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Danube Transnational Programme
JOINTISZA

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Draft Updated Integrated Tisza River Basin Management Plan

Annex 13. Report on Tisza River Basin reservoirs, discharge, water use and demand

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

DANUBE REGION strategy

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1 Background and introduction

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, hydropower production, and recreation. The largest tributaries of the Danube River by catchment area are the Tisza River (157 186 km^2) and Sava River (97 713 km^2). Additionally, the population is higher in the Tisza River Basin (14 Million) than in the Sava River Basin (8.5 Million). In comparison with average discharge of the Sava River (1 559 m^3/s) Tisza River has only half of it (825 m^3/s). As a result, demand in water is higher in the Tisza River Basin, which raises concerns about the need to ensure a harmonised and sustainable water resource management in the Tisza River Basin. Although the reserves of water are sufficient for the current users, expected increase in water use accompanied with fluctuating climate may have adverse effects on water quantity.

Data and information presented in this Annex are reported by Tisza countries based on template that follow approach applied for development of the First Tisza Analysis Report (TAR 2007) and other studies and background documents relevant for Tisza River Basin water quantity (present use and demand by the 2021) within the scope of International Commission for the Protection of the Danube River (ICPDR) Tisza Group and other ICPDR expert groups. With respect to Climate Change effects on water quantity management, in this Annex only relevant projects and studies TRB wide significant and Tisza countries specific are included. Relevant Climate Change TRB (countries specific) adaptation measures are elaborated in the ITRBMP Update Annex 14.

General info & approach used for data collection and evaluation

In this Annex data and information presented in chapters 3-8 water use - PRESENT &DEMAND are based on following criteria:

- *The last 3 years refer to period 2013-2015 (present water use) and*
- *Total demand and consumption by 2021*

Data and information reported for Hydropower, navigation and irrigation are included in ITRBMP Update chapters 1 and 7.

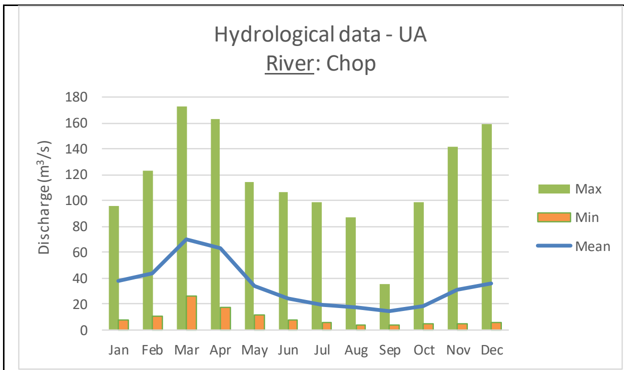
Consumptive use:

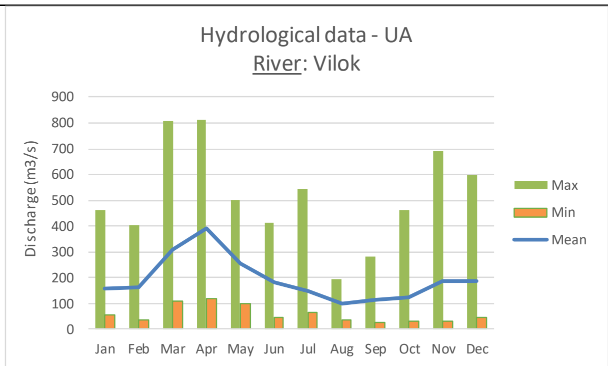
Water abstracted which is no longer available for use because it has evaporated, transpired, been incorporated into products and crops, or consumed by man or livestock. Water losses due to leakages during the transport of water between the point or points of abstraction and the point or points of use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

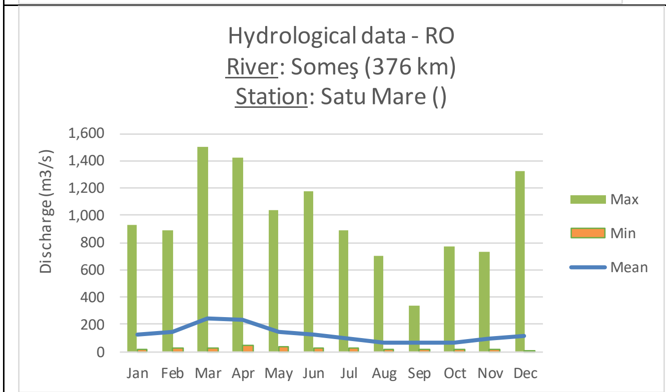
2 TRB Water Resources – Surface Water: Discharge Data and Water Storage

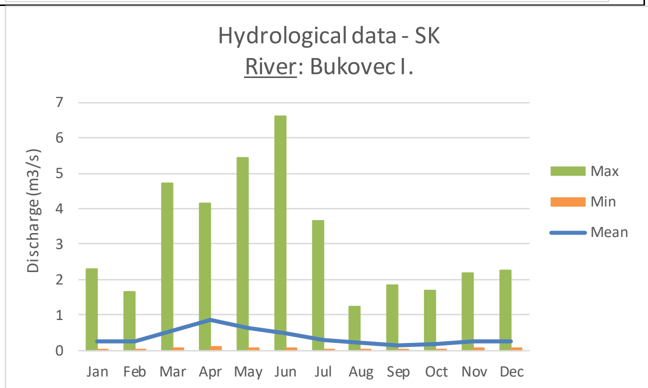
TRB Interannual Discharge data

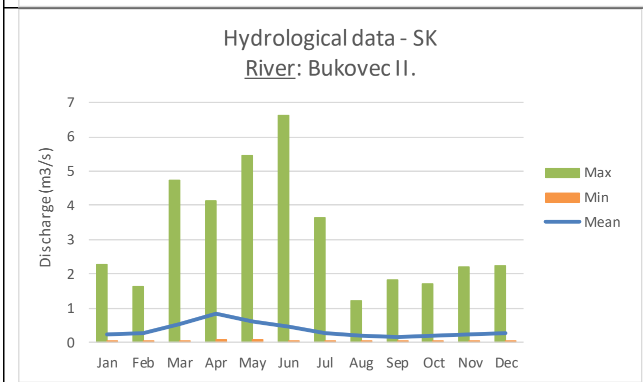
Figures below summarized interannual discharge data (mean, maximum and minimum values) based on data and information provided by Tisza countries.

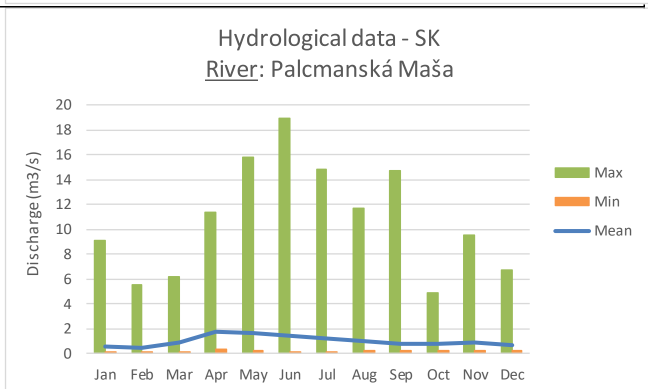


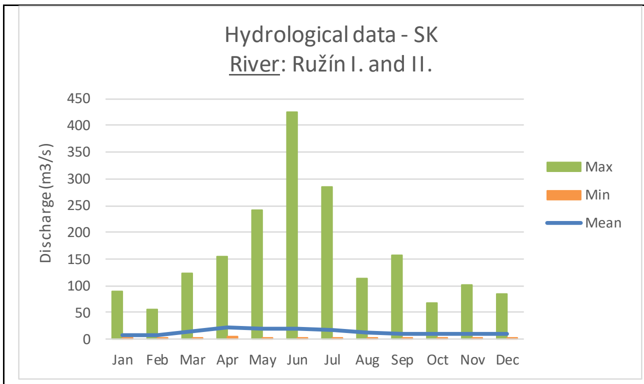


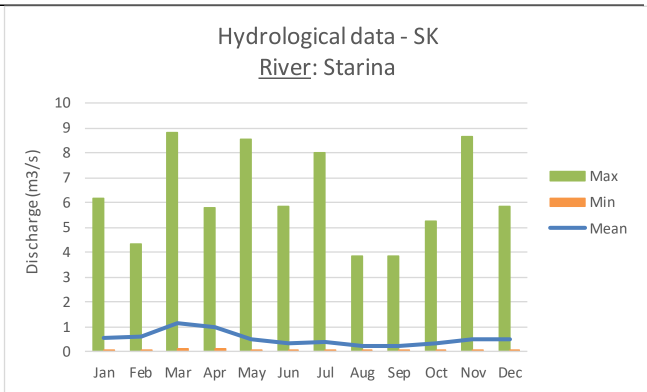


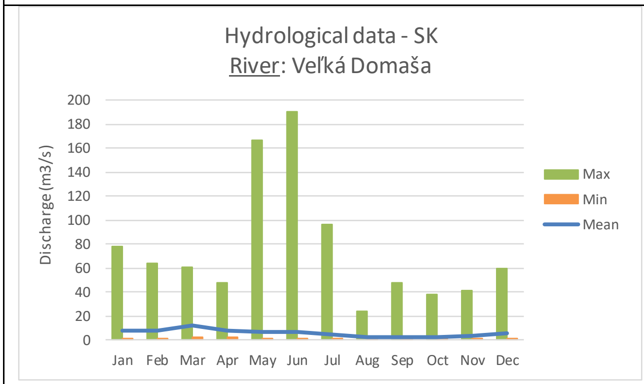


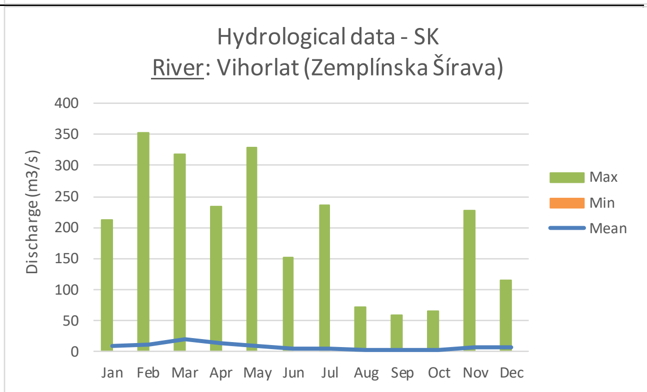


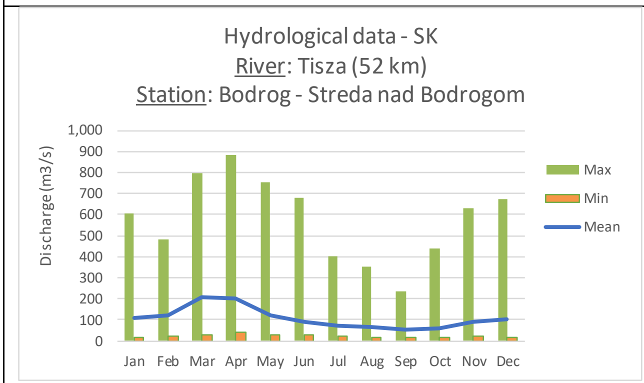


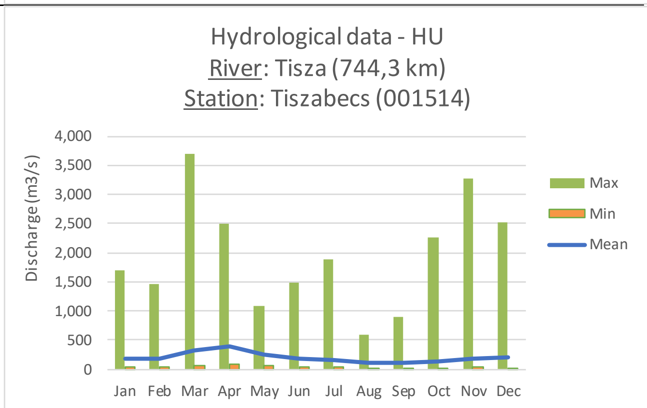

Hydrological data - SK
River: Ružín I. and II.
Discharge (m3/s)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Max
Min
Mean

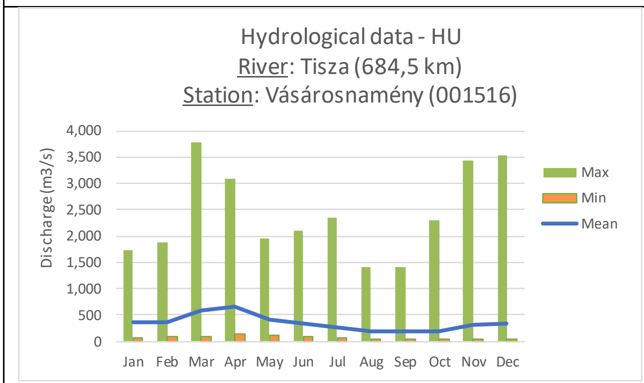

Hydrological data - SK
River: Starina
Discharge (m3/s)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Max
Min
Mean

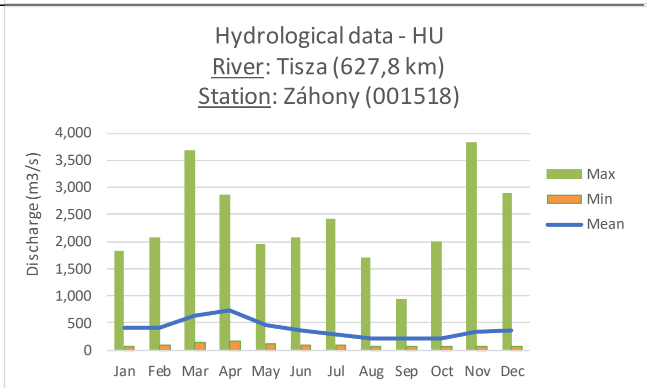

Hydrological data - SK
River: Veľká Domaša
Discharge (m3/s)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Max
Min
Mean

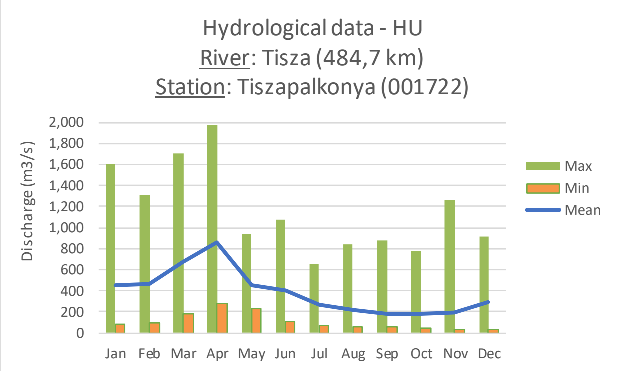

Hydrological data - SK
River: Vihorlat (Zemplínska Šírava)
Discharge (m3/s)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Max
Min
Mean

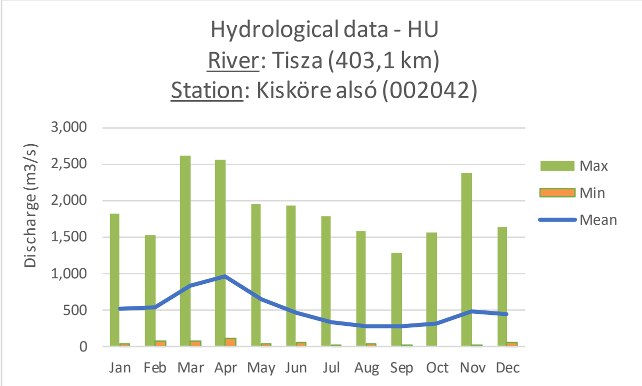

Hydrological data - SK
River: Tisza (52 km)
Station: Bodrog - Streda nad Bodrogom
Discharge (m3/s)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Max
Min
Mean

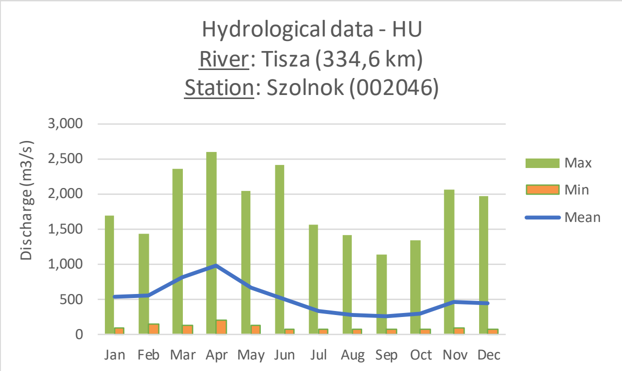

Hydrological data - HU
River: Tisza (744,3 km)
Station: Tiszabecs (001514)
Discharge (m3/s)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Max
Min
Mean

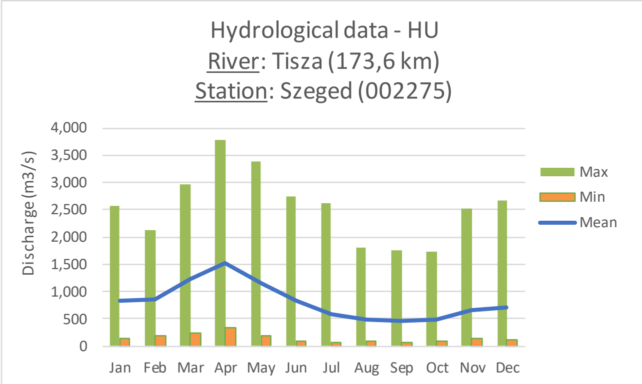

Hydrological data - HU
River: Tisza (684,5 km)
Station: Vásárosnamény (001516)
Discharge (m3/s)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Max
Min
Mean

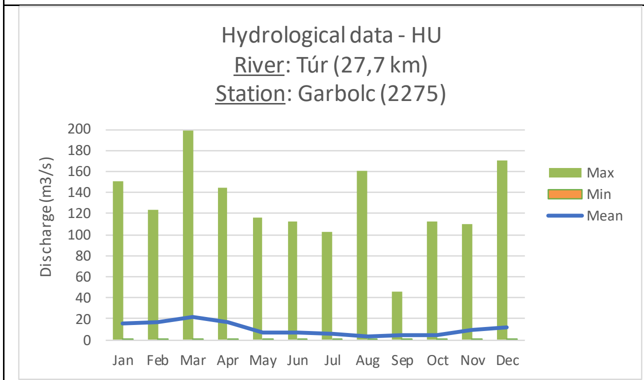

Hydrological data - HU
River: Tisza (627,8 km)
Station: Záhony (001518)
Discharge (m3/s)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Max
Min
Mean

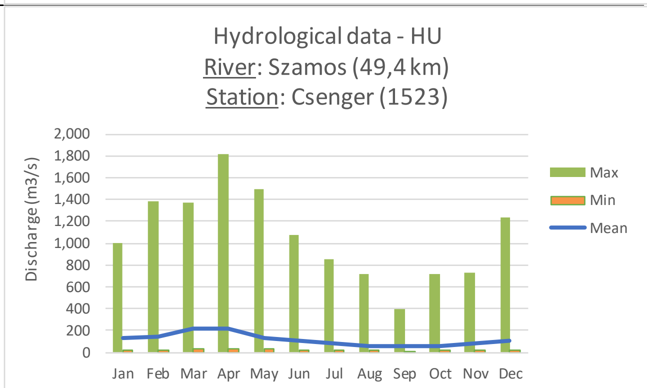

Hydrological data - HU
River: Tisza (484,7 km)
Station: Tiszapalkonya (001722)
Discharge (m3/s)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Max
Min
Mean

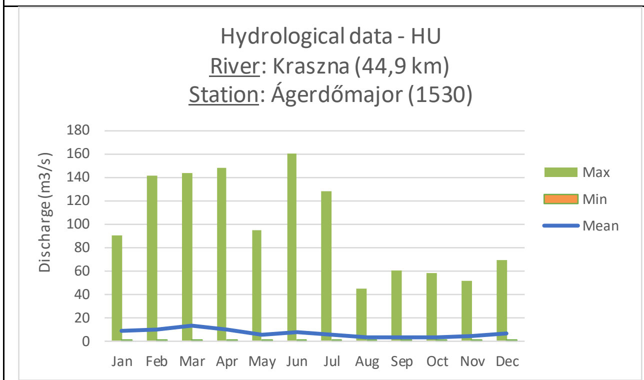

Hydrological data - HU
River: Tisza (403,1 km)
Station: Kisköre alsó (002042)
Discharge (m3/s)
3,000
2,500
2,000
1,500
1,000
500
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Max
Min
Mean

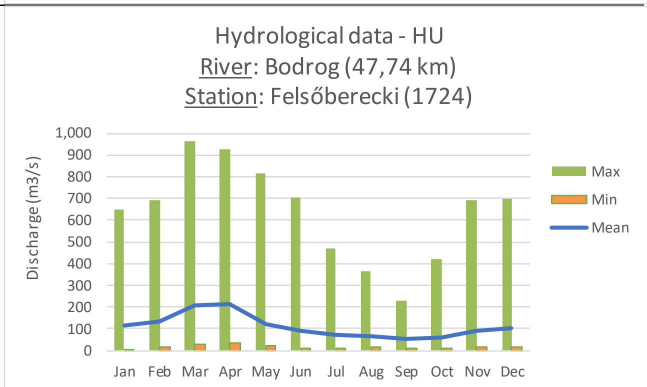

Hydrological data - HU
River: Tisza (334,6 km)
Station: Szolnok (002046)
Discharge (m3/s)
3,000
2,500
2,000
1,500
1,000
500
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Max
Min
Mean


Hydrological data - HU
River: Tisza (173,6 km)
Station: Szeged (002275)
Discharge (m3/s)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Max
Min
Mean


Hydrological data - HU
River: Túr (27,7 km)
Station: Garbolc (2275)
Discharge (m3/s)
200
180
160
140
120
100
80
60
40
20
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Max
Min
Mean


Hydrological data - HU
River: Szamos (49,4 km)
Station: Csenger (1523)
Discharge (m3/s)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Max
Min
Mean


Hydrological data - HU
River: Kraszna (44,9 km)
Station: Ágerdőmajor (1530)
Discharge (m3/s)
180
160
140
120
100
80
60
40
20
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Max
Min
Mean


Hydrological data - HU
River: Bodrog (47,74 km)
Station: Felsőberecki (1724)
Discharge (m3/s)
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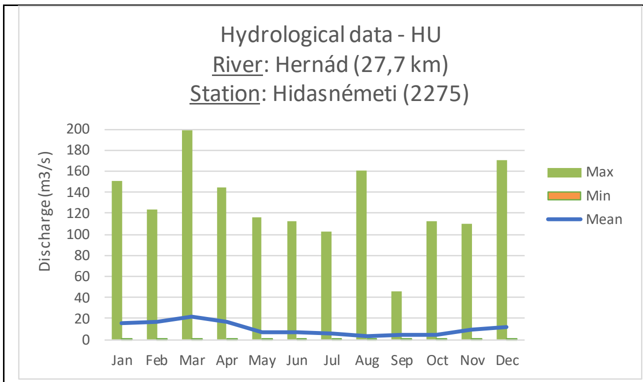
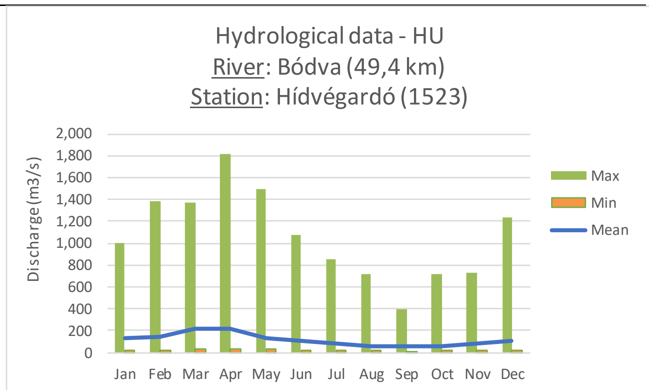
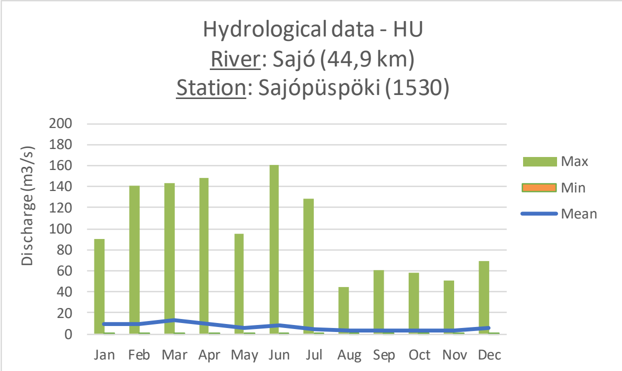
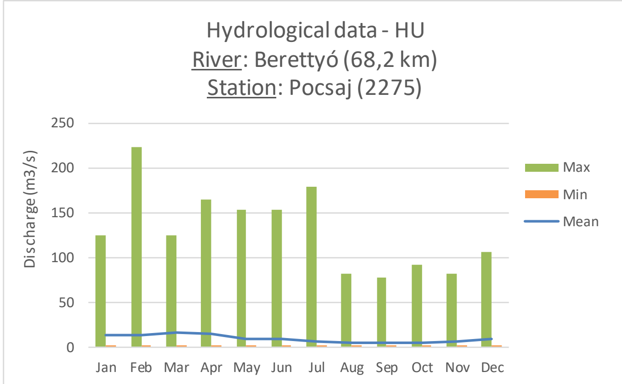
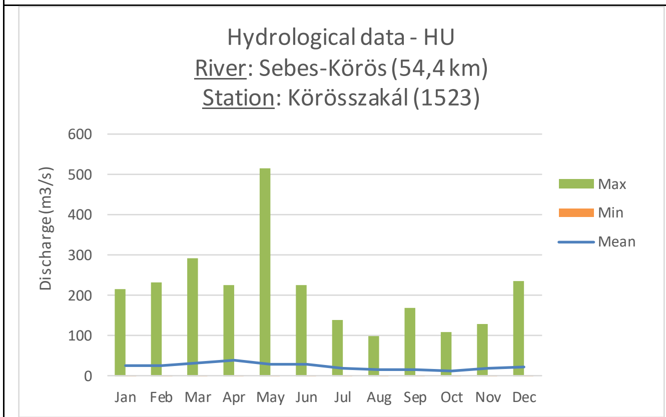
900
800
700
600
500
400
300
200
100
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Max
Min
Mean

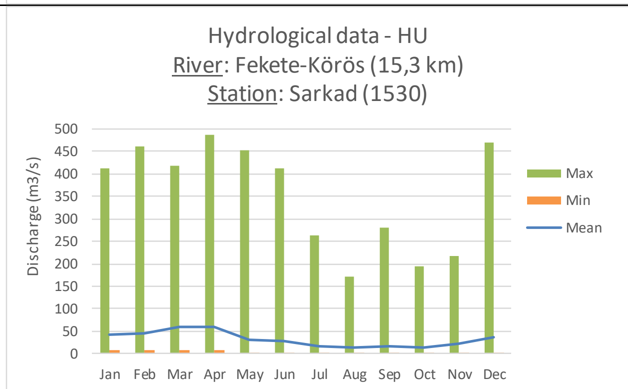

Hydrological data - HU
River: Hernád (27,7 km)
Station: Hidasnémeti (2275)
Discharge (m3/s)
200
180
160
140
120
100
80
60
40
20
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Max
Min
Mean

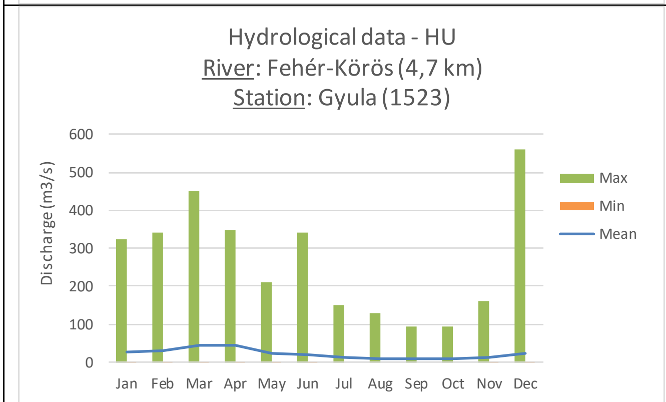

Hydrological data - HU
River: Bódva (49,4 km)
Station: Hídvégardó (1523)
Discharge (m3/s)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Max
Min
Mean

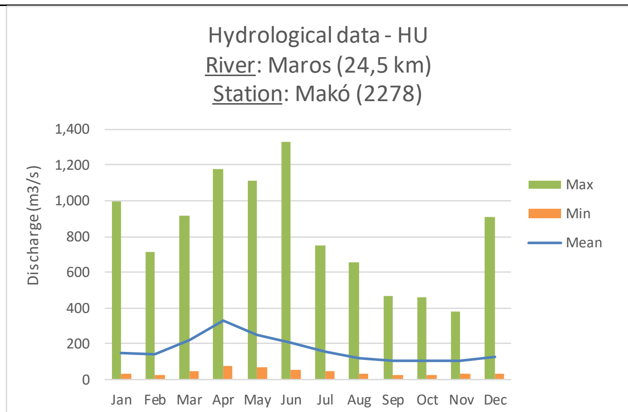

Hydrological data - HU
River: Sajó (44,9 km)
Station: Sajópüspöki (1530)
Discharge (m3/s)
200
180
160
140
120
100
80
60
40
20
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Max
Min
Mean

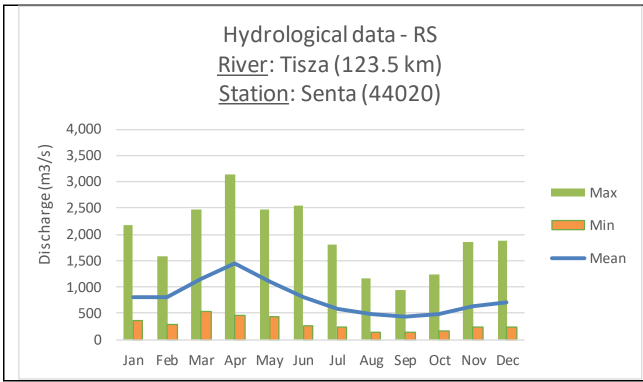

Hydrological data - HU
River: Berettyó (68,2 km)
Station: Pocsaj (2275)
Discharge (m3/s)
250
200
150
100
50
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Max
Min
Mean


Hydrological data - HU
River: Sebes-Körös (54,4 km)
Station: Körösszakál (1523)
Discharge (m3/s)
600
500
400
300
200
100
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Max
Min
Mean


Hydrological data - HU
River: Fekete-Körös (15,3 km)
Station: Sarkad (1530)
Discharge (m3/s)
500
450
400
350
300
250
200
150
100
50
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Max
Min
Mean


Hydrological data - HU
River: Fehér-Körös (4,7 km)
Station: Gyula (1523)
Discharge (m3/s)
600
500
400
300
200
100
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Max
Min
Mean


Hydrological data - HU
River: Maros (24,5 km)
Station: Makó (2278)
Discharge (m3/s)
1,400
1,200
1,000
800
600
400
200
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Max
Min
Mean



Figures II.1. TRB hydrological stations spatial distribution reported by Tisza countries for annual (mean, maximum and minimum) and inter-annual discharge.

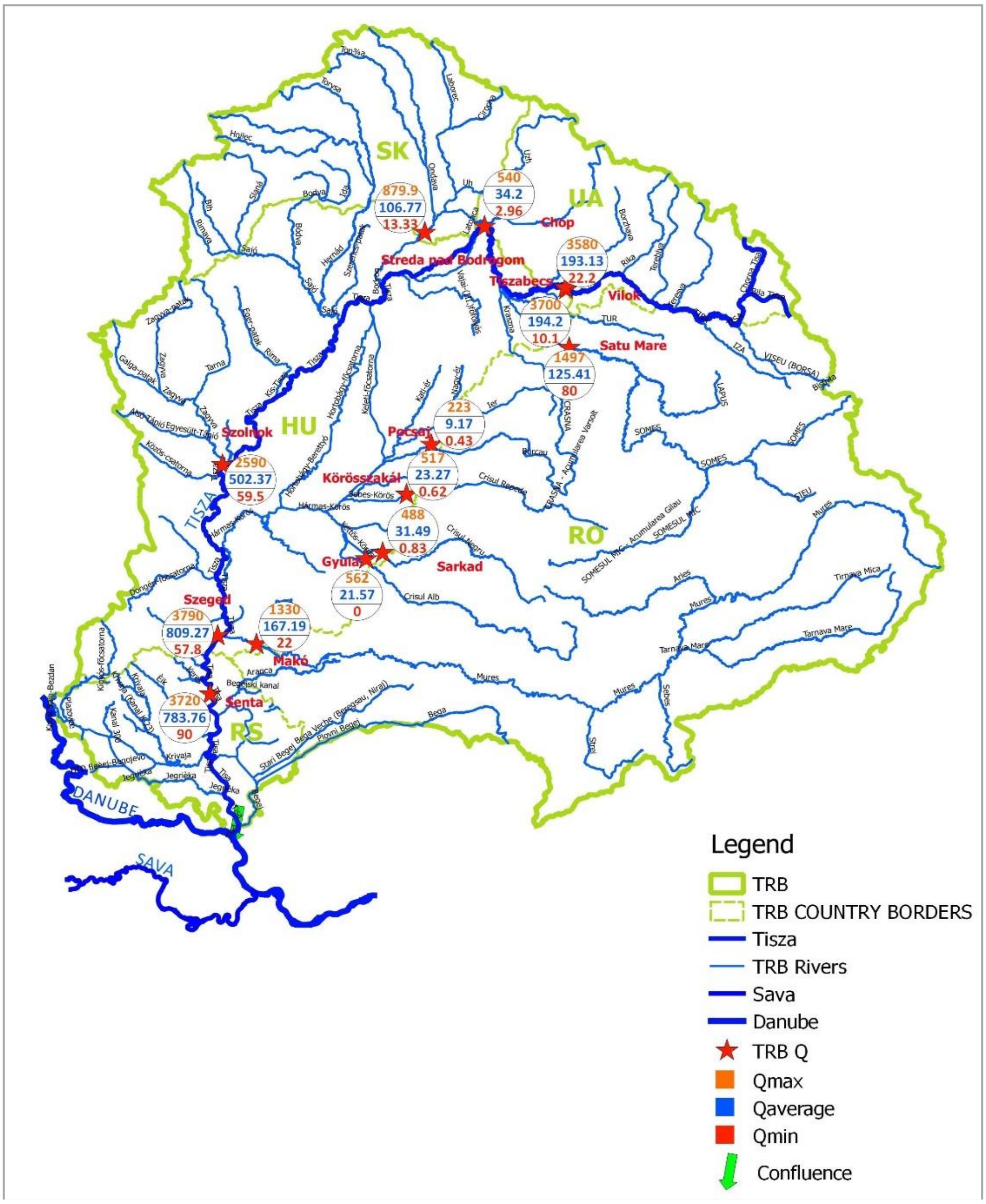


Figure II.2. TRB spatial distribution of Hydrological Stations reported for annual discharge

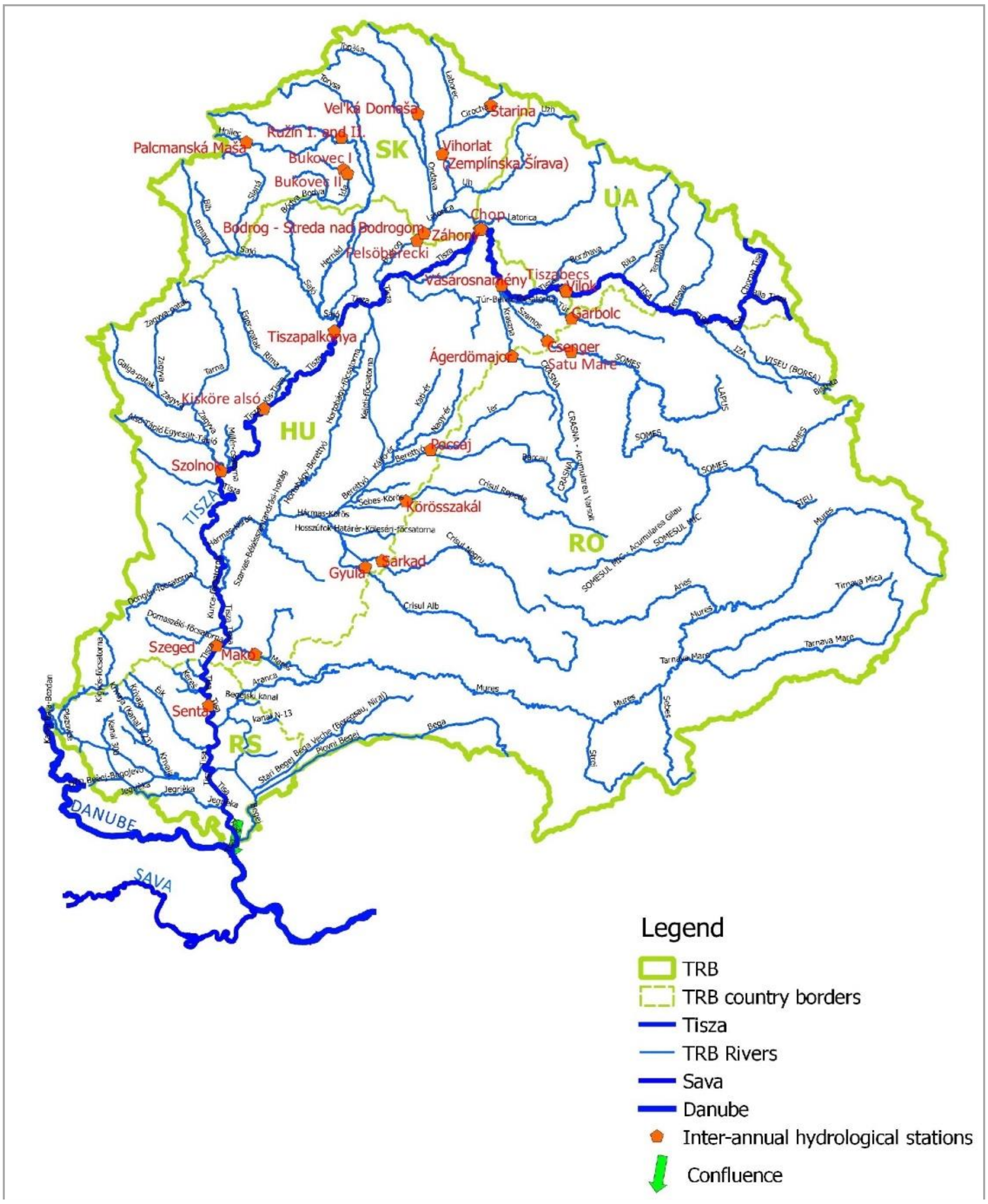


Figure II.3. TRB spatial distribution of Hydrological Stations reported for inter annual discharge

TRB water storage – reservoirs data and information

Total number of reservoirs within the TRB is 125 scattered over the basin. The greatest number is located in Romania 77, followed by 23 in Hungarian share of TRB, 9 in Ukraine and Serbia and 7 in Slovakia.

With respect to volume there are 91 reservoirs with water storage ≤ 10 million cubic meters (Mm^3) with total volume of 241.57 Mm^3. The Table II.1 and Figure II.4 outline synthesis with respect to this volume.

Table II.1. Outline of TRB reservoirs with volume ≤ 10 Mm^3 per Country

Tisza Countries	UA	RO	SK	HU	RS
Number of reservoirs	9	48	1	24	9
Percentage of reservoirs per country	10.0	53.33	1.11	26.67	9.89
Volume per country Mm^3	17.703	132.465	2.19	72.665	23.45

As presented in Figure II.5 45 (approximately 50%) reservoirs with volume ≤ 10 Mm^3 are multipurpose. With respect to reservoirs with single purpose, all 26 reservoirs that serve only for flood protection are located in Romanian share of TRB, and 2 with flood retention purpose only are in Hungary. Nine reservoirs for irrigation are within Serbian share of TRB and 1 is in Hungary. Reservoirs for hydropower generation are located in Romania (5), and those for WS are located in Romania and Hungary, 1 and 2, respectively.

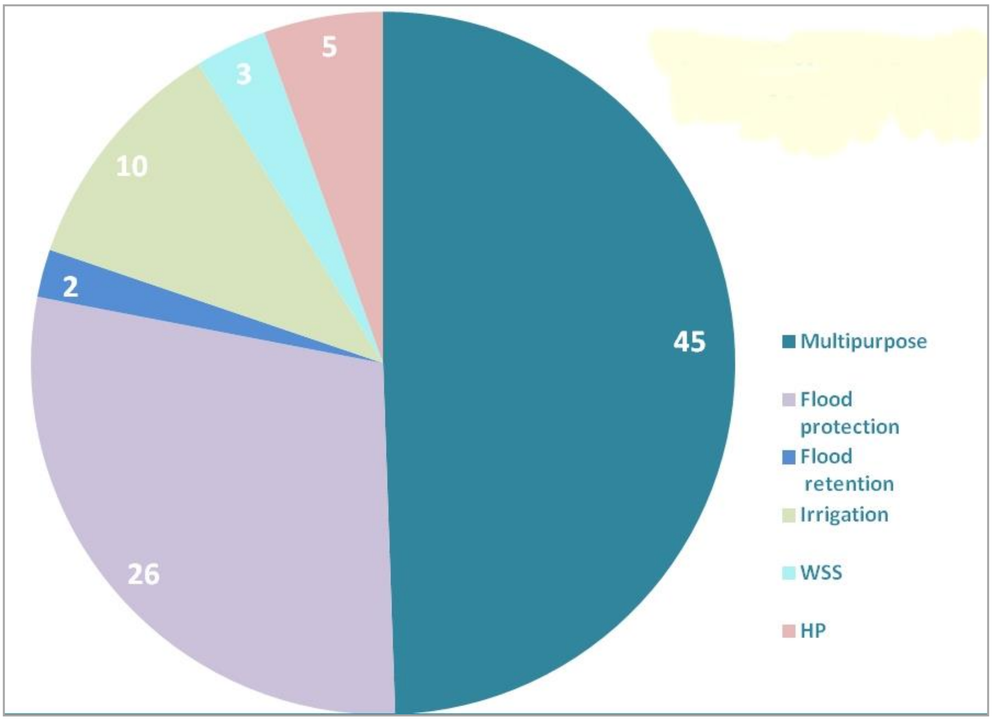


Figure II.4. Number of reservoirs with volume ≤ 10 Mm^3 within the TRB

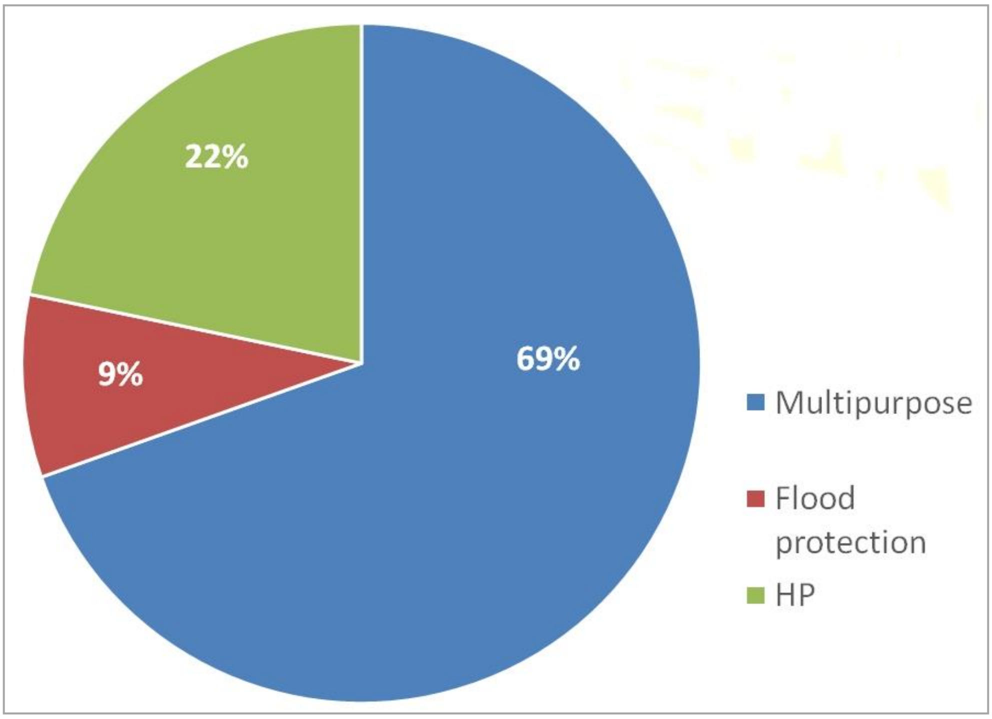


Figure II.5. Percentage of reservoirs with volume > 10 Mm^3 within the TRB

Remarks regarding the reservoirs provide by Ukraine are following:

- All water reservoirs in Tisza basin (Ukraine) were built in 1950-1960s and are very silted (silting covers around 30-40%)
- Volume and area of water reservoir are mentioned for operational regime (normal banked-up water level).
- Water reservoirs “Gorbok”, “Zaluzh”, “Mochilo” and “Fornosh” belong to one irrigation system “Chorny Mochar”.
- All water reservoirs in Tisza basin have complex use, except Tereblya-Rikska HPP, which is used only for hydropower.
- Water reservoir of Tereblya-Rikska HPP belong to sub-basins of two rivers: Tereblya (water in-take) and Rika (discharge from water reservoir).

Spatial distribution of TRB reservoirs with respect to purpose and volume are exhibited in Figures II.6 and II.7 respectfully.

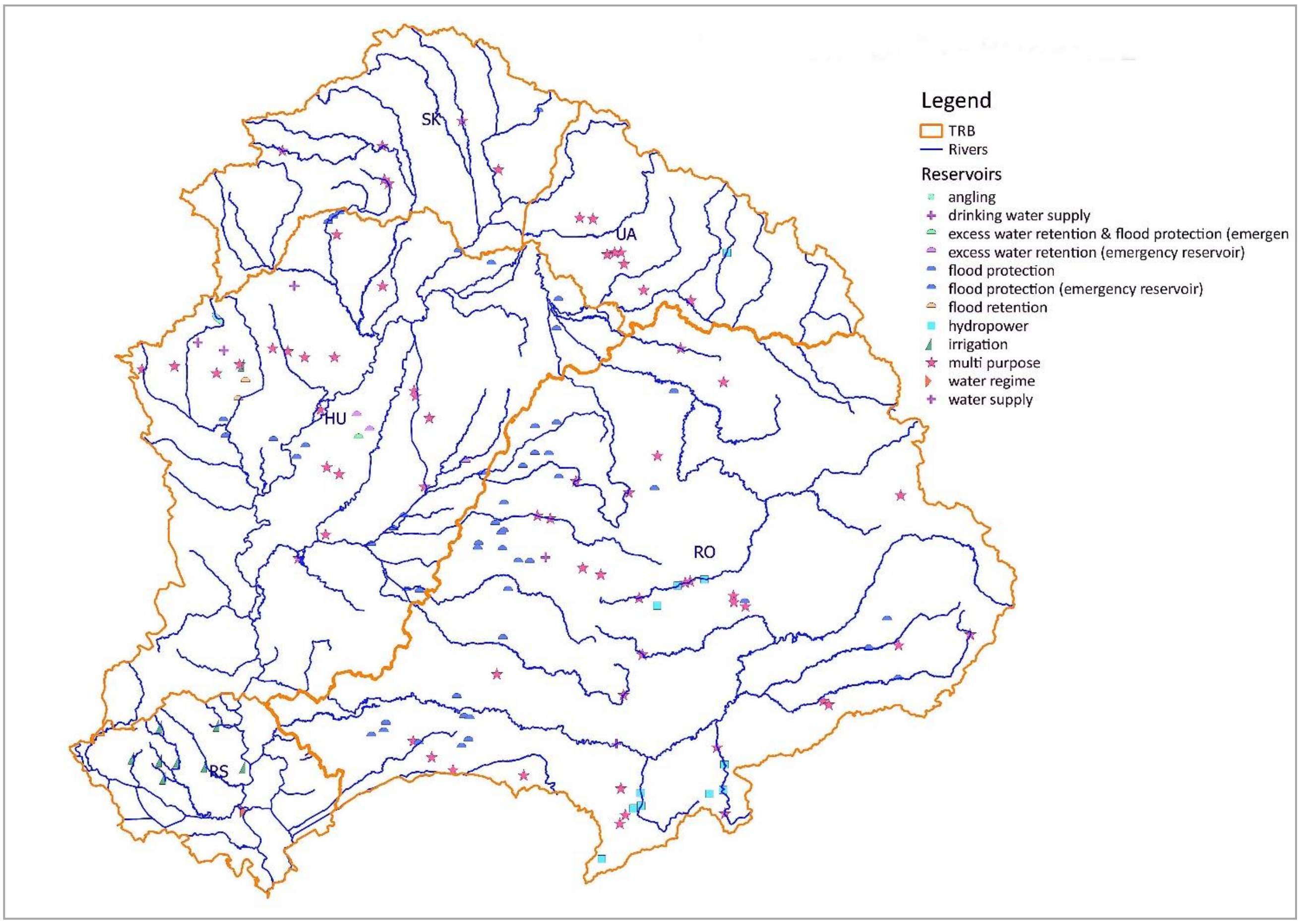


Figure II.6. TRB reservoirs spatial distribution with respect to purpose

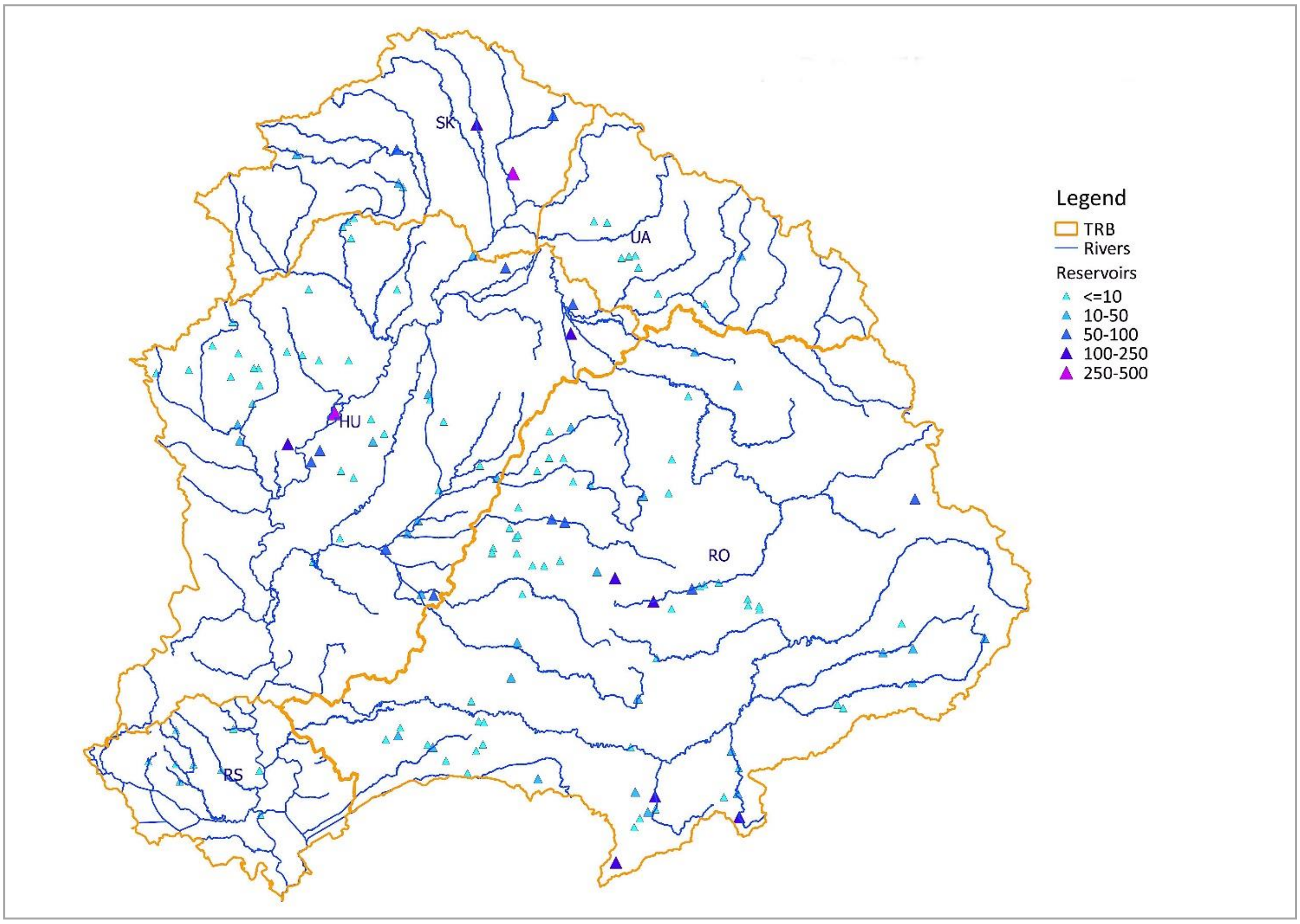
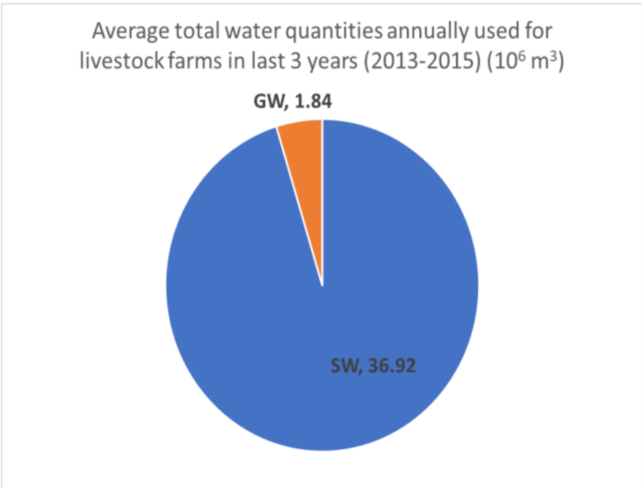
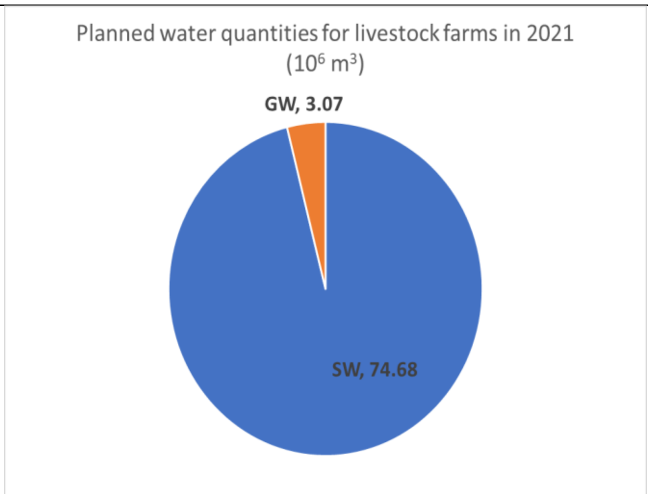


Figure II.7. TRB reservoirs spatial distribution with respect to volume

3 TRB water use and demand: Other agricultural use (livestock farms, fish production, etc.)





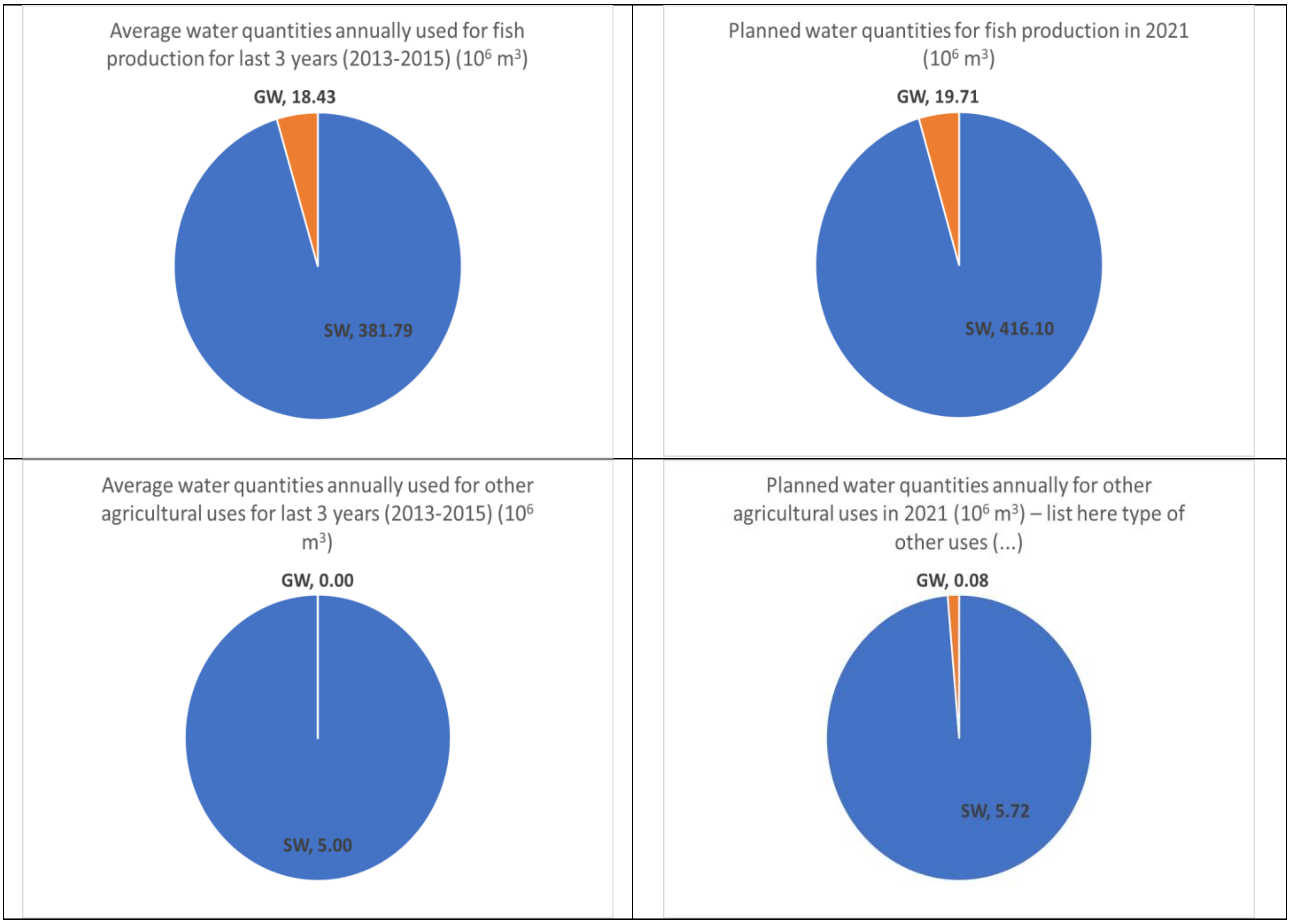
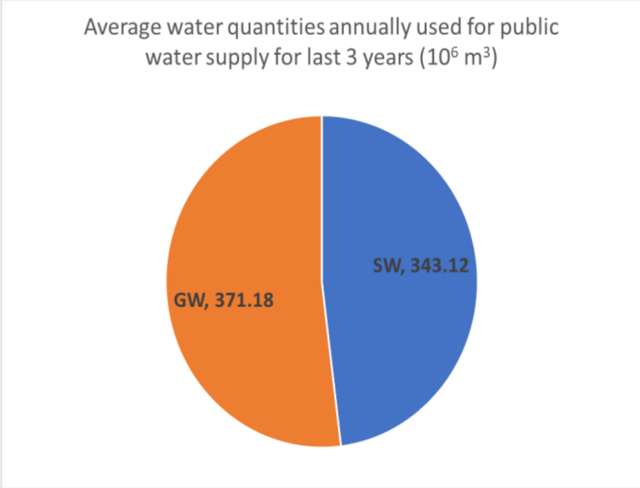


Figure III.1. TRB other agricultural use comparison between present water use and future water demand

Table III.1. TRB other agricultural water use comparison between present water use and future water demand

JOINTISZA	UA	RO	SK	HU	RS	Summary
Average water quantities annually used for livestock farms for last 3 years (10^6 m^3)	0.9	3.63	1.23	13	20	38.76
Average water quantities annually used for fish production for last 3 years (10^6 m^3)	9.8	153.78	0.89	165	70.75	400.22
Average water quantities annually used for other agricultural uses for last 3 years (10^6 m^3)	-	NA	NA	-	5	5
Planned water quantities for livestock farms in 2021 (10^6 m^3)	0.5	36.02	1.23	15	25	77.75
Planned water quantities for fish production in 2021 (10^6 m^3)	10	169.92	0.89	175	80	435.81
Planned water quantities annually for other agricultural uses in 2021 (10^6 m^3)	0.8	NA	NA	-	5	5.8

4 TRB water use and demand: Public water supply



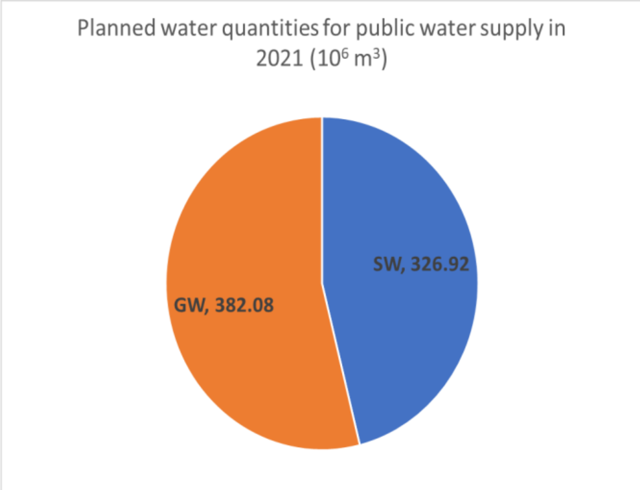


Figure IV.1. TRB public water supply comparison between present water use and future water demand with respect to source

Table IV.1. TRB public water supply comparison between present water use and future water demand

JOINTISZA	UA	RO	SK	HU	RS	Summary
Total capacity of public water supply systems (m^3/s)	0.7	93.78	5.5	9	1.7	110.68
Average water quantities annually used for public water supply for last 3 years (10^6 m^3)	22.1	362.91	58.97	218	52.32	714.3
Planned capacity of public water supply systems in 2021 (m^3/s)	0.5	NA	5.5	9.1	1.8	16.9
Planned water quantities for public water supply in 2021 (10^6 m^3)	17	347	60	225	60	709

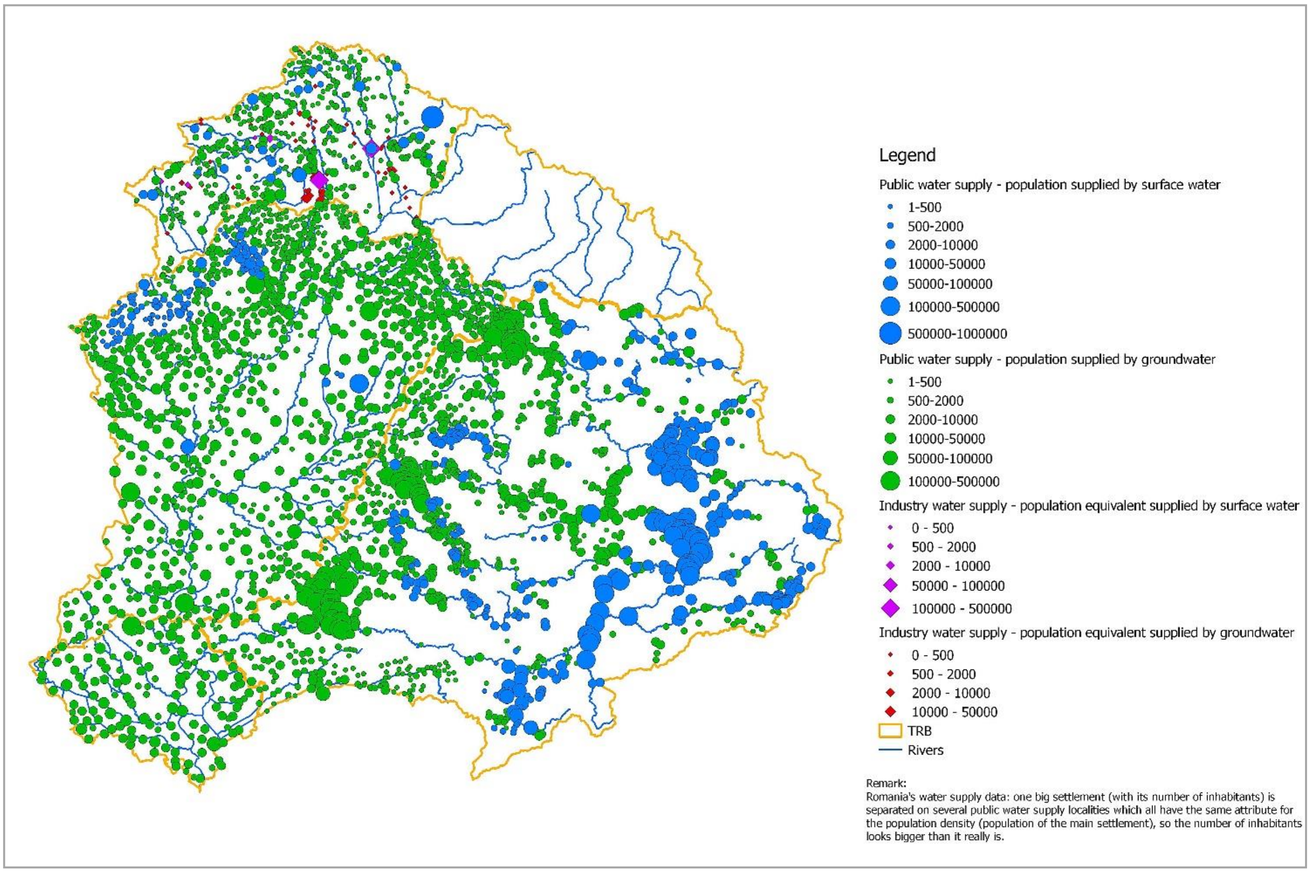


Figure IV.2. TRB water source spatial distribution– public water supply

5 TRB water use and demand: Water supply of industry - including thermal power plant cooling

Water supply for industry

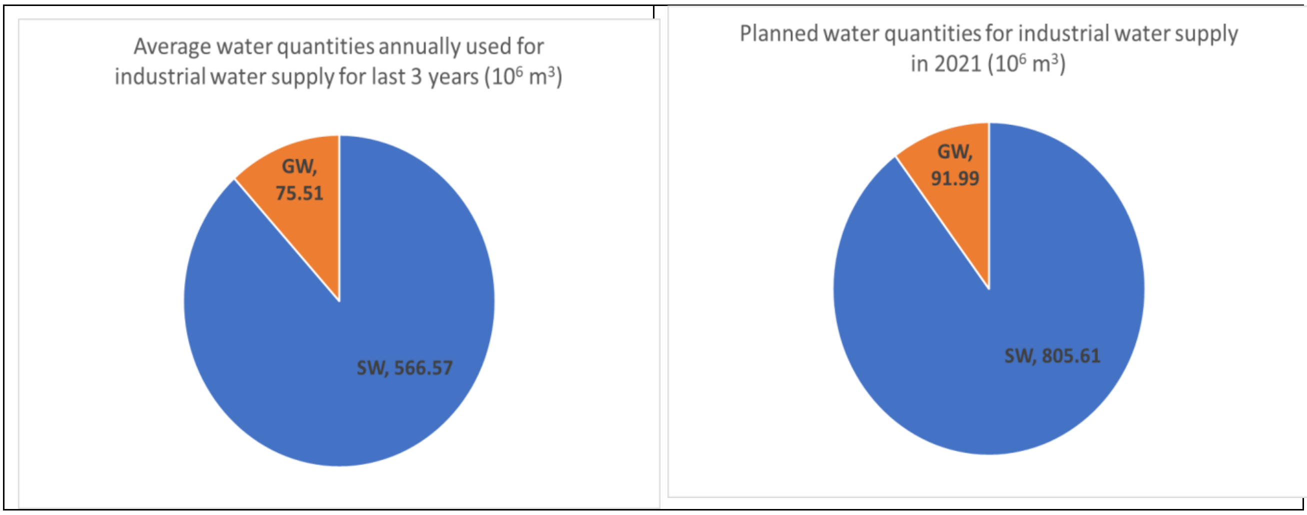


Figure V 1. TRB water supply of industry (including thermal power plant cooling) comparison between present water use and future water demand with respect to source

Table V.1. TRB water supply comparison between present water use and future water demand for industry (including thermal power plant cooling)

JOINTISZA	UA	RO	SK	HU	RS	Summary
Total capacity of industrial water supply systems (m³/s)	0.03	NA	21.3	6.5	2.96	30.79
Average water quantities annually used for industrial water supply for last 3 years (10⁶ m³)	1.1	505.92	39.41	86.3	9.35	642.08
Planned capacity of industrial water supply systems in 2021 (m³/s)	0.03	NA	21.3	6.5	3.2	31.03
Planned water quantities for industrial water supply in 2021 (10⁶ m³)	1.1	756	40	90	10.5	897.6

6 TRB water use and demand: Hydrological requirement for good water status

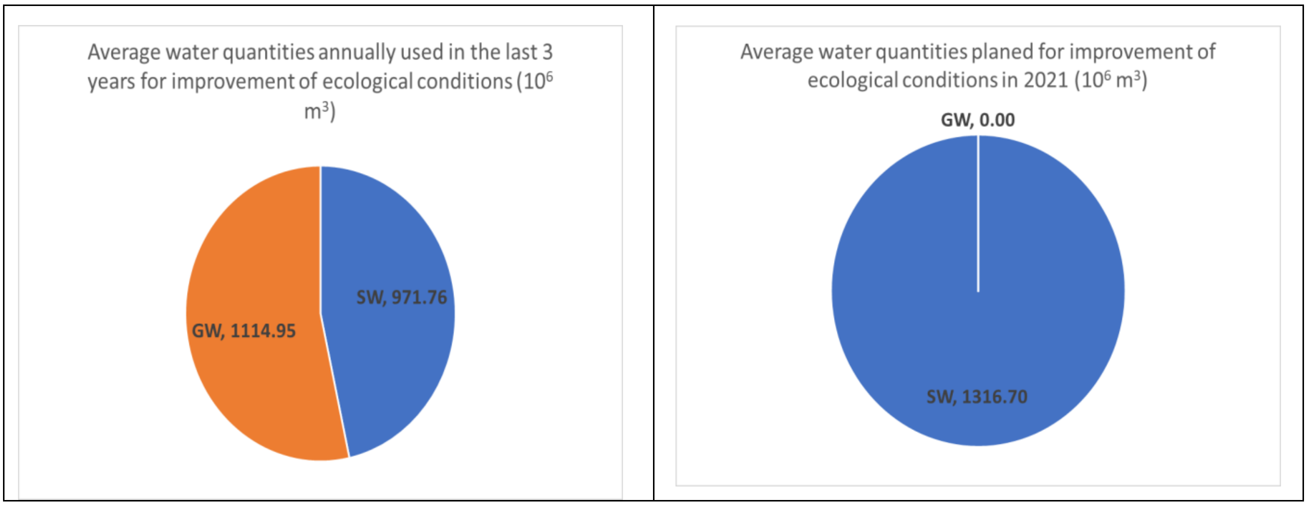


Figure VI 1. TRB hydrological requirement for good water status - comparison between present water use and future water demand with respect to source

Table VI 1. TRB hydrological requirement for good water status - comparison between present water use and future water demand

JOINTISZA	UA	RO	SK	HU	RS	Summary
Average water quantities annually used in the last 3 years for improvement of ecological conditions (10⁶ m³)	*	498.26	1 321.03	15.3	252.12	2 086.71
Average water quantities planed for improvement of ecological conditions in 2021 (10⁶ m³)		998.7	NA	18	300	1 316.7

7 TRB water use and demand: Other uses

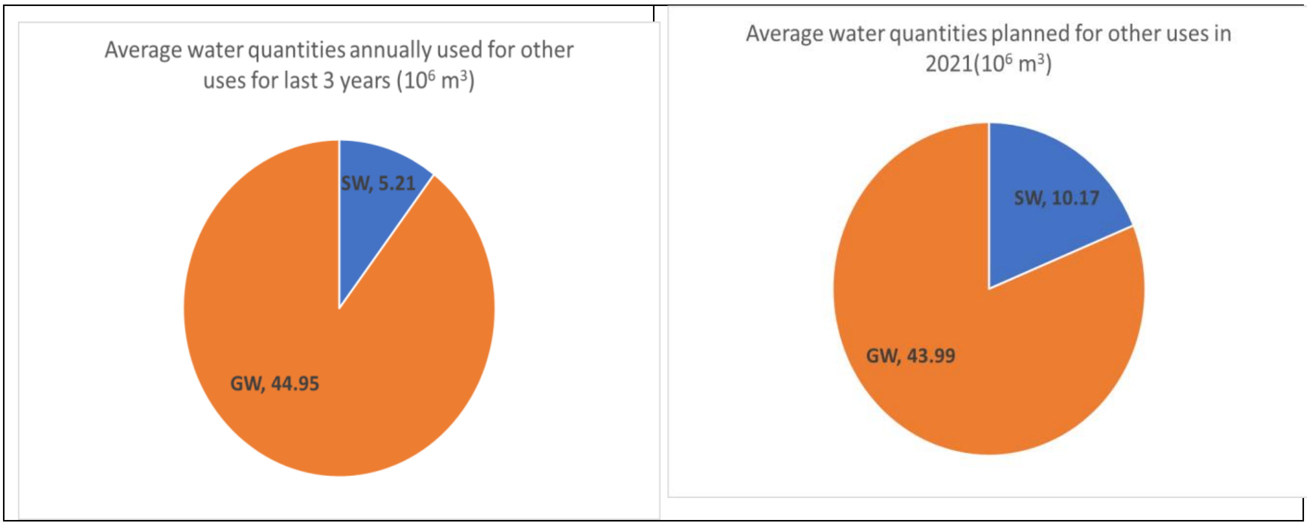


Figure VII 1. TRB other water uses - comparison between present water use and future water demand with respect to source

Table VII 1. TRB other water uses - comparison between present water use and future water demand

JOINTISZA	UA	RO	SK	HU	RS	Summary
Average water quantities annually used for improvement of ecological conditions for last 3 years (10^6 m^3)	1.4	RO	0.16	48.6	0	50.16
Average water quantities annually used for improvement of ecological conditions in 2021 (10^6 m^3)	2	NA	0.16	47	5	54.16

8 TRB water use and demand: Preservation of hydraulic regimes and ecological conditions in canal network

Table VIII.1. TRB water use – preservation of hydraulic regimes and ecological conditions in canal network

MONTH	COUNTRY/ Location/*other*				
	UA	HU		RS	
	Channel Verke	Keleti-főcsatorna, intake from Tisza	Nagykunsági-főcsatorna, intake from Tisza at Abádszalók	PS Bezdan	Slu. Bezdan
	-	*48.022963 21.321919*	*47.475547 20.561640*	*45.3074934 18.3124176*	*45.306111 18.3087486*
	$10^6 m^3$				
I	0	21.4	0	0	0
II	0	21.4	0	0	0
III	0	21.4	8	0	0
IV	0	12.9	12.3	4	4
V	3.8	12.9	12.3	4	6.3
VI	3.8	12.9	12.3	8	23.5
VII	3.8	12.9	12.3	12	39.8
VIII	3.8	12.9	12.3	8	43.8
IX	3.8	12.9	12.3	8	43.8
X	3.8	24.1	12.3	4	27.1
XI	-	24.1	2.7	0	15.8
XII	-	24.1	2.7	0	0
TOTAL	22.8*	213.7	99.6	48	204.1

* Only 1,5 m^3 / sec is provided from Borzhava to Verke (more is not possible because of the channel overgrowing).

Table VIII.2. TRB water demand (2021) – preservation of hydraulic regimes and ecological conditions in canal network

MONTH	COUNTRY/ Location/*other*				
	UA	HU		RS	
	Channel Verke	Keleti-főcsatorna, intake from Tisza	Nagykunsági-főcsatorna, intake from Tisza at Abádszalók	PS Bezdan	Slu. Bezdan
	-	*48.022963 21.321919*	*47.475547 20.561640*	*45.3074934 18.3124176*	*45.306111 18.3087486*
	$10^6 m^3$				
I	0	21.4	0	0	0
II	0	21.4	0	0	0
III	0	21.4	8	0	0
IV	0	12.9	12.3	4	4
V	7.6	12.9	12.3	4	6.3
VI	7.6	12.9	12.3	16	28
VII	7.6	12.9	12.3	20	45
VIII	7.6	12.9	12.3	20	45
IX	7.6	12.9	12.3	16	45
X	7.6	24.1	12.3	4	27.1
XI	-	24.1	2.7	0	15.6
XII	-	24.1	2.7	0	0
TOTAL	45.6 *	213.7	99.6	84	216

* Channel Verke will be partly cleaned and water supply from Borzhava will increase up to 3 m^3/sec. The water supply should be conducted only during May-November (in other months it is prohibited because of fish spawning in Borzhava).

9 Other Projects and Studies Relevant for Water Quantity Issues (Country Specific)

As presented during the JOINTISZA project meetings, following projects and studies are relevant for water quantity issues:

- ICPDR Tisza EG studies and projects;
- EU JRC water- food- energy – environment nexus;
- ICPDR strategy on adaptation to climate change (2012, 2018);
- *CARPATCLIM* - Climate of the Carpathian Region, the regional project financed by the Joint Research Center of the European Commission – JRC;
- *CCWaterS* – Climate *Change and Impacts on Wat*er Supply, the transboundary project funded by European Regional Development Fund (ERDF) and IPA;
- *WATCAP* - Water and Climate Adaptation Plan for the Sava River Basin funded by World Bank;
- *CC-WARE* - Integrated transnational strategy for water protection and mitigating water resources vulnerability, the transboundary project funded by European Regional Development Fund (ERDF) and IPA;
- *ClimWatAdapt* - Climate Adaptation–modeling water scenarios and sectoral impacts, funded by the European Commission - DG Environment;
- *SEERISK* -Joint Disaster Management Risk Assessment and Preparedness in the Danube macro-region;
- *OrientGate* A network for the integration of climate knowledge into policy and planning;
- *PROMITHEAS-4K* - knowledge transfer and research needs for preparing mitigation/adaptation policy portfolios;
- South East European Forum on Climate Change Adaptation - SEE Forum on CCA *(CCAFORUM);*
- Weather extremes and climate change in Serbia financed by the Ministry of Education, Science and Technological Development;
- Studying climate change and its influence on the environment: impacts, adaptation and mitigation (CLENIAM - III43007), funded by the Ministry of Education and Science of the Republic of Serbia;

Romania country specific projects

Within the Action Plan of National Climate Change Strategy there are foreseen action related to researches for achieving risk reduction of water scarcity objective. National Institute of Hydrology and Water Management is involved in research related to impact of climate change on water.

In the last years, for various river basins in Romania, a series of complex studies have been carried out on the estimation of the impact of climate change on water resources and on the maximum flow in the analyzed basins. *The used methodology was based on the following stages: Hydrological model selection; Hydrological model calibration; Establishment of the climate change scenario; Long-term flow simulation using the hydrological model; Analysis of the study results*.

The study of the effect of climate change on water resources and on maximum discharges in a river basin was based on two long-term hydrological simulations, each for a period of 30 years, the first simulation being carried out for the reference period 1971÷2000 and the second for the next period 2021÷2050.

The input data in the hydrological model were the precipitation and temperature series resulting from the processing of data obtained from climatic simulations using the REMO regional model (simulations that are available in National Institute of Hydrology and Water Management (as a result of the FP6 CLAVIER Project collaboration). To estimate the effect of climate change on water resources, the flow simulation at monthly time step was done using the WatBal hydrological model. This model consists of two main components. The first is the water balance component, which uses continuous functions to describe water movement in a conceptualized river basin and the second one is the component that allows computing of the potential evapotranspiration using the Thornthwaite method.

The methodology used was applied to 20 river basins in Romania: Vișeu, Iza, Tur, Someș, Mureș, Timiș-Bega, Bega-Veche, Bârzava, Moravița, Caraş, Nera, Radimna, Berzasca, Cerna, Jiu, Olt, Vedea, Argeș, Ialomița and Siret, the surface of which represents 71.63% of the of the Romanian territory. Some of them are located within the TRB (Vișeu, Iza, Tur, Someș, Mureș, Bega, Bega-Veche).

Discharge series, with a monthly time step, resulting from the two long-term simulations, were analyzed comparatively in order to identifying the changes in the monthly, seasonal and annual discharge regime.

To estimate the effect of climate change on maximum discharges, the flow simulation at 6-hour time step was done using the CONSUL hydrological model. This deterministic mathematical model allows simulation of flow in both small and large complex river basins, which are divided into homogeneous units (sub-basins). The model allows the calculation of flow hydrographs on sub-basins, their routing and composition on the main river and tributaries.

The methodology used was applied to 8 river basins in Romania: Crişul Repede, Crişul Negru, Crişul Alb, Mureş, Jiu, Olt, Ialomiţa and Siret, the surface of which represents 53.0% of the Romanian territory. Four river basins (Crişul Repede, Crişul Negru, Crişul Alb and Mureş) are located with the RO part of the TRB. Discharge series, with a 6 hours' time step, resulting from the two long-term simulations, were analyzed comparatively in order to identifying the changes in the maximum monthly, maximum multiannual and maximum with different probabilities of exceeding, as well as the distribution of annual maximum discharges over the year. Another research study mentioned in the Action Plan of National Climate Change Strategy and performed with the National Institute of Hydrology and Water Management is "Identification for national main potential of water scarcity areas in the current regime and the perspective of climate change". Some details are presented in Romanian Country report on measures: Chapter 5 – Drought and water scarcity measures (by 2021) - Maps with water scarce areas identified for the Tisza Basin.

Serbia country specific projects

In addition to projects and studies in Republic of Serbia the following list includes legal and other frameworks relevant for Climate Change and Water Quantity issues:

- The Water Management Strategy of the territory of the Republic of Serbia (Official Gazette of the Republic of Serbia no. 3/2017);
- The Second National Communication of the Republic of Serbia under the UNFCCC (Submitted on the ICPDR Danubius, December 2016);
- South East European Climate Change Framework Action Plan for Adaptation- SEE/CCFAP-A (2008);
- Jaroslav Černi Institute for the Development of Water Resources (JCI), 2010-2012, Climate Change Impacts on River Hydrology in Serbia – National Study in Serbian (financially supported by Water Directorate – Ministry of agriculture, forestry and water management of Serbia);
- Jaroslav Černi Institute for the Development of Water Resources (JCI), 2012-2016, Climate Change Impacts on Water Resources in Serbia – National Study in Serbian (project is financed by the Ministry of education, science and technological development);
- Weather extremes and climate change in Serbia financed by the Ministry of Education, Science and Technological Development;
- Studying climate change and its influence on the environment: impacts, adaptation and mitigation (CLENIAM - III43007), funded by the Ministry of Education and Science of the Republic of Serbia.

10 Results and Conclusions

The purpose of reservoirs within the TRB is over 50% for multipurpose reservoirs. Based on map TRB reservoirs spatial distribution with respect to volume, there are two reservoirs with volume 250 -500 Mm^3 one in Slovakia and one in Hungary. Reservoirs with volume range between 10 and 250 Mm^3 exists in Romania, Slovakia and Hungary. Reservoirs with volume equal to or smaller than 10 Mm^3 exists in all Tisza Countries.

With respect to water use and demand within the TRB and relevance of the interlinkage between water quantity and quality increase in water demand in comparison to present use is evident.

In summary, according to data reported by Tisza countries total water quantity for present uses (irrigation, other agricultural use, public water supply, industrial water supply, other uses) is 1,409.84 Mm3, regardless the source of water is significantly smaller than planned water demand by the end of the next planning period 2 585.67 Mm^3, e.g., approximately 54%. The most significant water demand increase within the TRB is planned for irrigation – 67%, and according to provided data with respect to water source the majority of water intake increase is planed from surface water.

For other agricultural use, water intake increase is planned both for surface and groundwater sources. Although the quantity of water for public water supply is higher at the present than future demand, there is planned increase of intake form groundwater. Based on data and information reported by Tisza countries, it is obvious that planned increase in water demand refer both to surface and ground water sources, from 566.57 to 805.61 Mm^3 and from 75.51 to 91.99 Mm^3, respectively. Since for some water uses elaborated with TRB water quantity issues data are not reported by all countries, these water uses are not included in water quantity summary comparison between present water use and planned water demand.

Instead of conclusion, all proposed measures that are relevant for water quantity and quality integration should be carefully and comprehensively elaborated at the TRB, and any issue or constrain that have or might have adverse impacts on the Integrated River Basin Management Planning within the TRB and with respect to transboundary level should be carefully re-evaluated and win - win upstream – downstream approach should be applied.

Abbreviations

TRB	Tisza River Basin
ICPDR	International Commission for the protection of the Danube River
ITRBMP	Integrated Tisza River Basin Management Plan
UNFCC	The United Nations Framework Convention on Climate Change
RBMP	River Basin Management Plan

References

Tisza Analyses Report (2007)

The First Integrated Tisza River Basin Management Plan

EU Water Framework Directive

The ICPDR CC adaptation strategy

ICPDR DanubeGIS

Data and information reported by Tisza countries:

Ukraine:
JOINTISZA Template (Report) for water quantity data collection –country report,
Slovakia:
JOINTISZA Template (Report) for water quantity data collection –country report
Romania
JOINTISZA Template (Report) for water quantity data collection –country report
Hungary
JOINTISZA Template (Report) for water quantity data collection –country report
Serbia
JOINTISZA Template (Report) for water quantity data collection –country report

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

Partners: General Directorate of Water Management, Hungary | Global Water Partnership Central and Eastern Europe, Slovakia | International Commission for the Protection of the Danube River, Austria | Ministry of Water and Forest, Romania | Ministry of Foreign Affairs and Trade, Hungary | National Administration "Romanian Waters", Romania | National Institute of Hydrology and Water Management, Romania | Public Water Management Company "Vode Vojvodine", Serbia | Regional Environmental Center for Central and Eastern Europe, Hungary | The Jaroslav Černi Institute for the Development of Water Resources, Serbia | Water Research Institute, Slovakia | World Wide Fund for Nature Hungary

Associated Partners: Interior Ministry, Hungary | Ministry of Agriculture and Environmental Protection Water, Serbia | Secretariat of the Carpathian Convention (SCC), Austria | State Agency of Water Resources of Ukraine | Tisza River Basin Water Resources Directorate, Ukraine