efforts are needed to prevent such disasters.

To respond to these challenges, the ICPDR established the Accident Prevention and Control Expert Group (APC EG). The APC EG provides the Danube countries with a platform for information exchange, know-how transfer and thematic discussions related to accident prevention, early warning and contingency management. Moreover, the APC EG supports the development and implementation of technical tools, projects and joint activities to prevent and control accidental pollution, including the implementation of safety measures for industrial sectors of high priority in the DRB. These activities also contribute to awareness raising on accidental pollution for the public, help orienting stakeholders and financial donors to priority industrial sectors where projects should be targeted and ensure transparency to the public.

The APC EG activities are focused on two main working fields: the emergency warning and the accident prevention. In the area of emergency warning, the Accident Emergency Warning System (AEWS) has been developed and is continuously operated and maintained by the ICPDR. The AEWS provides the countries with a 24/7 communication system aiming at timely responding to any transboundary emergency situation and at ensuring time enough for putting in place quick emergency control measures. The accident prevention field is related to identification and assessment of accident hazard hot-spots and to recommendation and promotion of sufficient safety measures.

Solotvyno salt mines, Ukraine

From 2007 to 2010, flooding of two operational mines and formation of huge earth surface gaps and other hazardous geological phenomena took place at the State Enterprise “Solotvynskyi Solerudnyk” activity territory. An expert conclusion of the Ministry of Emergencies of Ukraine has defined this ecological disaster as a state level emergency. 3 countries (SK, UA and HU) are affected by a potential water quality problem.
The hydrogeological and geotechnical conditions of the mineral salt deposit in Solotvyno, in the Transcarpathian region of Ukraine, are reported to be precarious. Due to the dissolution process and mining works, a number of underground cavities and sinkholes have formed.

According to official data, the degraded territory covers approximately 300 residential houses, a school, a kindergarten, two municipal institutions, power lines, the gas pipeline network, local roads and a cemetery. A policy of resettlement of 70 residential houses has been initiated, but the inhabitants have not been resettled due to religious or familial reasons; this illustrates the diverse cultural and social currents in the area.
In December 2010, the situation related to these dangerous exogenic geological processes within the territory of Solotvyno salt mines was classified as an emergency by a decision of the Transcarpathian Regional State Administration. Later, this decision was approved by the expert report of the Ministry of Emergency Situations of Ukraine (No. 02- 17292 /165 dated from 09.12.2010). This resulted in the announcement of an environmental disaster at state level by the Ministry.

On 12 January 2016, Hungarian and Ukrainian civil protection authorities addressed a letter to Commissioner Stylianides and the Director-General of DG ECHO, Ms Monique Pariat, concerning a cross-border environmental pollution concern at the Solotvyno salt mine complex in Ukraine.

The Union Civil Protection Mechanism (UCPM) was activated on 17 June 2016 with a view to deploying a small preparatory/scoping mission to support the national authorities. The scoping mission took place between 2 and 9 July 2016, and produced a technical report shared with all PS, as well as Ukrainian authorities.
Based on the findings of the scoping mission, it was decided to deploy an advisory mission in order to conduct a comprehensive risk assessment at the “Solotvyno salt mines area”. The deployment took place from 14 September until 7 October 2016.

According to the report Integrated Tisza River Basin Management Plan, 2011, compiled and published by the International Commission for the Protection of the Danube River (ICPDR), Vienna, Austria: “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.”

In 2008 a new SWQS (surface water quality standard) standard was proposed for Chloride -200 mg/l-, as threshold value for the designation of good surface water quality. Measurements by the Upper Tisza Regional Water Directorate (Nyíregyháza, Hungary) showed maximum chloride concentrations above this threshold in 2008 (more than 500mg/l at Tjachiv, 35 river km downstream from Solotvyno).
After the period of active mining in Solotvyno the average annual concentration in chloride reduced. A distinction has thus to be made between instantaneous peak concentrations (also taking seasonality into account) and overall long-term chloride concentrations in the river water.

Other sources of pollution - waste

Municipal waste originating from upstream floodplains is carried by floods in a high amount, causing severe pollution in the Tisza River.

Household and industrial waste is deposited into the floodplain of the Upper Tisza and its tributaries. There are several regions in the headwaters' area where local citizens can't afford to pay for the treatment of household waste adding also that waste management system is lacking in smaller settlements. The floodplain stores deposited waste until floods take it away. Plastic bottles, bags and other garbage swept away by floods, turn the Tisza River into a dump covering the whole surface of the river.

This problem is a constant topic of every Ukrainian-Hungarian transboundary water-related meetings. Upper and the Middle Tisza District Water Directorates in Hungary are in charge – as the responsible water directorates of the area –to abolish the impacts of plastic pollution in the river. There is compensation from Ukraine that partly covers Hungarian costs, while negotiations to solve the situation are continuous.

The accident risk hot-spot inventory[5]

The update of the accident risk hot-spot inventory is close to finalisation; however, a final fine tuning is needed to ensure full comparability and consistency in the TRB. The database and the assessment report will be available only after these corrections, probably in winter or spring 2019.

Besides the hot-spot inventories, the APC EG also focuses on activities related to practical measures to be implemented for risk mitigation. This includes organising thematic discussions, workshops and trainings, developing and promoting sectorial guidelines, checklists and catalogues of measures and facilitating project implementation on safety measures for industrial sectors of high priority in the DRB. Recently, the APC EG has been working on the issue of mining and industrial tailings management facilities (TMFs). A number of TMFs associated with high potential risk exist in the DRB, where the level of safety is insufficient. The APC EG is therefore particularly addressing this issue in cooperation with the UNECE JEG by undertaking a basin-wide risk assessment specifically on the TMFs, by recommending specific checklists and measures to improve safety conditions at the TMFs and by organising certified trainings for facility operators and authority inspectors.

2.1.4 Hydromorphological alteration

Key findings and progress

Concerning the **river continuity** in total 180 barriers were identified in the TRB. The key driving forces causing continuity interruption are water abstraction (44%), flood protection (29%) and hydropower (18%).

Out of the 180 barriers reported by the countries 29 was equipped until 2015 with functional fish migration aids. 131 barriers will remain a hindrance for fish migration as of 2015 and are currently classified as significant pressures. For 20 of the remaining barriers it is still necessary to determine whether fish migration is possible or they were reported to be located outside of the fish area.

With regard to **river morphology**, approximately 27 (11%) SWBs out of a total number of 237 SWBs are near natural to slightly altered. Water bodies reported to be moderately altered are 35 (17%) and 15 (7%) are

5 ICPDR: The Danube River Basin District Management Plan –Update 2015 http://www.icpdr.org/main/sites/default/files/nodes/documents/drbmp-update2015.pdf

extensively to severely altered. Water bodies reported in the 2-class system show that 46 (19%) are nearly natural and 83(35%) are slightly to severely altered.
Concerning **the wetlands/floodplains** and their connection to water bodies since for the 1st ITRBM Plan partly also historical wetlands/floodplains have been reported without being considered to have a reconnection potential, the updated data set addresses now those wetlands/floodplains considered to have a definite reconnection potential, which can be difficult to be assessed e.g. due to different land uses taking place on the former wetlands/floodplains. In total 16,333 ha wetlands/floodplains have been identified to have a reconnection potential in the Tisza River Basin and out of 237 WBs 8 WBs (2 WBs of the Tisa River and 6 WBs in TRB tributaries) are having a recommendation potential beyond 2015. The areas with potential to be reconnected to the Tisza River and its tributaries are located in Ukraine, Slovakia and Serbia.

Hydrological alterations were identified in numbers: 78 impoundments, 33 cases of water abstractions and only one case of hydropeaking in Hungary.

12 FIPs have been reported for the TRB. 9 of them are located in the Tisza River itself. These all projects are related to flood protection and are located in Romania (9) and Hungary (3).

Hydromorphological alterations and their effects gained vital significance in water management due to their impacts on the abiotic sphere as well as on the ecology and ecological status of the river system. Anthropogenic pressures resulting from various hydro-engineering measures can significantly alter the natural structure of surface waters. This structure is essential to provide adequate habitats and conditions for self-sustaining aquatic species. The alteration of natural hydromorphological conditions can have negative effects on aquatic populations, which might result in failing the EU WFD environmental objectives.

Agriculture, hydropower generation and flood protection are the key water uses that cause hydromorphological alterations. In some countries development schemes include reservoirs with multiple purposes. Hydromorphological alterations can also result from anthropogenic pressures related to urban settlements and other sources. These drivers can influence pressures on the natural hydromorphological structures of surface waters in an individual or cumulative way.

The identified three key hydromorphological pressure components of basin-wide importance (Interruption of longitudinal river continuity and morphological alterations; Disconnection of adjacent wetlands/floodplains, and Hydrological alterations) are presented here in details:

2.1.4.1 Interruption of river continuity and morphological alteration

Transversal structures in the rivers like dams and weirs are interrupting the longitudinal continuity and therefore hinder fish from migration. Further effects can include changes of the natural river dynamics, river morphology (with high emphasis on river bed incision due to the interruption of sediment transport).

The 1st Tisza River Basin included an assessment of barriers causing longitudinal continuity interruption for fish migration. Morphological alterations were considered as an important pressure component but not assessed on the basin-wide scale. This data gap was for the first time reduced for the 2013 Update DBA, with the collection of information on morphological alterations to water bodies, which are directly linked to habitat degradation. Same approach is applied for assessment of hydromorphological alterations in the TRB.

Alteration of river continuity for fish migration

Table II. 9 provides information on the applied criteria for the pressure assessment on continuity interruption for fish migration. Compared to data which was provided for the 1st DRBM Plan in 2009, a significant number of barriers which were reported actually do not meet the criteria for the pressure assessments. This is because in 2009 e.g. also river bed stabilization structures for flood risk management like ramps of limited height were reported as barriers equipped with functional fish migration aids. Since these structures do not cause a hindrance for fish migration, this issue has been clarified in the updated data set which was used for the assessments in this report. Due to this reason the total number of barriers is differing from the number reported in the 1st ITRBM Plan.

Table II.9: Continuity interruption for fish migration: Criteria for pressure assessment

Pressure	Provoked alteration	Criteria for pressure assessment
Alteration of river continuity	Interruption of fish migration and access to habitats	Anthropogenic interruption, rhithral >0.7m height, potamal >0.3m height, or lower in case considered as relevant on the national level[6]

In total 180 barriers were identified in the TRB. The key driving forces causing continuity interruption are water abstractions (44%), flood protection (29%) and hydropower (18%). More detailed information on the number of continuity interruptions and associated main uses are illustrated in Figure II. 18 for the different countries. In many cases barriers are not linked to a single purpose due to their multifunctional characteristics (e.g. hydropower uses, agriculture and flood protection). Out of total number of barriers the main portion (86) is located in Romanian part of the TRB, 59 on the territory of Slovakia and 32 in Hungary. Rest three barriers were reported by Ukraine (1 - hydropower) and by Serbia (2 - water abstraction).

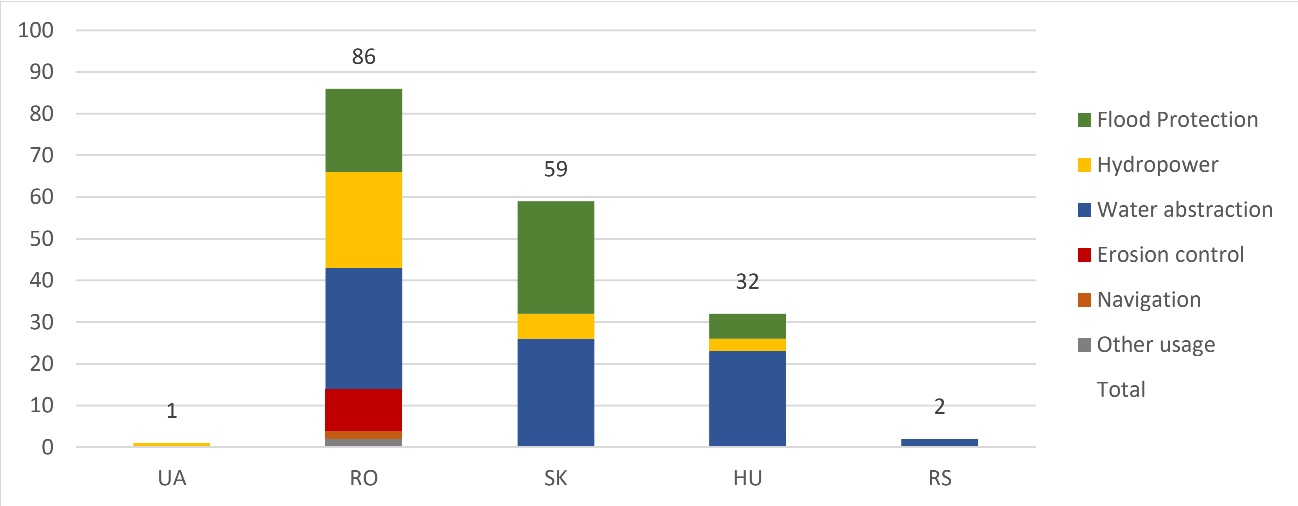

Figure II. 18 Number of barriers and associated main uses

Out of 180 the barriers reported by the countries 29 to be equipped in 2015 with functional fish migration aids. 131 barriers will remain a hindrance for fish migration as of 2015 and are currently classified as significant pressures (see Figure II.19). For the remaining barriers 20 it either still needs to be determined whether fish migration is possible or they were reported to be located outside of the fish area (details see Map 9). On the Tisza River itself 3 barriers are located while the rest of barriers are affecting the tributaries of the TRB.

[6] Rhithral are the headwater sections of rivers and potamal the lowland sections.

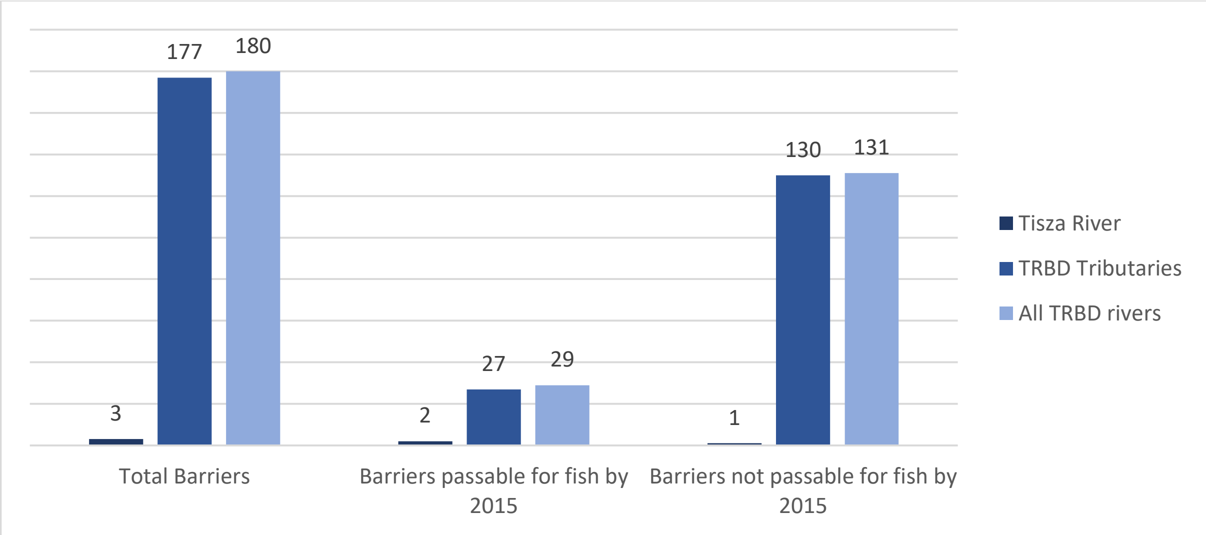

Figure II. 19 Current situations on river continuity interruption for fish migration in the TRB

Alteration of river morphology

Deterioration of the natural river morphology influences habitats of the aquatic flora and fauna and can therefore impact water ecological status. Therefore, the EU WFD requires in Annex II the identification of significant morphological alterations to water bodies. Elements defining river morphology include:

- river depth and width variation,
- structure and substrate of the river bed, and
- structure of the riparian zone.

Aggregated information on the alteration of river morphology was collected on the level of the water body. Since most countries have a five-class system and others a three-class system in place for the assessment of the morphological condition, it was agreed on the DRB level and this approach is applied also in case of the TRB to provide information on the morphological alterations of water bodies in the following three classes system:

- Near-natural to slightly altered (1 - 2);
- Moderately altered (3);
- Extensively to severely altered (4 -5).

This system has been applied in Hungary and Slovakia. In three countries (UA, RO and RS,) a two-class system is applied, whereas data is indicated separately according to the following classification:

- Near-natural;
- Slightly altered to severely altered.

The pressure analysis concludes that 27 (11%) SWBs out of a total number 237 of SWBs are near natural to slightly altered. Water bodies reported to be moderately altered are 35 (15%) and 17 (7%) are extensively to severely altered. Water bodies reported in the 2-class system presents that 46 (19%) are near natural and 83 (35%) are slightly to severely altered see Figure II. 20 and Map 10. For the remaining water bodies, no information on the classification of river morphology is yet available.

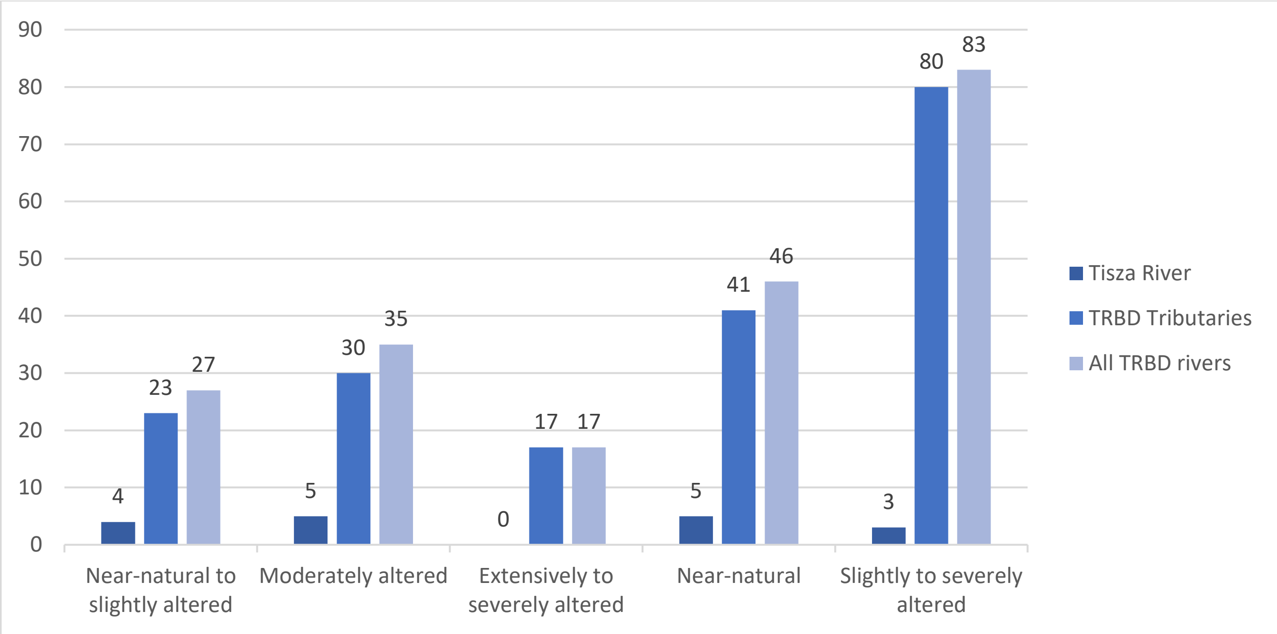

Figure II.20 Morphological alteration to water bodies of the Tisza River, the TRBD tributaries and all TRBD rivers

One of the main morphological problems in the Tisza and Maros rivers is the river bed incision as a consequence of several pressures (e.g. flood protection technics, mining, land cover changes). While active floodplain is significantly elevating after flood periods the river bed is narrowing and deepening.

Further harmonisation efforts are required in the future towards a better comparable assessment of morphological alterations to the rivers in the DRBD which will be utilised also for the TRB.

2.1.4.2 Disconnected adjacent wetlands/floodplain

Wetlands/floodplains and their connection to water bodies play an important role in the functioning of aquatic ecosystems and have a positive effect on water status. Connected wetlands/floodplains play a significant role when it comes to retention areas during flood events, may also have positive effects on the reduction of nutrients and the improvement of habitats and morphology. As an essential part of the river system they are hotspots for biodiversity, also providing habitats for e.g. fish and waterfowls that use such areas for spawning, nursery and feeding grounds.

The 1st ITRBM Plan concluded that 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 basis of the pressure analysis for the 1st ITBM Plan was the consideration that disconnected wetlands/floodplains are potential pressures to aquatic ecosystems on the basin-wide level and that the highest possible area of those which have a reconnection potential should be re-connected in order to support the achievement of the environmental objectives. Therefore, restoration efforts and measures were taken to facilitate the achievement of WFD environmental objectives.

The pressure analysis focused on analysing the location and area of disconnected wetlands/floodplain at areas larger than 100 ha or which have been identified as of basin-wide importance with a definite potential for reconnection by 2015. Since for the 1st ITRBM Plan partly also historical wetlands/floodplains have been reported without being considered to have a reconnection potential, the updated data set addresses now those wetlands/floodplains considered to have a definite reconnection potential, which can be difficult to be assessed e.g. due to different land uses taking place on the former wetlands/floodplains.

In total **16,333 ha** wetlands/floodplains have been identified to have a reconnection potential in the Tisza River Basin and out of 208 WBs 8 WBs (2 WBs of the Tisa River and 6 WBs in TRB tributaries) are having a reconnection potential beyond 2015. Number of river water bodies with wetlands/floodplains, having a reconnection potential beyond 2015 as well as relation to overall number of water bodies is shown in Table II.10.

Table II. 10: Number of river water bodies with wetlands/floodplains, having a reconnection potential beyond 2015 as well as relation to overall number of water bodies

	Number of WBs	WBs with reconnection potential	% with reconnection potential
Tisza River	17	2	11.76%
TRB tributaries	220	6	2.73%
All TRB rivers	237	8	**3.38%**

The areas with potential to be reconnected to the Tisza River and its tributaries are located in Ukraine, Slovakia and Serbia. An overview of river water bodies with wetlands/floodplains, having a reconnection potential beyond 2015 is summarised in table II.11.

Table II.11: Overview of river water bodies with wetlands/floodplains, having a reconnection potential beyond 2015

Country	River	WB code	Wetland/floodplain no.	Size ha
Ukraine	Tisza	UATISR04	27	7,625
	Borzhava	UABOR02	6	5,368
Romania	0	0	0	0
Slovakia	Bodrog	SKB0001	3	735
	Latorica	SKB0140	1	350
	Uh	SKB0150	4	41
	Hornad	SKH0004	1	7
	Tisza	SKT0001	1	529
Hungary	0	0	0	0
Serbia	Begej	RSBEG	1	1,678
Total			**44**	16,333

Out of the total recommended size of wetlands/floodplains (> 100 ha or of basin-wide importance) 1,678 ha are partly reconnected in the territory of Serbia where some of the required measures were already completed but further measures should be, having positive effects on water status and flood mitigation. The remaining wetlands/floodplains, covering an area of 12,993 ha in Ukrainian part of the TRB and 1,662 ha in Slovakia, have a remaining potential to be re-connected to the Tisza River and its tributaries in the next WFD cycles (see Figure 21 and Map 11).

The indication of reconnection potential for wetlands/floodplains in Romania and Hungary does not indicate that there are wetlands/floodplains with reconnection potential. Figure II. 21 illustrates relevant project information for the basin-wide scale for wetlands/floodplains with an area larger 100 ha.

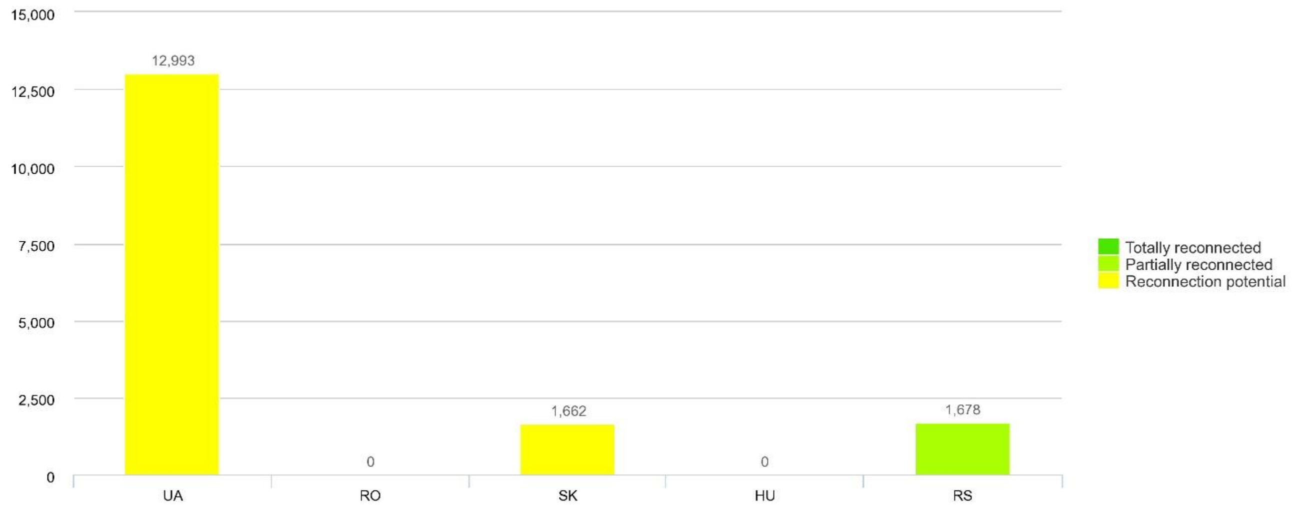

Figure II.21 Area [ha] of TRB wetlands/floodplains (> 100 ha or of basin-wide importance) which are reconnected or with reconnection potential

2.1.4.3 Hydrological alterations

The main remaining pressure types causing hydrological alterations are in numbers: 65 impoundments, 27 cases of water abstractions and only one case of hydropeaking in Hungary (Sebes Koros), WB number HUAEP953). The provoked alterations and applied criteria used for the assessment are shown in Table II.12. the actual number of significant cases might be higher compared to the currently known figures.

Table II.12: Hydrological pressure types, provoked alterations and criteria for the respective pressure/impact analysis

Hydrological pressure	Provoked alteration	Criteria for pressure assessment
Impoundment	Alteration/reduction in flow velocity and flow regime of the river sections caused by artificial transversal structures	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 and dynamics of discharge/flow in water	Flow below dam <50% of mean annual minimum flow[7] in a specific time period (comparable with Q 95)
Hydropeaking	Alteration of flow dynamics/discharge pattern in river and water quantity	Water level fluctuation >1 m/day or less in the case of known/observed negative effects on biology

[7] A pressure provoked by these uses is considered as significant when the remaining water flow below the water abstraction (e.g. below a hydropower dam) is too small to ensure the existence and development of self-sustaining aquatic populations and therefore hinders the achievement of the environmental objectives. Criteria for assessing the significance of alterations through water abstractions vary among EU countries. Respective definitions on minimum flows should be available in the national RBM Plans.

Impoundments

Impoundments are caused by barriers that – in addition to interrupting river/habitat continuity – alter the upstream and downstream flow conditions of rivers. The character of the river is changed to lake-like type due to the decrease of flow velocities and eventual alteration of discharge. Additionally, impoundments can lead to erosion and deepening processes downstream of the impounded section, inducing a decrease of the groundwater table and consequently, dry out of the adjacent wetlands and also sediment flow is altered.

The pressure analysis shows that 78 impoundments are located in the TRB (see Figure 22 and Map 12). These impoundments affect 891 km of all rivers lengths in the TRB with catchment areas > 1,000 km^2, it means that about 9% of the total river length in the TRB are affected by impoundments. In the Tisza River itself 4 impoundments are reported with length of 350 km (1%), whilst in the tributaries 74 impoundments are located with a total length of 541 km (14%).

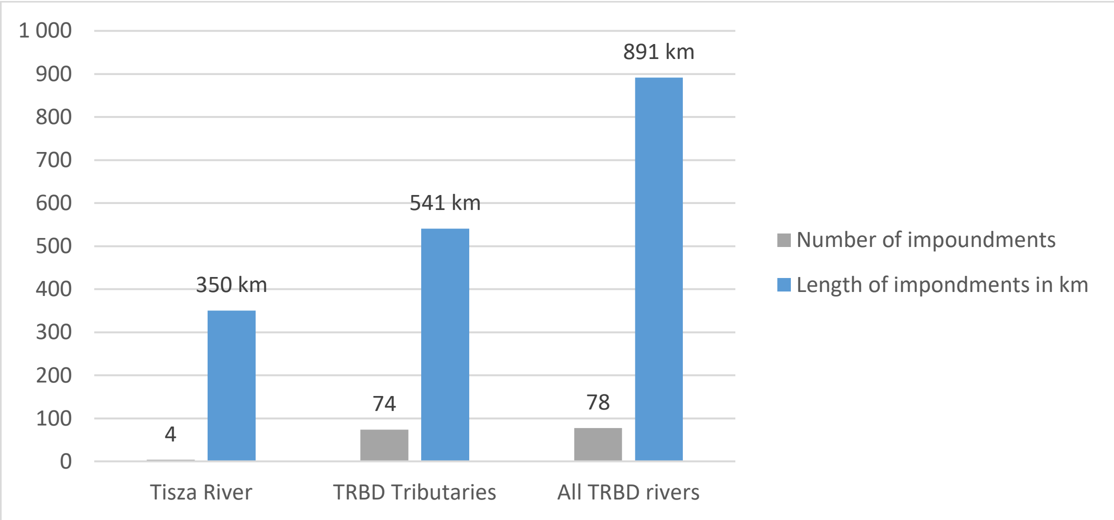

Figure 22 Number and length of impoundments in the TRB

Water abstractions

Water quality and quantity are intimately related within the concept of 'good status'. Water abstractions can significantly reduce the quantity of water and impact the water status in case where the minimum ecological flow of rivers is not guaranteed. Addressing this important issue, a Guidance No 31 - Ecological flows on ecological parameters/ecological flows and hydrological parameters for assessing quantitative aspects and the link to GES have been developed in the frame of the WFD CIS process (Guidance Document no. 31 "Ecological flows in the implementation of the WFD" and was published in 2015.

The pressure analysis concludes that in total 33 significant water abstractions are causing alterations in water flow in TRB rivers. Water abstractions related mainly to hydropower generation (18), public water supply (6), cooling purposes for electricity production (1), agriculture, forestry and irrigation (2). All water abstractions are located in Romania (29) and Hungary (4), see Figure II. 23 and Map 13.

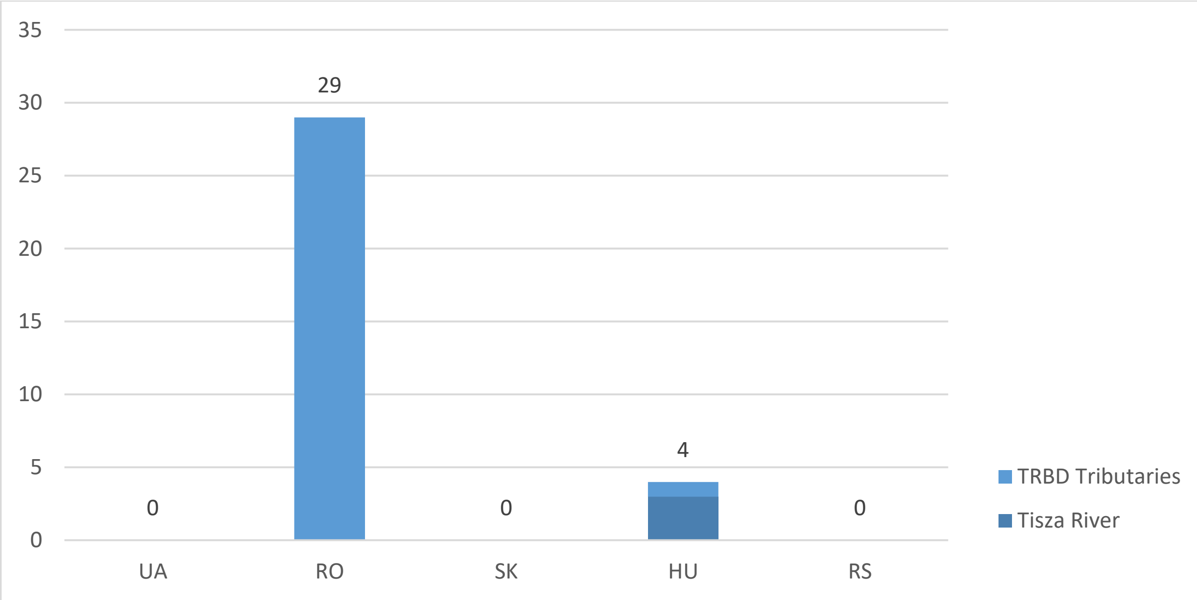

Figure 23 Number of significant water abstractions in the Tisza River and TRB tributaries with catchment areas > 1,000 km²

2.1.4.4 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 (FIPs) 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 during implementation of those projects (e.g. oil spills, antifouling agents, etc.).

The future infrastructure projects are listed based on specific selection criteria shown in Table II.13:

Table II. 13: Criteria for the collection of future infrastructure projects for the Tisza River and other TRB rivers with catchment areas >1.000 km²

	Tisza River	Other TRB rivers with catchment areas >1.000 km²
Criteria	Strategic Environmental Assessment (SEA) and/or Environmental Impact Assessments (EIA) are performed for the project	Strategic Environmental Assessment (SEA) and/or Environmental Impact Assessments (EIA) are performed for the project
	or	**and**
	project is expected to provoke transboundary effects	project is expected to provoke transboundary effects

All FIPs (until 2021) including brief descriptions (if provided) are compiled in Annex 3 and Map 14. The pressure analysis concludes that 12 FIPs have been reported for the TRB. 9 of them are located in the Tisza River itself. These all projects are related to flood protection and are located in Romania (9) and Hungary (3)

2.1.5 Other issues

To be completed by WG on **WP 4 Water Quantity issues**

Abbreviations

AEWS	Accident Emergency Warning System
ARS	Accidental Risk Spots
BAT	Best Available Techniques
BAP	Best Agricultural Practice
BEP	Best Environmental Practices
BLS	Baseline Scenario
BOD5	5-day Biochemical Oxygen Demand
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
E-PRTR	European Pollutant Release and Transfer Register
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)
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 updated management plan for Crisuri hydrographical area

The updated management plan for Mures river basin

The updated management plan for Banat hydrographical area

The update of Hungarian River Basin Management Plan
https://www.vizugy.hu/index.php?module=vizstrat&programelemid=149

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