INTERNATIONAL SAVA RIVER BASIN COMMISSION

2nd Sava River Basin Analysis Report

2016

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Prepared by: International Sava River Basin Commission (ISRBC) in cooperation with institutions of the Parties to the Framework Agreement on the Sava River Basin (Bosnia and Herzegovina, Croatia, Serbia and Slovenia) and Montenegro.

Overall coordination and editing: Secretariat of ISRBC.

Contact:

International Sava River Basin Commission

Kneza Branimira 29

Zagreb, Croatia

Phone: + 385 1 488 6960

Fax: + 385 1 488 6986

E-mail: isrbc@savacommission.org

Web: www.savacommission.org

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Disclaimer

The Sava River Basin Analysis report is based on data and information delivered by the Sava countries. Part of the data has been collected by ICPDR through DanubeGIS. Other data and information used for this report originates mostly from the first Sava River Basin Management Plan. The rest of information originates from various sources: different project reports, ISRBC's documents, etc. The data has been dealt with, and is presented, to the best of our knowledge. However, inconsistencies cannot be ruled out. The data will be re-collected and updated through the process of developing the 2nd Sava River Basin Management Plan.

The borders between the countries cooperating in preparation of the Sava River Basin Analysis have not been finally determined. The content and maps of this report do not prejudice the determination or marking the borders in any way.

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LIST OF ACRONYMS AND ABBREVIATIONS

AEWS	Accident Emergency Warning System
AL	Albania
AWB	Artificial water body
BA	Bosnia and Herzegovina
BOD	Biochemical oxygen demand
BPL	Biopollution index level
COD	Chemical oxygen demand
DRPC	Convention on Cooperation for the Protection and Sustainable Use of the Danube River
DW	Drinking water supply
EEA	European Environment Agency
EIA	Environmental Impact Assessments
EP	Electricity production
EU WFD	European Water Framework Directive
EUR	Euro
FAO	Food and Agriculture Organization of the United Nations
FASRB	Framework Agreement on the Sava River Basin
FBiH	Federation of Bosnia and Herzegovina
FFWS	Flood Forecasting and Warning System in the Sava River Basin
FIP	Future infrastructure project
FP	Flood protection
FRM	Flood risk management
FRMP	Flood Risk Management Plan
GDP	Gross domestic product
GVA	Gross value added
HPP	Hydroelectricity power plant
HMWB	Heavily modified water body
HR	Croatia
HU	Hungary
HYMO	Hydromorphological
IAS	Invasive alien species
ICPDR	International Commission for Protection of Danube River
IPS	Industrial pollution sources
IR	Irrigation
ISRBC	International Sava River Basin Commission
IW	Industrial water supply
ME	Montenegro
OM	Operational monitoring
PE	Population Equivalent
PEG RBM	Permanent Expert Group for River Basin Management
PFRA	Preliminary Flood Risk Assessment
PIAC	Principal International Alert Center
RBM	River Basin Management
RBMP	River Basin Management Plan
RS	Serbia
SI	Slovenia
SM 1	Surveillance monitoring I

SM 2	Surveillance monitoring II
SRB	Sava River Basin
SRBA	Sava River Basin Analysis
TE	Thermoelectric power plant
TN	Total Nitrogen
TNMN	Transnational monitoring network
TOC	Total organic carbon
TP	Total Phosphorus
USD	US Dollar
WB	Water body
WBIF	Western Balkans Investment Framework

1 Introduction

The four Sava riparian countries: Bosnia and Herzegovina, Croatia, Serbia and Slovenia (the Parties of FASRB) ratified in 2004 the multilateral Framework Agreement on the Sava River Basin (FASRB) as a basis for transboundary cooperation of governments, institutions and individuals for sustainable development of the region.

FASRB defines three main goals of cooperation:

- Establishment of an international regime of navigation on the Sava River and its navigable tributaries;
- Establishment of sustainable water management;
- Undertaking measures to prevent or limit hazards, and reduce and eliminate adverse consequences, including those from floods, ice hazards, droughts and incidents involving substances hazardous to water.

The implementation of FASRB is coordinated by the International Sava River Basin Commission (ISRBC), with the permanent Secretariat as its executive body. ISRBC is given the capacity for making decisions in the field of navigation and providing recommendations on all other issues.

One of the most important and challenging joint effort of the Parties has been the development of an integrated Sava River Basin Management Plan (Sava RBMP) as provided in Article 12 of the FASRB and in accordance with *Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy* (EU WFD).

The process started in 2006 under the overall coordination of the Permanent Expert Group for River Basin Management (PEG RBM). As the first step the Sava River Basin Analysis (SRBA) report has been developed in accordance with Article 5 of the EU WFD. The report served as a comprehensive assessment of surface and groundwater, establishing a baseline for subsequent stages in the river basin planning cycle. It also an analysis of water quantity and integration issues including detailed elaboration of flood management and navigation development in the basin. The SRBA report was accepted by ISRBC in September 2009.

Development of the Sava RBMP started at the end of 2009, with the European Union (EU) support provided through "Technical assistance in the preparation and implementation of the Sava River Basin Management Plan", managed directly by DG Environment and by a direct grant to ISRBC for support in the plan preparation. Following the public consultation process, the draft Plan was submitted to the Parties in March 2013 for their national procedures of the Plan adoption. Finally, the Plan was approved by the Parties at their 5th meeting, held on December 2, 2014 in Zagreb (HR).

EU WFD requires the revision of the characteristic of the river basin district, review of the environmental impact of human activity and economic analysis of water use in the six years cycles.

This document represents an update of the first SRBA and a good basis for development of the 2nd Sava RBMP.

The following thresholds for elaboration of the basin-wide issues in the SRB remain the same as in the first planning cycle:

For surface waters: the Sava River and its tributaries with catchments larger than 1,000 km^2, and a few rivers with catchments smaller than 1,000 km^2 but which are, for different reasons, declared as rivers of a basin-wide importance (Sotla/Sutla, Lašva and Tinja);

For groundwater: trans-boundary and national groundwater bodies (GWBs), with area larger than 1,000 km^2, and some other GWBs with area smaller than 1,000 km^2 but which are important due to various other criteria (e.g. socio-economic importance uses, impacts, pressures, interaction with aquatic eco-system).

2 General characteristics

2.1 Basic facts

2.1.1 Location, area and countries sharing of the basin

The Sava River Basin is a major catchment of the South Eastern Europe covering the total area of approximately 97,700 km^2. It represents one of the most significant sub-basins of the Danube River Basin, with the share of 12 %.

The basin area is shared among six countries: Slovenia, Croatia, Bosnia and Herzegovina, Serbia, Montenegro and Albania (Table 1).

Table 1: Countries in the Sava River Basin

Country	Flag	Country Code	FASRB status
Republic of Slovenia		SI	Party
Republic of Croatia		HR	Party
Bosnia and Herzegovina		BA	Party
Republic of Serbia		RS	Party
Montenegro		ME	Not the Party. Cooperation based on MoU between ISRBC and ME[1]
Republic of Albania		AL	Not the Party

Table 2 presents some basic figures with regard to the countries' share of the Sava River Basin area.

Table 2: Share of the Sava countries territory belonging to the Sava River Basin

	SI	HR	BA	RS	ME	AL
Total country area [km^2]	20,273	56,542	51,129	88,361	13,812	27,398
Share of national territory in the Sava River Basin [%]	52.80	45.20	75.80	17.40	49.60	0.59
Area of the country in the Sava River Basin [km^2]	11,734	25,373	38,349	15,147	6,929	179
Share of the international Sava River Basin [%]	12.01	25.97	39.25	15.50	7.09	0.18

Population of the five countries (Albania is not included since only negligible part of the basin area belongs to its territory) of the region is approximately 18 million. Half of this number resides in the Sava River Basin: in Slovenia 61%, in Croatia 50%, in Bosnia and Herzegovina 88%, in Serbia 26% and in Montenegro around 33% of the population lives in this basin.

An overview of the Sava River Basin is presented in Map 1.

[1] Memorandum of Understanding on cooperation between ISRBC and Montenegro was signed in Belgrade on December 9, 2013 (http://www.savacommission.org/event_detail/0/0/303/3)

2.1.2 Climate

The Sava River basin has in general moderate climate, with clearly distinctive cold and hot seasons. The winter can be severe with abundant snowfalls, while summer is hot and long. There are 2 general types of climate conditions within the basin:

- Alpine or mountainous climate, prevailing in the upper Sava Basin within Slovenia and also in Dinaric Alps at higher elevations;
- Moderate continental or mid-European climate, dominating in lower elevations of the catchment including Pannonian lowland;

Dividing lines between these climate types are not sharp.

Average annual air temperature for the whole Sava Basin was estimated to about 9.5°C. Winter temperatures (December to February) are low (Mean monthly temperature in January falls to about -1.5°C), while high temperatures occur during the summer season (June – September) (almost 20°C).

Precipitation amount and its annual distribution are very variable and has a common feature: rainfall and snowfall of different duration are likely to occur all over the whole catchment. Average annual rainfall over the Sava River Basin was estimated at about 1,100 mm.

2.1.3 Relief and topography

Terrain in the Sava River Basin is very variable. It significantly changes from the source on the west to its confluence with the Danube River on the east (Figure 1).

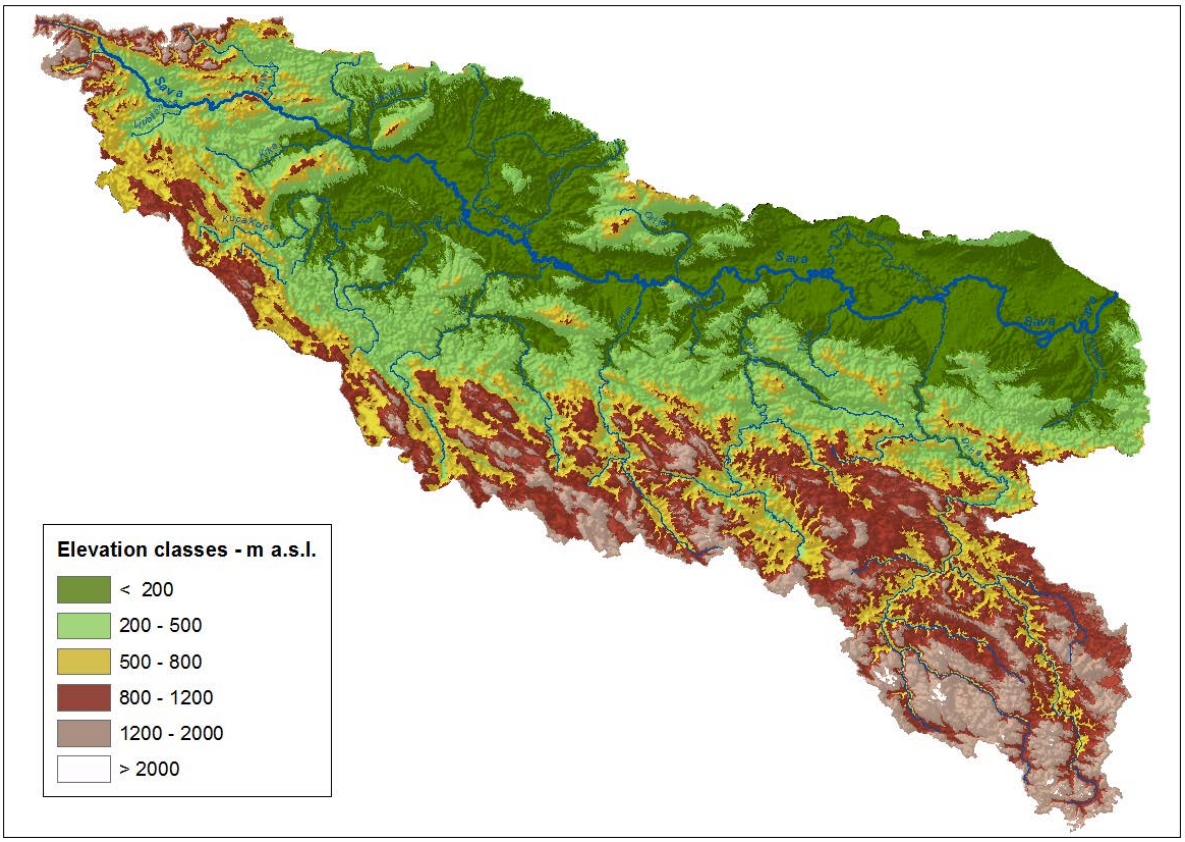


Figure 1: Sava River Basin relief characteristics

Rugged mountains (the Alps and the Dinarides) dominate in Slovenia, southern part of Croatia, Bosnia and Herzegovina, Montenegro and Northern Albania. Considerable part of this area is covered by forests.

The northern part of SRB is situated in the Pannonia Plain, which is characterized by fertile agriculture land.

Generally, elevation of the Sava River Basin varies between approx. 70 m a.s.l. at the mouth of the Sava River in Belgrade (Serbia) and 2,864 m a.s.l. (Triglav, Julian Alps). The mean elevation of the basin is approx. 545 m a.s.l.

According to FAO classification, the dominant slope in the basin is moderately steep. Mean value of slope in the Sava River Basin is 15.8 %.

2.1.4 Land cover/land use in the basin

For an overview of the land cover/land use in the Sava River Basin, the EEA Corine database for Europe was used and the actual/revised versions v.18.5 of layers, prepared by GISAT in February 2016. The comparison between the main land cover classes according to Corine 2000 (used in the 1st Sava RBMP) and Corine 2006 and 2012 is shown in Table 3. The detailed land cover classes according the Corine 2012 are indicated in Annex I and presented in Map 2.

Table 3: Distribution of main land cover classes

Land class	Corine 2000		Corine 2006		Corine 2012	
	Area (km^2)	Share (%)	Area (km^2)	Share (%)	Area (km^2)	Share (%)
Artificial surfaces	2,179	2.23	2,415	2.48	2,451	2.52
Agricultural areas	41,381	42.36	40,215	41.26	40,178	41.22
Forests and semi natural areas	53,458	54.71	54,111	55.52	54,117	55.53
Wetland	78	0.08	90	0.09	91	0.09
Inland water - Water bodies	616	0.63	632	0.65	625	0.64

2.1.5 Hydrologic characteristics

Spatial distribution of elements of hydrologic balance is heterogeneous. Long-term average annual precipitation ranges between 600 mm and 2,300 mm. The largest precipitations take place in far western catchments (Sava Dolinka and Sava Bohinjka Rivers) and at upper parts of catchments of the Kupa, Piva, Tara, Una, Vrbas, Drina and Lim Rivers. Areas with smallest precipitation are found in Slavonia, Srem, Semberija and the Kolubara River catchment.

Spatial distribution of evapotranspiration is heterogeneous, too. Its variation is significant over the basin area. Long term evapotranspiration ranges between 320 and 710[2] mm/year. Highest values appear in the Middle Posavina region and catchments of the Lonja, Ilova and Kupa Rivers. Lowest value of evapotranspiration is present in upper parts of catchments of the Drina, Bosna and Vrbas Rivers. Areas with relatively small evapotranspiration are the upper Sava (in Slovenia) as well as the upper catchments of the Kupa and Una Rivers. The average evapotranspiration for the whole catchment area is approx. 530 mm/year.

Spatial distribution of runoff largely follows pattern of spatial distribution of precipitation. It varies from 150 mm/year (under 5 l/s/km^2) up to 1,200 mm/year (almost 40 l/s/ km^2). In general, the right tributaries of the Sava River are characterized by much higher water yield than the left tributaries (e.g. Una River 23 l/s/ km^2, Vrbas and Bosna Rivers 15 and 19 l/s/ km^2, Ukrina and Tinja Rivers, 12 l/s/ km^2). The Drina River, as the largest tributary of the Sava River, due to high precipitation (long term annual average is over 2,000 mm) has a very high water yield: between 40 and 50 l/s/ km^2. The left tributaries (Krapina, Lonja and Orljava and Bosut Rivers) gets annually 700 – 1,000 mm of rain but

[2] Source: The World Bank "Water & Climate Adaptation Plan for the Sava River Basin", August 2015

relatively big evapotranspiration reduces unit-area runoff to just a few l/s/ km^2, which at the hilly regions can rise to 12 l/s/ km^2. A long-term average unit-area-runoff for the complete catchment area of about 18 l/s/km^2.

Average discharge of the Sava River at the confluence with the Danube River in Belgrade (Serbia) is about 1,700 m^3/s.

Using the results from previously prepared studies, the range of annual average flows (largest and smallest estimated values) (Figure 2), low flows (Figure 3) characterized with 100-years return period and maximum annual discharges (Figure 4) is presented in the longitudinal profile of the Sava River[3].

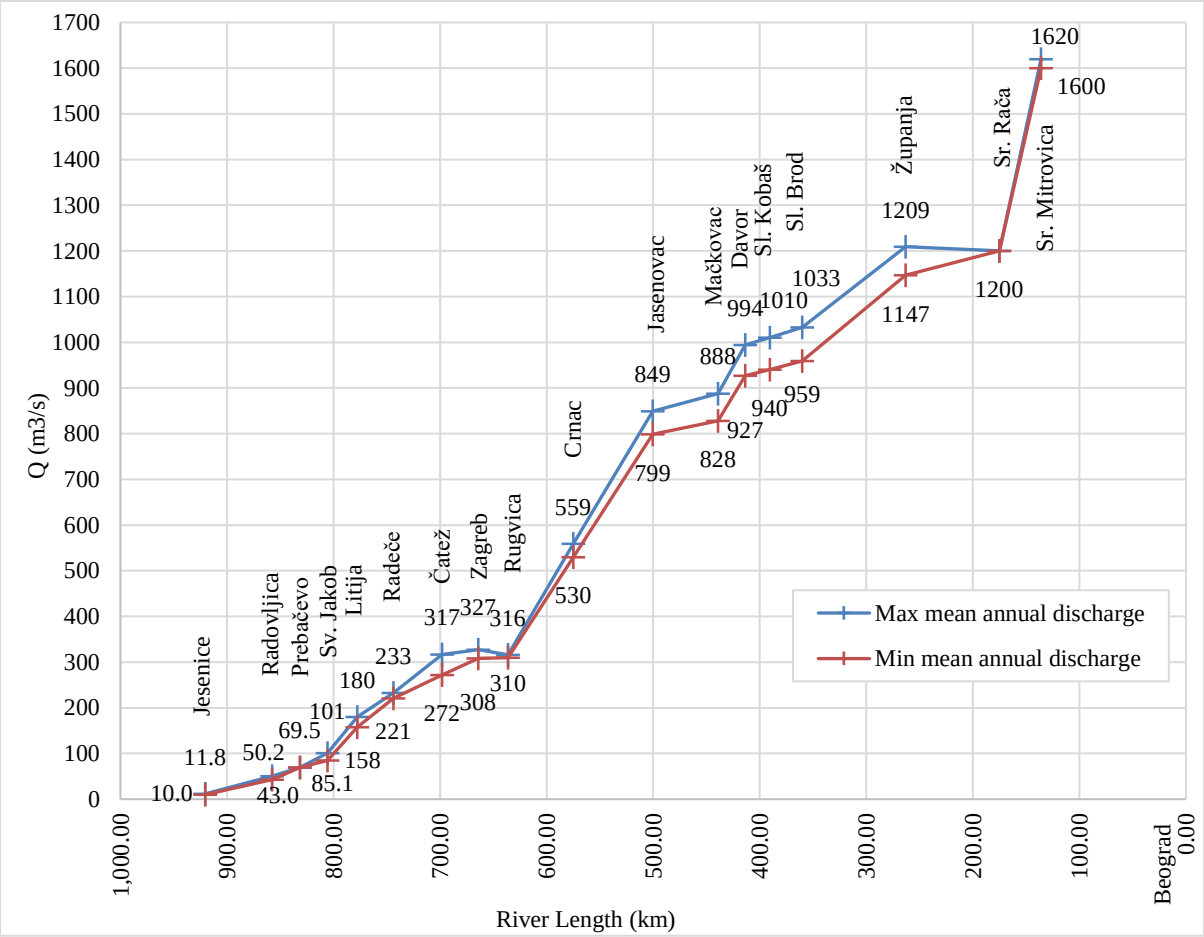


Figure 2: Spectrum of mean annual discharges along the Sava River

[3] Figures 2,3,4,5 -Source: S. Prohaska : "Hydrology report for the Sava River basin analysis", 2009

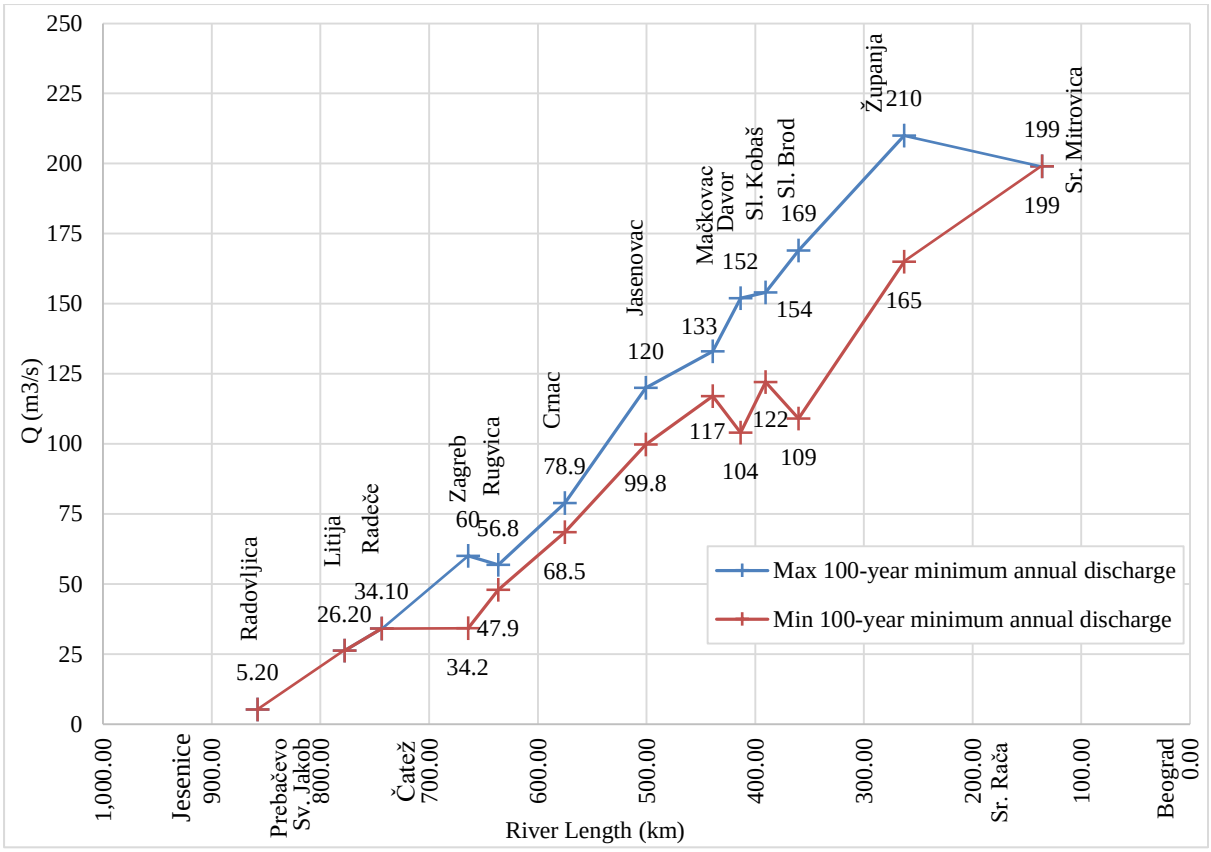


Figure 3: Spectrum of 100-year minimum annual discharges along the Sava River

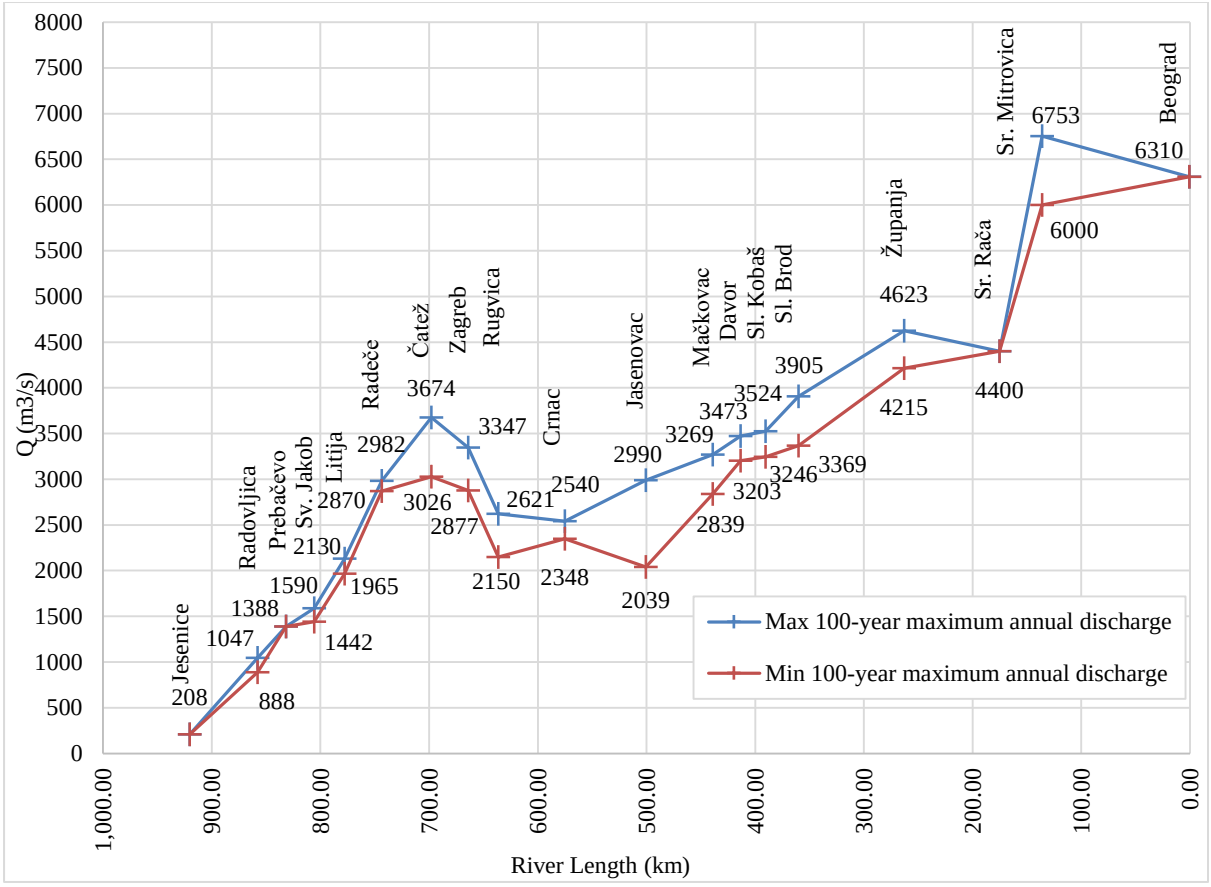


Figure 4: Spectrum of 100-year maximum annual discharges along the Sava River

2.2 Main hydrographic features

2.2.1 Description of the Sava River

The Sava River is formed by two mountainous streams: the Sava Dolinka (left) and the Sava Bohinjka (right). From the confluence of these headwaters the Sava River is 945 km long. Together with its longer headwater, the Sava Dolinka River, in the north-west, it measures 990 km. It flows through in a NW-SE direction through Slovenia, Croatia, Bosnia and Herzegovina and Serbia. It also forms the border between Croatia and Bosnia and Hercegovina.

There is a common understanding that the course of the river can be divided into 3 sections:

- Upper Sava, between the confluence of Sava Dolinka and Sava Bohinjka and Rugvica (km 658)[4]. The catchment area of the Upper Sava comprises mountainous and hilly relief;
- Middle Sava, between Rugvica and the mouth of the Drina River (km 178) is a lowland, alluvial section, characterized by wide floodplains, and mouths of numerous tributaries;
- Lower Sava, downstream of the mouth of the Drina River, is also alluvial section. There are no significant tributaries on this section. The most downstream, 100 km long section is under the influence of the Danube.

The longitudinal profile of the Sava River is shown in Figure 5. The most obvious detail on the longitudinal profile of the Sava River is the sharp change in the channel slope (knickpoint) close to the city of Zagreb. Upstream of the hydrological station Radovljica, the average longitudinal slope of the Sava River is close to 10‰ (this Sava River section definitely has a torrential character). Between Radovljica and Rugvica (km 658) it drops to ~ 2‰, and lowers to ~0.05‰ between Rugvica and Belgrade.

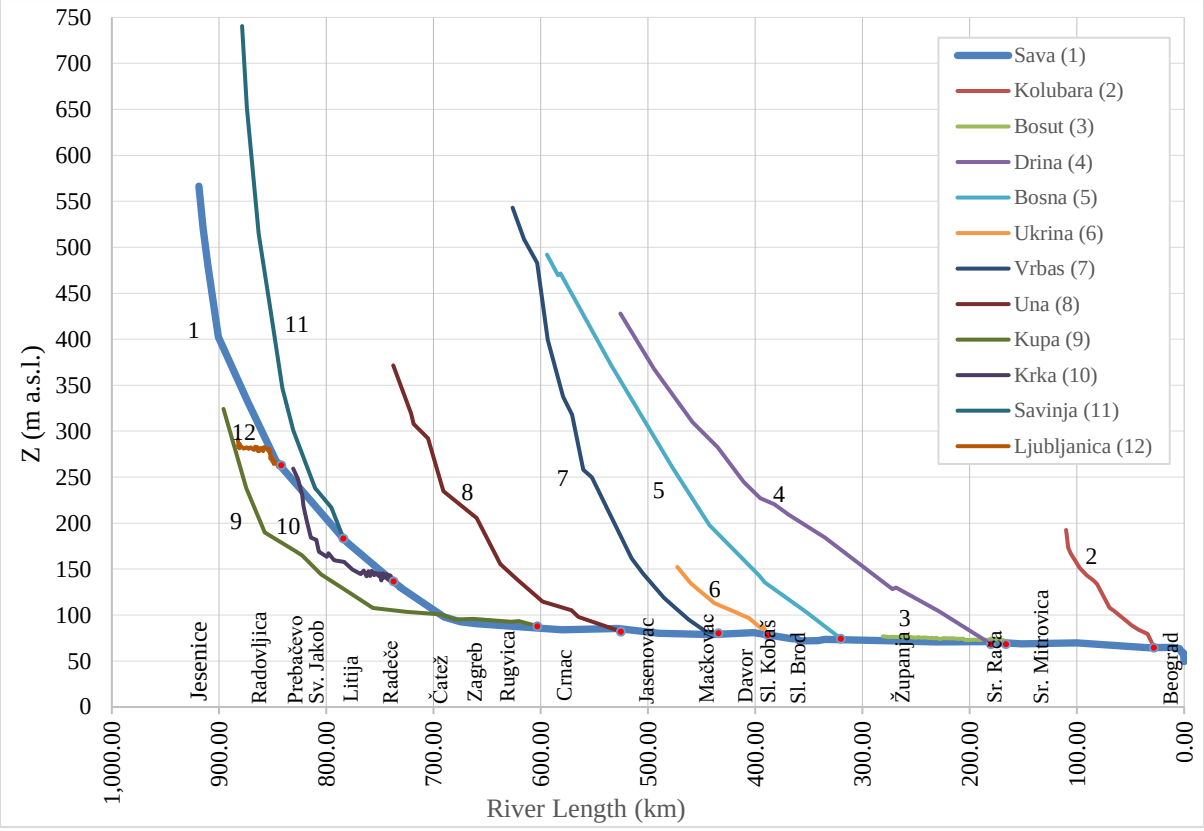


Figure 5: Schematic longitudinal profiles of the Sava River and some of its main tributaries

[4] Measured from the Sava River mouth

2.2.2 Description of the Sava River main tributaries

The Sava River and its main tributaries, designated according to the agreed criteria, are presented in Table 4.

Table 4: Sava River and its main tributaries

River name	River basin size (km^2)	River length (km)	Sava River Basin countries sharing the river basin	Tributary order	Confluence to the Sava/tributary L-left side R-right side
Sava	97,713.2	944.7	SI, HR, BA, RS, ME	-	-
Ljubljanica	1,860.0	40.00	SI	1st	R
Savinja	1,849.0	93.60	SI	1st	L
Krka	2,247.0	94.70	SI	1st	R
Sotla/Sutla	584.3	89.70	SI, HR	1st	L
Krapina	1,237.0	66.87	HR	1st	L
Kupa/Kolpa	10,225.6	118.3	SI, HR, BA	1st	R
Dobra	1,428.0	104.21	HR	2nd	R
Korana	2,301.5	147.62	HR, BA	2nd	R
Glina	1,427.1	112.22	HR, BA	2nd	R
Lonja	4,259.0	47.95	HR	1st	L
Česma	3,253.0	105.75	HR	2nd	L
Glogovnica	1,302.0	64.48	HR	3rd	R
Ilova (Trebež)	1,796.0	104.56	HR	1st	L
Una	9,828.9	157.22	HR, BA	1st	R
Sana	4,252.7	141.10	BA	2nd	R
Vrbas	6,273.8	235.00	BA	1st	R
Pliva	1,325.7	31.45	BA	2nd	L
Orljava	1,618.0	93.44	HR	1st	L
Ukrina	1,504.0	80.9	BA	1st	R
Bosna	10,809.8	272.00	BA	1st	R
Lašva	958.1	55.20	BA	2nd	L
Krivaja	1,494.5	74.3	BA	2nd	R
Spreča	1,948.0	147.28	BA	2nd	R
Tinja	904.0	88.10	BA	1st	R
Drina	20,319.9	335.67	ME, BA, RS	1st	R
Piva	1,784.0	43.50	ME	2nd	L
Tara	2,006.0	134.20	ME, BA	2nd	R
Ćehotina	1,237.0	118.66	ME, BA	2nd	R
Prača	1,018.5	62.67	BA	2nd	L
Lim	5,967.7	278.5	AL, ME, RS, BA	2nd	R
Uvac	1,596.3	117.70	RS, BA	3rd	R

River name	River basin size (km^2)	River length (km)	Sava River Basin countries sharing the river basin	Tributary order	Confluence to the Sava/tributary L-left side R-right side
Drinjača	1,090.6	90.00	BA	2nd	L
Bosut	2,943.1	132.18	HR, RS	1st	L
Kolubara	3,638.4	86.70	RS	1st	R

Common feature of almost all right tributaries of the Sava River is their torrential behavior, particularly in their upper sections while left tributaries (except in Slovenia) drain mostly flat areas and low hills of the Pannonian basin. The slopes and flow velocities of the left tributaries are smaller and the streams are meandering.

The longitudinal profile of some of the tributaries is also provided in Figure 5.

The overview of the Sava River Basin with main tributaries sub-basins over territories of the Sava countries is given in Figure 6.

Figure 6: Sava River sub-basins – overview by the Sava countries

2.3 Typology[5]

2.3.1 Surface water types

2.3.1.1 Ecoregions

Annex XI of the EU WFD provides Map A in order to enable the development of a typology according to System A in Annex II1, paragraph 1.2. Table 5 presents ecoregions relevant for the Sava countries. The ecoregions of the Sava River Basin are presented in Map 3.

Table 5: Ecoregions in the Sava River Basin

Ecoregion	SI	HR	BA	RS	ME
04 - Alps	x				
05 – Dinaric western Balkan	x	x	x	x	x
06– Hellenic western Balkan					x
11 - Hungarian lowlands	x	x		x	

Croatia and Serbia have introduced sub-ecoregions (Table 6) to further differentiate the ecoregions given in the EU WFD.

Table 6: Sub-ecoregions or bio-ecoregions in the Sava River Basin

Ecoregion	Country	Sub-ecoregions or bio-ecoregions
05	Croatia	Continental Dinaric sub ecoregion
	Serbia	Upper Kolubara hydro-faunistical complex
		Drina-Lim hydro-faunistical complex
		Uvac hydro-faunistical complex
11	Serbia	Sava River Basin

Ecoregion 04 - Alps

Ecoregion 4 (Alps) represents the northern and north-western part of Slovenia where the rivers with the most of the catchments in Alps flows (e.g. Tržiška Bistrica, Kokra, Kamniška Bistrica and the Sava River to the confluence with Ljubljanica). In the central Slovenia the border between ecoregions 4 and 5 is a natural border between mountains and the Sava plain but on the north-west not higher than to elevation of 400 m. On southwest the ecoregion 4 extends to the karst area without permanent surface rivers with catchment area > 10 km^2. On the east of Slovenia the ecoregion 04 includes Pohorje and Kozjak and borders with the ecoregion 11 (Hungarian lowland - Pannonian lowland). The border is set at elevation of approx. 400m.

[5] Data originates from the 1st Sava River Basin Analysis (September 2009).

Ecoregion 05 - Dinaric western Balkan

Section of the Sava River which flows through the Posavsko hribovje (ecoregion 4) belongs to the ecoregion 5. Southern Slovenia also belongs to ecoregion 5, which is the largest ecoregion in Slovenia and comprises more than 40 % of the Sava River Basin in Slovenia.

In Croatia ecoregion 5 covers landscape with calcareous rock of Mesozoic era, altitude 150-900 m a.s.l. where the karst phenomena could be observed.

In Serbia ecoregion 5 covers the part of the catchment of the Sava River - part of the Kolubara Basin (sub-catchments of the Gradac, Jablanica, Obnica, Ribnica (incl. Lepenica) Rivers, larger part of the Drina River Basin (except the most downstream part – see explanation bellow) and basin of the Lim and the Uvac Rivers. The boundary between the ecoregions 5 and 11, according to research results, is situated along the boundary of the Kolubara basin.

All Bosnia and Herzegovina in the Sava River Basin and northern part of Montenegro belong to ecoregion 5. Lithological composition in Bosnia and Herzegovina is divided according to dominant participation of carbonate, silicate and siliceous formations. Carbonate sediments make the terrains of higher and high mountain massifs in the area of south, southwest and east part of the country. Silicate and siliceous soil type is present in the largest part on north, while in middle area it mostly makes the underlaying stratum of mountain massifs, that is of river valleys and wide area of alluvial sediments. Organic soil type is conditionally separated on several isolated locations throughout Bosnia and Herzegovina. Concerning the altitude, area of Bosnia and Herzegovina is situated in between 90 m a.s.l. in the area of Posavina and Semberija and over 2,100 m a.s.l. on high mountains of the southeast and northwestern part. Fertile plains are mostly situated in the valleys of the Sava, Bosna, Drina, Vrbas and Una Rivers and the outstanding ones are Posavina, Semberija, Lijevče polje, etc.

Ecoregion 06 - Hellenic western Balkan

Ecoregion 6 is located in southeastern part of the Sava River Basin in Montenegro and Albania. It extends over approx. 600 km^2 (496 in Montenegro and 104 in Albania), which is about 0.62% of the SRB. It is mountainous area mostly at elevations above 1,000 m a.s.l., including high mountain range Prokletije. The relief is heterogeneous, with numerous peaks, steep slopes, river valleys and includes different biogeographical units, including high mountain rocky grounds and pastures (above 1,800 m a.s.l), complexes of coniferous forests (generally between 1,500 and 1,800 m a.s.l), submediterranean Balkan mostly deciduous forests (e.g. at southwestern and eastern slopes of Prokletije). Glacial lakes and numerous streams are located in the area.

Ecoregion 11 - Hungarian lowlands

The whole hilly and plain northeastern part of Slovenia and plains of Savinja River and Krško-Brežiška kotlina plain are the part of ecoregion 11. In the Krško-Brežiška kotlina the border between ecoregions 5 and 11 is at elevation of 200 m a.s.l., but all streams with karst springs belong to ecoregion 5. Ecoregion 11 also includes the Sava River section after the confluence with Savinja River.

In Croatia to ecoregion 11 belongs typical lowland landscape with broad floodplains, altitude < 200 m a.s.l. and streams with meandering channel form, alluvial stream bed with dominant calcareous, siliceous, mixed or organic sediments (cobbles, gravel, sand), waters with diverse concentration of calcium carbonate are present.

In Serbia to ecoregion 11 belongs part of the Kolubara River Basin (lower Kolubara), as well as the main course of the Sava River and its tributaries.

2.3.2 River types

All countries cover the obligatory factors (altitude, latitude, longitude, geology, size) given for System B in the EU WFD Annex II, 1.2.1 as more flexible, objective, credible and acceptable classification of the water body types. All countries have introduced mean substratum composition as an optional

factor for river typology. Further Croatia and Slovenia have introduced additional optional factors (Table 7).

The stream types of the Sava River are presented in Table 8, while the stream types for the Sava River tributaries in Table 9. Table 10 presents the number of stream types per ecoregion, altitude, catchments size and geology class.

Table 7: Factors applied in the typology of the Sava

Descriptor	Obligatory or optional System A or B	Country	Class boundaries				
Ecoregion	A obligatory	EU WFD	05		04		11
		SI	X		X		X
		HR	X				X
		BA	X				
		RS	X				X
		ME	n/a				
Altitude (h)		EU WFD	0-200 m		200-800 m		>800 m
		SI	Altitude is considered within definition of bioregions, which are defining different river types. Additionally altitude is considered within river types, if it exceeds 700 m height				
		HR	0-200		200-800		>800
		BA	<200		200-500	500-800	>800
		RS	<200		200-500	500-800	>800
		ME	n/a				
Catchment area [km^2]		EU WFD	<100		<1,000	<10,000	>10,000
		SI	<10	10-100	100-1,000	1,000-10,000	>10,000
		HR	10-100		100-1,000	<10,000	
		RS	<100	100-1,000	1,000-4,000	4,000-10,000	>10,000
		BA	<100	100-1,000	1,000-4,000	4,000-10,000	>10,000
		ME	n/a				
Geology		EU WFD	siliceous		calcareous		organic
		SI	X		X		
		HR	X		X		X
		BA	X		X		X
		RS	X		X		X
		ME	n/a				
Mean substratum composition							
		HR	Bedrock, boulder, Boulder covered with travertine, Cobble, gravel, sand, silt, pebbles				
		BA	Fine substrates (clay, silt, very fine sand), gravel), medium (gravel, cobbles), coarse (cobbles, boulders)				

Descriptor	Obligatory or optional System A or B	Country	Class boundaries		
		RS	fine (clay, silt, sand, gravel), medium (sand, gravel, cobbles), coarse (gravel, cobbles, boulders)		
Other descriptors					
Discharge [m^3/s]		HR	<2	2-20	>20
Specific		SI	Hydrology (permanent), karst spring influence, lake outflow influence, limnocrene spring influence		

Table 8: Stream types defined for the Sava River

Country	River	Length of stream type	No of WBs stream type	Code
		km		
SI	Sava	34.17	2	SI_R_SI_11_VR6a-PN-Sa-neraz - Panonska Sava - nerazvejana
		25.29	2	SI_R_SI_11_VR6b-PN-Sa-raz - Panonska Sava - razvejana
		34.61	2	SI_R_SI_4_KB-AL-D_2_KI - Karbonatne Alpe-Donavsko porečje
		25.38	1	SI_R_SI_4_PA-hrib-D_2 - Srednje velike reke_Predalpska hribovja-donavsko porečje
		44.99	3	SI_R_SI_4_VR1-AL-Sa - Alpska Sava
		57.10	2	SI_R_SI_5_VR3-DN-Sa - Dinarska Sava
HR	Sava	55.23	3	T07B-Lowland watercourses of upper flow of very large rivers, calcareous bed
		282.64	5	T08B-Lowland watercourses of middle flow of very large rivers, siliceous bed
		168.01	2	T09B-Lowland watercourses of lower flow of very large rivers, siliceous bed (Sava basin)
BA	Sava	338.85	3	BA_Type1.15 - Very large loweland rivers, siliceous, fine sediments
RS	Sava	232.24	3	Type_1.1-Very large rivers, lowland, silicious, fine sediments

Table 9: Number of stream types of relevant tributaries

Country	River	Length of stream type	No of WBs stream type	Code
		km		
SI	Ljubljanica	23.19	1	SI_R_SI_5_PD-hrib-ravni_3_Mean - Srednje do velike meandrirajoče reke_Preddinarskahribovjainravnine

Country	River	Length of stream type km	No of WBs stream type	Code
		16.86	2	SI_R_SI_5_VR4-Lj - Ljubljanica
	Savinja	48.97	2	SI_R_SI_11_PN-zALvpliv_3 - Srednje do velike reke_Panonske ravnine z alpskim vplivnim območjem
		44.99	1	SI_R_SI_4_KB-AL-D_2 - Srednje velike reke_Karbonatne Alpe-donavsko porečje
	Krka	24.44	1	SI_R_SI_11_PN-KrBr-kotl_3 - Srednje do velike reke_Krško-brežiška kotlina
		39.39	1	SI_R_SI_11_VR7-Kk - Krka
		31.11	1	SI_R_SI_5_PD-hrib-ravni_2_KI - Predinarska hribovja in ravnine
	Sotla (Sutla)	58.92	1	SI_R_SI_11_PN-KrBr-kotl_2 - Srednje velike reke_Krško-brežiška kotlina
		31.86	1	SI_RSI_11_PN-zALvpliv_1 - Male reke_Panonske ravnine z alpskim vplivnim območjem
	Kolpa (Kupa)	21.30	1	SI_R_SI_5_ED-hrib_2_KI - Srednje velike reke pod kraškim izvirom_Dinarska hribovja
		97.05	2	SI_R_SI_5_VR5-Ko - Kolpa
HR	Sotla (Sutla)	55.11	1	T04B-Lowland watercources of medium sized rivers, siliceous bed
		18.88	1	T02A-Foothill small rivers, siliceous bed
		11.28	1	T04A-Foothill watercourses of medium sized rivers, calcereoous/siliceous bed
	Krapina	59.92	3	T05B-Lowland watercourses of large rivers, siliceous bed
	Kupa (Kolpa)	133.77	1	T06A-Lowland watercourse of very large rivers, siliceous bed with river basin located in calacareou*
		133.77	3	T14A-Foothill watercourses of large travertine rivers, calcareous bed of carst
		51.56	1	T14C-Lowland watercourses of large rivers, calcareous bed
	Dobra	43.15	1	T14A-Foothill watercourses of large travertine rivers, calcareous bed of carst
		1.44	1	T12A-Foothill small rivers, calacareous bed of carst
		18.19	1	T14B-Lowland watercourses of large travertine rivers, calcareous bed
	Korana	87.25	3	T14A-Foothill watercourses of large travertine rivers, calcareous bed of carst
		24.37	1	T14B-Lowland watercourses of large travertine rivers, calcareous bed
		26.95	1	T14C-Lowland watercourses of large rivers, calcareous bed
	Glina	7.97	1	T02B-Foothill small rivers, calcareous bed

Country	River	Length of stream type km	No of WBs stream type	Code
		54.82	2	T04B-Lowland watercources of medium sized rivers, siliceous bed
		2.56	1	T04D-Lowland watercources of medium sized rivers, calcareous bed
		20.12	1	T03C-Lowland small rivers, calcareous bed
		26.89	1	T05B-Lowland watercourses of large rivers, siliceous bed
	Česma	47.92	2	T05B-Lowland watercourses of large rivers, siliceous bed
		24.68	1	T03A-Lowland small rivers, siliceous bed
		32.78	1	T04B-Lowland watercources of medium sized rivers, siliceous bed
		6.23	1	T05A-Lowland watercources of medium sized rivers, calcareous/siliceous bed
		33.71	1	T05B-Lowland watercourses of large rivers, siliceous bed
	Glogovnica	14.39	1	T05B-Lowland watercourses of large rivers, siliceous bed
		25.77	1	T04B-Lowland watercources of medium sized rivers, siliceous bed
		24.63	1	T03A-Lowland small rivers, siliceous bed
	Ilova	43.42	1	T05B-Lowland watercourses of large rivers, siliceous bed
		21.80	1	T03A-Lowland small rivers, siliceous bed
		31.65	1	T04B-Lowland watercources of medium sized rivers, siliceous bed
	Una	49.72	2	T14A-Foothill watercourses of large travertine rivers, calcareous bed of carst
		12.94	1	T05A-Lowland watercources of medium sized rivers, calcareous/siliceous bed
		70.93	1	T05B-Lowland watercourses of large rivers, siliceous bed
	Orljava	31.02	1	T05B-Lowland watercourses of large rivers, siliceous bed
		37.33	1	T04B-Lowland watercources of medium sized rivers, siliceous bed
		11.82	1	T02A-Foothill small rivers, siliceous bed
		6.79	1	T04A-Foothill watercourses of medium sized rivers, calcereoous/siliceous bed
	Bosut	10.92	1	T04B-Lowland watercources of medium sized rivers, siliceous bed

Country	River	Length of stream type km	No of WBs stream type	Code
		70.15	3	T05C-Lowland watercourses of large rivers, siliceous/organic bed
		11.87	1	T03B-Lowland small rivers, organic bed
BA	Korana	23.34	1	BA_Type4.29 - Small loweland-upland rivers, organic, medium sediments
	Una	72.95	1	BA_Type3.4 - Medium loweland-upland rivers, carbonate, large sediments
		9.85	1	BA_Type4.4 - Small loweland-upland rivers, carbonate, large sediments
		58.90	1	BA_Type3.1 - Medium loweland rivers, carbonate, large sediments
		70.57	1	BA_Type2.14 - Very large loweland rivers, siliceous, medium sediments
	Sana	34.66	1	BA_Type3.14 - Medium loweland rivers, siliceous, medium sediments
		36.72	1	BA_Type3.4 - Medium loweland-upland rivers, carbonate, large sediments
		16.61	1	BA_Type4.4 - Small loweland-upland rivers, carbonate, large sediments
		37.65	1	BA_Type3.2 - Medium loweland rivers, carbonate, medium sediments
		15.37	1	BA_Type3.1 - Medium loweland rivers, carbonate, large sediments
	Vrbas	86.40	4	BA_Type3.4 - Medium loweland-upland rivers, carbonate, large sediments
		14.50	1	BA_Type5.22 - Mountain stream, siliceous, large sediments
		57.76	1	BA_Type4.7 - Small upland-mountainous rivers, carbonate, large sediments
		90.97	2	BA_Type2.14 - Very large loweland rivers, siliceous, medium sediments
	Pliva	21.78	3	BA_Type3.4 - Medium loweland-upland rivers, carbonate, large sediments
		10.67	1	BA_Type4.4 - Small loweland-upland rivers, carbonate, large sediments
	Ukrina	80.91	2	BA_Type3.14 - Medium loweland rivers, siliceous, medium sediments
	Bosna	125.57	2	BA_Type2.14 - Very large loweland rivers, siliceous, medium sediments
		48.90	1	BA_Type3.4 - Medium loweland-upland rivers, carbonate, large sediments
		37.67	1	BA_Type2.16 - Very large loweland rivers, siliceous, fine sediments

Country	River	Length of stream type km	No of WBs stream type	Code
		36.93	1	BA_Type2.4 - Very large loweland rivers, siliceous, large sediments
		8.38	1	BA_Type4.4 - Small loweland-upland rivers, carbonate, large sediments
		22.05	1	BA_Type3.4 - Medium loweland-upland rivers, carbonate, large sediments
	Lašva	2.13	1	BA_Type5.22 - Mountain stream, siliceous, large sediments
		11.72	1	BA_Type4.17 - Small loweland-upland rivers, siliceous, medium sediments
		19.16	2	BA_Type4.5 - Small loweland-upland rivers, carbonate, medium sediments
		22.32	1	BA_Type4.20 - Small upland-mountainous rivers, siliceous, medium sediments
	Krivaja	62.22	2	BA_Type3.5 - Medium loweland rivers, carbonate, medium sediments
		4.73	1	BA_Type4.8 - Small upland-mountainous rivers, carbonate, medium sediments
		6.47	1	BA_Type3.19 - Medium upland-mountainous rivers, siliceous, large sediments
	Spreča	52.22	1	BA_Type4.17 - Small loweland-upland rivers, siliceous, medium sediments
		16.36	1	BA_Type5.4 - Loweland-upland stream, carbonate, large sediments
		86.50	2	BA_Type3.14 - Medium loweland rivers, siliceous, medium sediments
	Tinja	37.96	2	BA_Type4.13 - Small loweland rivers, siliceous, large sediments
		34.75	1	BA_Type4.15 - Small loweland rivers, siliceous, fine sediments
		26.20	1	BA_Type5.16 - Loweland-upland stream, siliceous, large sediments
	Drina	245.24	4	BA_Type1.14 - Very large loweland rivers, siliceous, medium sediments
		69.32	2	BA_Type2.16 - Very large loweland rivers, siliceous, fine sediments
		21.04	1	BA_Type2.4 - Very large loweland rivers, siliceous, large sediments
	Ćehotina	36.06	2	not defined
	Prača	14.71	2	BA_Type4.4 - Small loweland-upland rivers, carbonate, large sediments
		17.98	1	BA_Type4.19 - Small upland-mountainous rivers, siliceous, large sediments
		15.98	1	BA_Type4.7 - Small upland-mountainous rivers, carbonate, large sediments

Country	River	Length of stream type	No of WBs stream type	Code
		km		
		14.62	1	BA_Type5.22 - Mountain stream, siliceous, large sediments
	Lim	44.73	1	BA_Type2.17 - Very large loweland rivers, siliceous, medium sediments
	Uvac	8.26	1	BA_Type3.17 - Medium loweland-upland rivers, siliceous, medium sediments
	Drinjača	25.35	2	BA_Type4.16 - Small loweland-upland rivers, siliceous, large sediments
		6.87	1	BA_Type4.10 - Small mountainous rivers, carbonate, large sediments
		4.96	1	BA_Type3.13 - Medium loweland rivers, siliceous, large sediments
		20.85	2	BA_Type5.19 - Upland-mountainous stream, siliceous, large sediments
		33.83	1	BA_Type4.4 - Small loweland-upland rivers, carbonate, large sediments
	Tara	24.43	1	BA_Type3.4 - Medium loweland-upland rivers, carbonate, large sediments
RS	Bosut	38.52	1	P3_V1_SIL-Medium rivers, lowland, siliceous
	Drina	242.77	4	Type_1.2-Very large rivers, lowland, silicious, medium sediments
	Lim	83.81	4	Type_1.6-Large, hilly, silicious, medium sediments
	Uvac	8.24	1	P3_V3_CAR-Medium rivers, mid-altitude, carbonates
		35.59	2	P3_V2_SIL-Medium rivers, hilly, siliceous
		30.48	2	P3_V4_CAR-Medium rivers, high-altitude, carbonates
		40.09	2	P3_V4_SIL-Medium rivers, high-altitude, siliceous
	Kolubara	24.38	2	P3_V1_SIL-Medium rivers, lowland, siliceous
		12.28	2	P3_V1_CAR-Medium rivers, lowland, carbonates
		54.66	2	P3_V1_SIL-Medium rivers, lowland, siliceous
ME	Ćehotina	91.90	3	n/a
	Lim	91.74	2	n/a
	Piva	46.68	2	n/a
	Tara	137.62	2	n/a

Table 10: Number of types per ecoregion, altitude, catchments size and geology class

	SI	HR	BA	RS	Total No
Ecoregions					
Alps	4				4
Dinaric Western Balkans	6	5	31	6	48
Hungarian lowlands	7	15		5	27
Altitude					
lowland	3	14	11	6	34
mid-altitude	13	5	5	3	26
High	3		7	2	12
Catchment area					
small	1	5	13		19
medium	9	4	5	8	26
large	7	5	1	1	14
very large		4	4	1	9
Geology					
siliceous	17	6	13	8	44
calcareous		9	8	3	20
organic		1	1		2
mixed		3			3

2.3.3 Reference Conditions

Reference conditions are so far defined for certain biological quality elements by Croatia, Serbia and Slovenia.

Reference conditions for Federation of Bosnia and Herzegovina (FBiH) are defined in the by-law Decree on the characterization of surface and groundwater, reference conditions and parameters for assessing the status of water and water monitoring (FBiH Official Gazette No. 14/01). For the first Sava RBMP in FBiH guidelines from the Decree will be used to determine reference values for

assessing the ecological and chemical status and potential, as well as the types of grouping according to similarity in relation to certain quality elements, or on the basis of analyzes of variance of selected biological parameters. In the Decree are separated chemical and physico-chemical quality elements of water that accompany the biological elements such as pH, oxygen regime parameters (dissolved oxygen, BOD_5, COD, $KMnO_4$, TOC) and indicators of nutrients (ammonium ion, nitrate, total nitrogen, total phosphorus, orthophosphate) together with the available biological parameters with emphasis on aquatic macroinvertebrate and hydromorphological elements. For the purpose of the first Sava RBMP in FBiH and pursuant to Section 1.2.5. of the above mentioned Decree, the reference values of physico-chemical, chemical, biological and hydromorphological parameters of water quality will equal the value of high water status.

Table 11 outlines the descriptors that have been applied in the Sava countries. The table cells in grey color indicate which descriptors are considered to be obligatory for the EU WFD compliant assessment methods.

Table 11: Descriptors applied for the definition of reference conditions for biological quality elements in rivers, fields in grey color indicate obligatory descriptors for the EU WFD compliant assessment methods

Country	Finished by (month-year)	BQE	Taxonomic composition	Abundance	Diversity	Sensitive to insensitive taxa	Age structure	Biomass	Other
BA		Phytoplankton							
		Macrophytes and Phytobenthos							
		Benthic Invertebrates							
		Fish Fauna							
HR	12-2007	Phytoplankton							x
		Macrophytes and Phytobenthos							x
		Benthic Invertebrates							x
		Fish Fauna							x
RS	6-2008	Phytoplankton	x	x	x				
	12-2008	Macrophytes x and Phytobenthos (x)	x (x)	(x)	(x)				
	12-2006	Benthic Invertebrates	x	x	x	x			
	12-2006	Fish Fauna	x	x	x		x		
SI	-	Phytoplankton							
	12-2007	Macrophytes and Phytobenthos	x	x					
	12-2008	Benthic Invertebrates	x	x	x	x			
	12-2009	Fish Fauna	x				x	x	

2.3.4 Identification of water bodies[6]

2.3.4.1 River water bodies

The Sava riparian countries have identified the location and boundaries of water bodies according to change in surface water categories, change of type, change of pressure and significant physical features. Bosnia and Herzegovina, Croatia and Slovenia have also introduced other criteria as indicated in Table 12.

Table 12: Criteria applied for the delineation of water bodies within the countries

Country	Change in surface water category	Change in type	Change in pressure/status	Significant physical features	Other
BA	x	x	x	x	Significant tributaries
HR	x	x			Karst phenomena
RS	x	x	(x)*	x	
SI	x	x	x	x	Natural hydromorphological characteristics

* Only pollution.

In total, the Sava countries have identified 28 water bodies for the Sava River (Table 13) and 167 water bodies for the tributaries.

The stated total number of WBs and total length of the Sava River and its tributaries is different from the real numbers due to problems with the harmonization of trans-boundary water bodies. The number of WBs is not harmonized on Sotla/Sutla River (SI has delineated one WB, while HR two WBs) , while the length of the WBs differs on Sotla/Sutla River (2 WBs – SI/HR), Kupa/Kolpa River (2 WBs – SI/HR), Una River (4 WBs –BA/HR) and Sava (2 WBs – HR/BA).

Tables 13, 14 and Figure 7 summarize the results of the water body delineation in terms of numbers and length of water bodies in the Sava River, while Tables 15, 16 and Figure 8 for the Sava River tributaries. The locations and boundaries of the surface water bodies are presented in Map 4.

Table 13: Basic information about water bodies in the Sava River

Country	WBs	Average length	Min. length	Max. length
	No.	km	km	km
SI	12	18.46	3.77	31.36
HR	10	50.59	4.64	105.28
BA	3	113.05	88.77	137.33
RS	3	77.41	32.74	126.46
Total	28			

[6] Data on water bodies originates from the ICPDR Danube GIS.

Table 14: Number of water bodies delineated in terms of number and length of water bodies in the Sava River per country

Country	<10 km	10-25 km	25-50 km	50-75 km	75-100 km	100-150 km
	No	No	No	No	No	No
SI	2	7	3			
HR	2		2	4	1	1
BA					1	2
RS			1	1		1

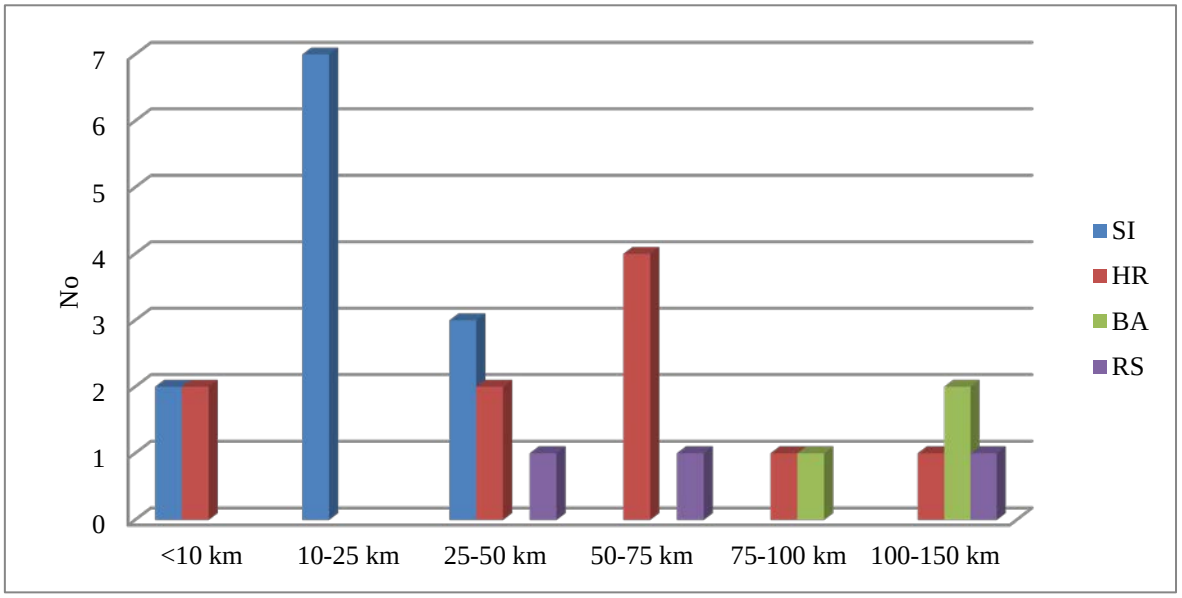


Figure 7: Histogram of water body sizes for the Sava River

Table 15: Basic information about water bodies in the Sava tributaries

Country	WBs	Average length	Min. length	Max. length
	No.	km	km	km
SI	14	31,29	4.57	85.00
HR	50	27.88	0.69	133.43
BA	72	27.86	1.64	83.70
RS	22	25.95	5.22	115.14
ME	9	40.88	9.40	69.04
Total	**167**			

Table 16: Number of water bodies delineated in terms of number and length in the Sava River tributaries per country

Country	<10 km	10-25 km	25-50 km	50-75 km	75-100 km	100-150 km
	No.	No.	No.	No.	No.	No.
SI	1	7	4	1	1	
HR	6	23	16	3		2
BA	15	27	17	9	4	
RS	4	13	3		1	1
ME	2		4	3		

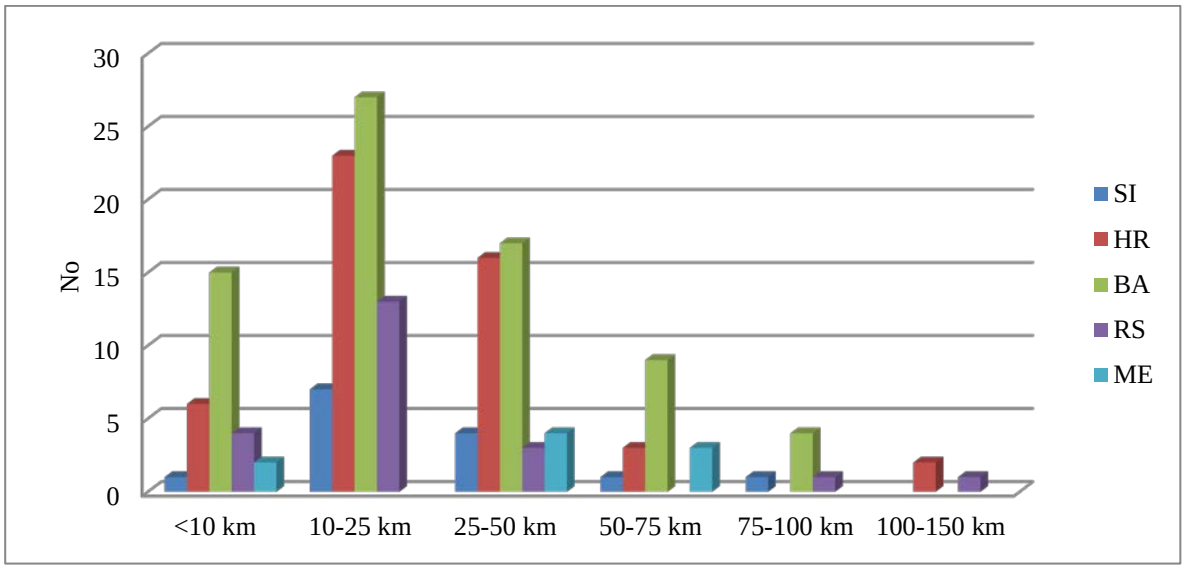


Figure 8: Histogram of water body sizes for the Sava River tributaries

2.3.4.2 Reservoirs

The agreed threshold value for reservoirs relevant for this analysis is $5*10^6$ m^3. The basic data on reservoirs with storage capacity above the threshold value are shown in Table 17.

Table 17: Reservoirs in the Sava River Basin

Category (capacity range)	Country	Location		Reservoir			Dam height
		River Basin	River	Name	Volume	Purpose	
Mm^3					Mm^3		m
5-10	SI	Sava	Sava Dolinka	Moste	6.24	EP, FP	59.60
	SI	Sava	Sava	Zbiljsko jezero	7.00	EP, FP	30.00
	SI	Sava	Sava	Vrhovo	8.65	EP, FP	24.00
	SI	Sava	Sava	Boštanj	8.00	EP, FP	7.47
	SI	Sava	Sava	Arto-Blanca	9.95	EP, FP	9.29
	SI	Sava	Sava	Krško	6.31	EP, FP	9.14
	HR	Kupa/Kolpa	Dobra	Gojak	4,55	EP	9.0 (Sabljaci) 13.0 (Bukovnik)
	RS	Drina	Uvac	Radoinja	7.00	EP	42.00
	RS	Kolubara	Velika Bukulja	Garaši	6.27	DW	35.00
10-50	SI	Sava	Sava	Trbojsko jezero	10.70	EP, FP	38.00
	BA	Sava	Rastošnica	Snježnica	20.60	EP	
	SI,HR	Sotla/Sutla	Sutla	Vonarje (Sutlansko jezero)	12.40	DW, IW, FP, IR, R	19.00
	HR	Kupa/Kolpa	Dobra	Lešće	25.70	EP	52.50
	HR	Ilova	Pakra	Pakra	12.00	DW, IW, FP, R	5.0-8.4
	RS	Drina	Lim	Potpeć	44.00	EP	46.00
	ME	Drina	Ćehotina	Otilovići	17.00	IW, DW,	59.00

Category (capacity range)	Country	Location		Reservoir			Dam height
		River Basin	River	Name	Volume	Purpose	
Mm^3					Mm^3		m
						FP	
	RS	Kolubara	Kladnica	Paljuvi Viš	14.00	IW	16.00
50-100	BA	Sava	Spreča	Modrac	88.00	IW, DW, FP, EP	28.00
	BA	Vrbas	Vrbas	Bočac	52.70	EP	52.00
	RS	Drina	Drina	Zvornik	89.00	EP	42.00
	RS	Kolubara	Jablanica	Rovni	52.00	DW,IR, IW	74.00
100-200	BA	Drina	Drina	Višegrad	161.00	EP	48.16
	RS	Drina	Beli Rzav	Lazići	170.00	EP	131.00
200-500	RS	Drina	Uvac	Uvac	213.00	EP	110.00
	RS	Drina	Uvac	Kokin Brod	273.00	EP	82.00
	RS	Drina	Drina	Bajina Bašta	340.00	EP	90.00
>500	ME	Drina	Piva	Mratinje	880.00	EP, FP	220.00

Legend on purpose:

IR – irrigation; DR– drainage; DW - drinking water supply; IW – industrial water supply; R – recreation; EP – electricity production; FP – flood protection.

2.4 Characterization of groundwater

2.4.1 Groundwater

Groundwater in the Sava River Basin is of significant importance, mostly as a source of public water supply of population and industry, but also as a support for aquatic eco systems.

Diverse geological structure in the Sava River Basin is represented by limestones, sandstones, gravel and permeable fluvial sediments as the main components of the aquifers of the important groundwater bodies. Different geological formations (with corresponding hydraulic properties of the aquifers), and the varying permeability of the overlying strata made groundwater bodies more or less protected from the anthropogenic influence.

According to the information provided in the first Sava RBMP, countries have identified 41 GWBs of basin wide importance which are indicated in Figure 9 and in Map 5.

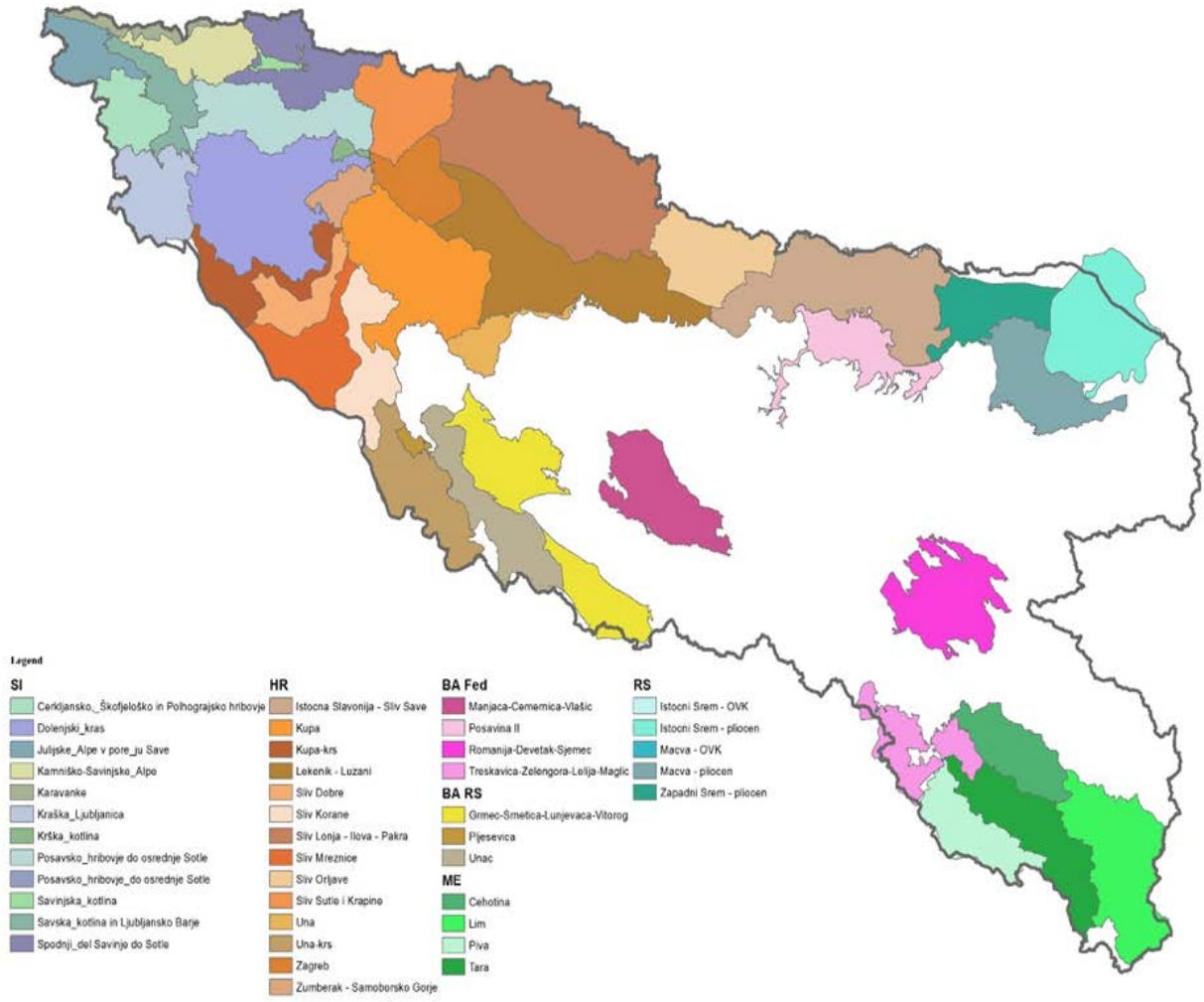


Figure 9: Reported GW bodies in the Sava River Basin (threshold value 1,000 km^2 or important)

2.4.2 Important groundwater bodies

Countries in the Sava River Basin have reported 41 important groundwater bodies in the Sava River Basin. The national breakdown of the GWBs related to size and number is indicated in Table 18 and Figures 10 and 11.

Table 18: Summary table of GWBs in the Sava River Basin

	SI	HR	BA	RS	ME	Sum
No of GWBs	11	14	7	5	4	41
Size	11,980.00	25,751.85	12,050.00	7,356.50	805.50	57,943.85
Percentage	21%	44%	21%	13%	1%	

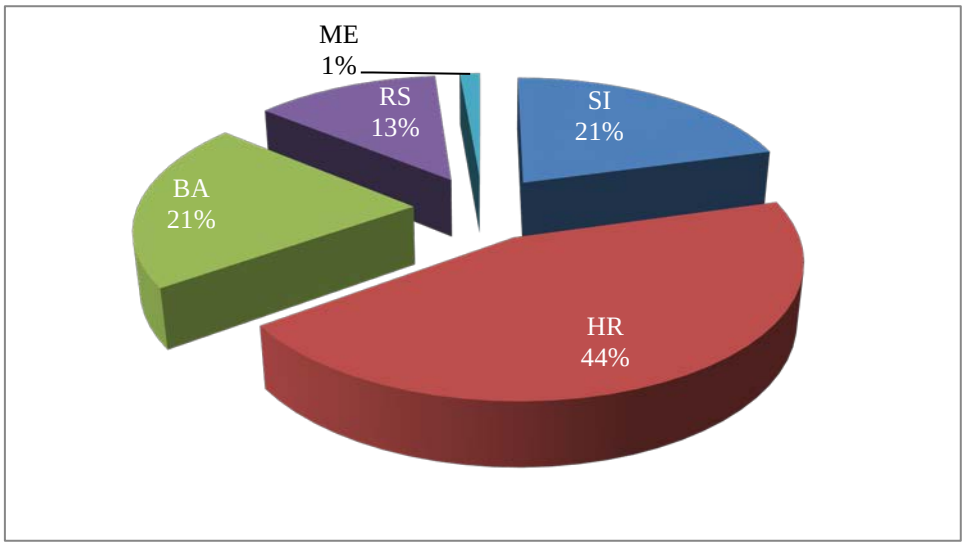


Figure 10: GWBs related to size in km^2 per country

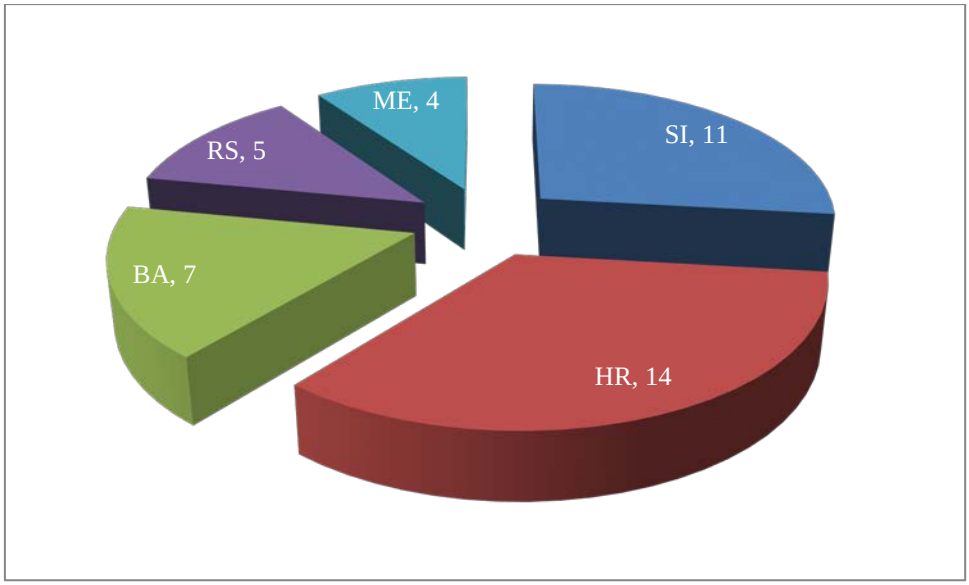


Figure 11: Number of GWBs per country

3 Identification of significant pressures[7]

Driving forces related to settlements, industry, agriculture and waste management, hydromophological alterations, future infrastructure projects, accidental pollution and invasive species have been considered as key elements that exert or may exert significant pressure on surface water bodies.

3.1 Significant pollution sources

Table 19 presents driving forces per country which have been considered for the analysis of pollution. In Tables 20 to 31 and related figures (12- 24) the pollution sources are quantified.

Table 19: Driving forces that have been considered for the analysis of pollution

		SI	HR	BA	RS	ME
Point sources of pollution						
Settlements						
	>100,000	1	3	4	0*	0
	10,000-100,000 PE	17	25	56	15	3
	2,000-10,000 PE	71	76	188	93	4
Industry						
	Energy sector	4	Included in category "Other activities"	Included in category "Other activities"	6	1
	Production and processing of metals	43	27	18	4	1
	Mineral industries	39	13	33	4	2
	Chemical industries	4	18	15	1	n/a
	Waste and wastewater management	83	3	3	n/a	5
	Paper and wood production and processing	6	6	14	1	5
	Intensive livestock production and aquaculture	3	n/a	6	2	n/a

[7] Data on significant pressures for SI, HR and RS originates from the Sava RBMP, except for hydromorphological alterations which originates from the ICPDR database.

		SI	HR	BA	RS	ME
	Animal and vegetable products from the food and beverage sector	32	50	75	2	4
	Other food industry	44	n/a	5	1	n/a
	Other activities	307	45	161	n/a	n/a
Agriculture						
	Cattle	248,166	191,196	348,087	163,219	50,014
	Sheep	73,370	324,084	760,664	256,701	99,083
	Pig	228,096	558.672	380,665	607,040	6,139
	Poultry	2,415,746	4,236,144	12,268,025	3,507,163	n/a
Abandoned sites and mining sites		n/a	n/a	n/a	n/a	n/a
Water abstractions		n/a	n/a	n/a	n/a	n/a

The sources of diffuse sources of pollution are indicated in Table 28 (TN) and Table 30 (TP).

*Belgrade is not included

3.1.1 Organic pollution

3.1.1.1 Significant sources of organic pollution from point sources

Table 20: Pollution from agglomerations > 2,000 PE emitted into environment

Country		Generated load		Emissions		Emissions	
	PE inventory	BOD	COD	BOD	COD	BOD	COD
	PE	t/a	t/a	t/a	t/a	%	%
SI	964,966	21,133	38,743	10,717	21,531	50.71%	55.57%
HR	2,442,741	53,496	106,992	35,514	73,122	66.39%	68.34%
BA	2,634,237	57,690	115,380	57,199	114,327	99.15%	99.09%
RS	698,663	15,301	29,528	14,382	27,734	93.99%	93.92%
ME	76,750	1,681	3,362	1,623	3,238	96.55%	96.31%
Total	6,817,357	149,301	294,005	119,435	239,952	80.00%	81.61%

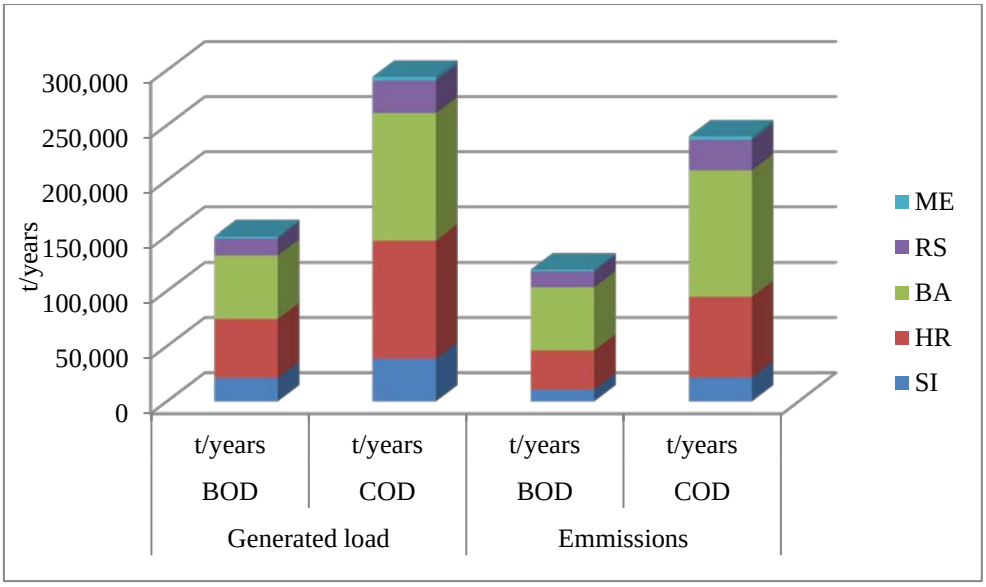


Figure 12: Total wastewater load from agglomerations > 2,000 PE in the Sava River Basin from the respective country (BOD5 and COD5)

Table 21: Pollution from significant industrial pollution sources emitted into environment[8]

Country	No of significant IPS	Discharges	
		BOD	COD
	No	t/a	t/a
SI	89	1,904	3,709
HR	5	1,542	2,553
BA	31	2,357	5,568
RS	10	2,856	4,424
ME	4	806	2,094
Total	139	9,465	18,348

[8] The detailed criteria on significant industrial pollution sources are provided in the Sava RBMP Background paper No.3: Significant pressures identified in the Sava River Basin (http://www.savacommission.org/dms/docs/dokumenti/srbmp_micro_web/backgroundpapers_final/no_3_background_paper_significant_pressures_in_the_sava_rb.pdf)

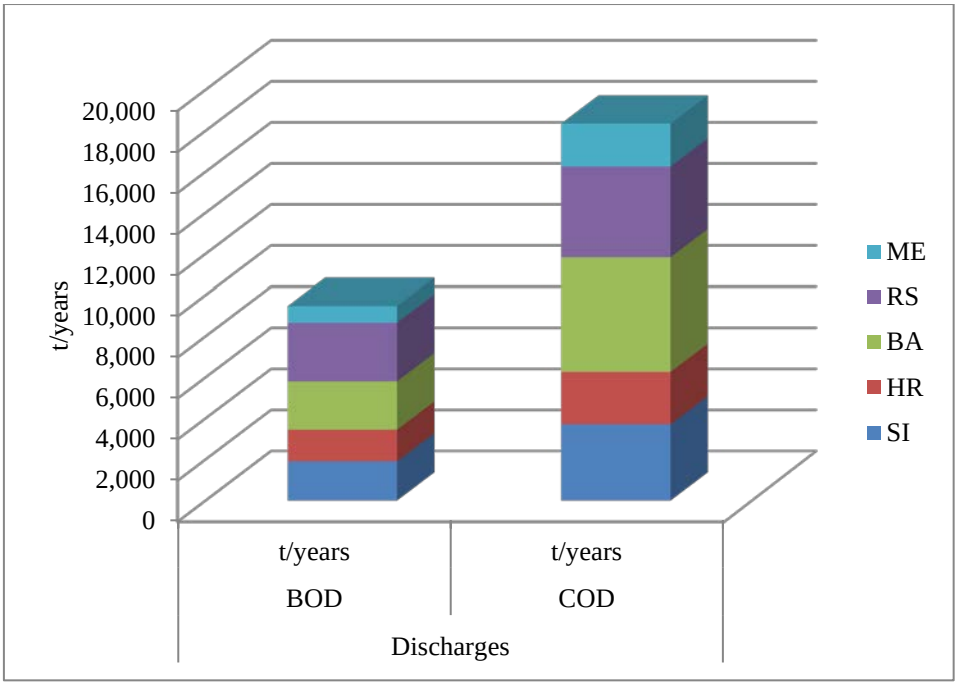


Figure 13: Discharged organic load from significant industrial pollution sources

3.1.2 Nutrient pollution

3.1.2.1 Significant sources of nutrients pollution from point sources

Table 22: Pollution from agglomerations > 2,000 PE emitted into environment

Country		Generated load		Emissions		Emissions	
	PE inventory	TN	TP	TN	TP	TN	TP
	PE	t/years	t/years	t/years	t/years	%	%
SI	964,966	3,874	704	3,179	615	82.06%	87.36%
HR	2,442,741	7,846	1,935	6,617	1,756	84.34%	90.75%
BA	2,634,237	8,461	1,971	8,425	1,966	99.57%	99.75%
RS	698,663	2,244	489	2,158	481	96.17%	98.36%
ME	76,750	247	50	242	50	97.98%	100.00%
Total	6,817,357	22,672	5,149	20,621	4,868	90.95%	94.54%

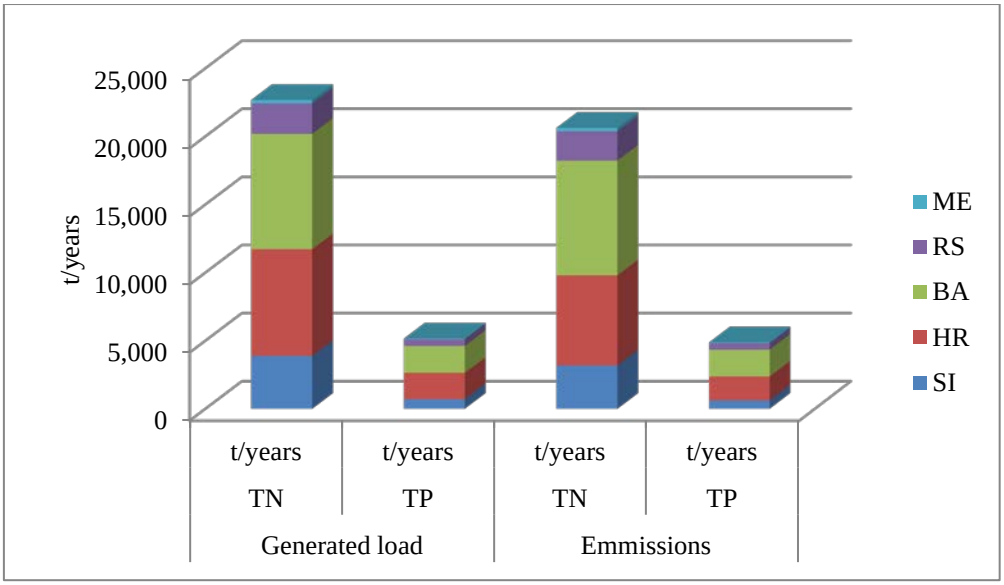


Figure 14: Total wastewater load from agglomerations > 2,000 PE in the Sava River Basin from the respective country (TN and TP)

Table 23: Pollution from significant industrial pollution sources emitted into environment[9]

Country	No of significant IPS	Discharges	
		TN	**TP**
	No	**t/years**	**t/years**
SI	89	301.14	27.27
HR	5	37.62	3.18
BA	31	371.32	31.31
RS	10	68.16	0.08
ME	4	17.81	n/a
Total	139	796.05	61.84

[9] The criteria on significant industrial pollution sources are provided in the Sava RBMP Background paper No.3: Significant pressures identified in the Sava River Basin (http://www.savacommission.org/dms/docs/dokumenti/srbmp_micro_web/backgroundpapers_final/no_3_background_paper_significant_pressures_in_the_sava_rb.pdf)

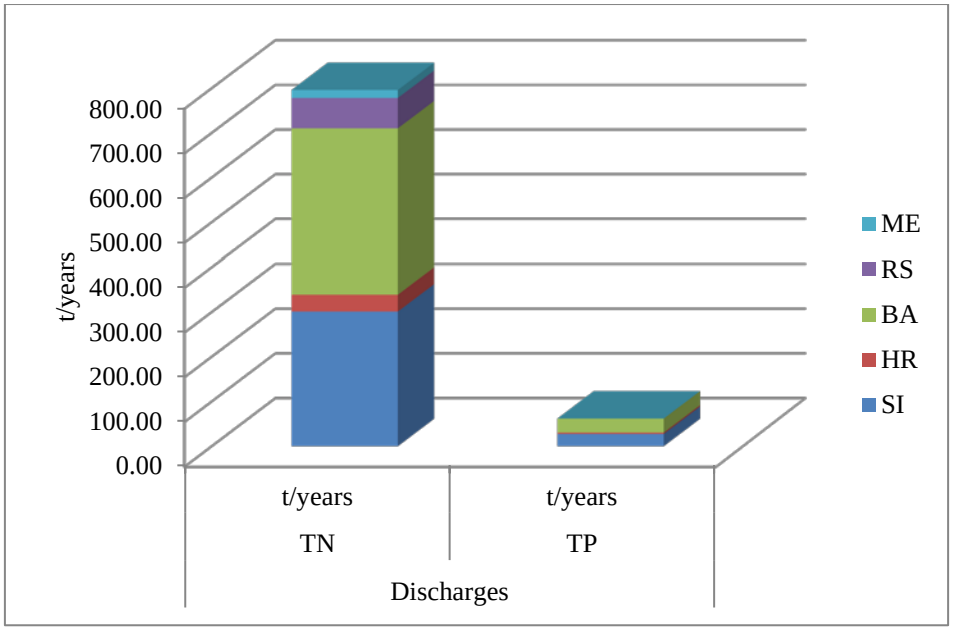


Figure 15: Discharged nutrient load from significant industrial pollution sources

Table 24: Pollution from agriculture emitted into environment

Country	Nutrient production				
	Cattle	Pigs	Sheep	Polutry	TN
	t/years	t/years	t/years	t/years	t/years
SI	12,968	4,514	575	1,422	19,479
HR	10,976	9,749	2,453	2,726	25,904
BA	8,863	1,099	3,499	2,779	16,240
RS	9,835	10,668	2,347	1,714	24,564
ME	2,964	106	1,039	133	4,242
Total	45,606	26,136	9,913	8,774	90,429

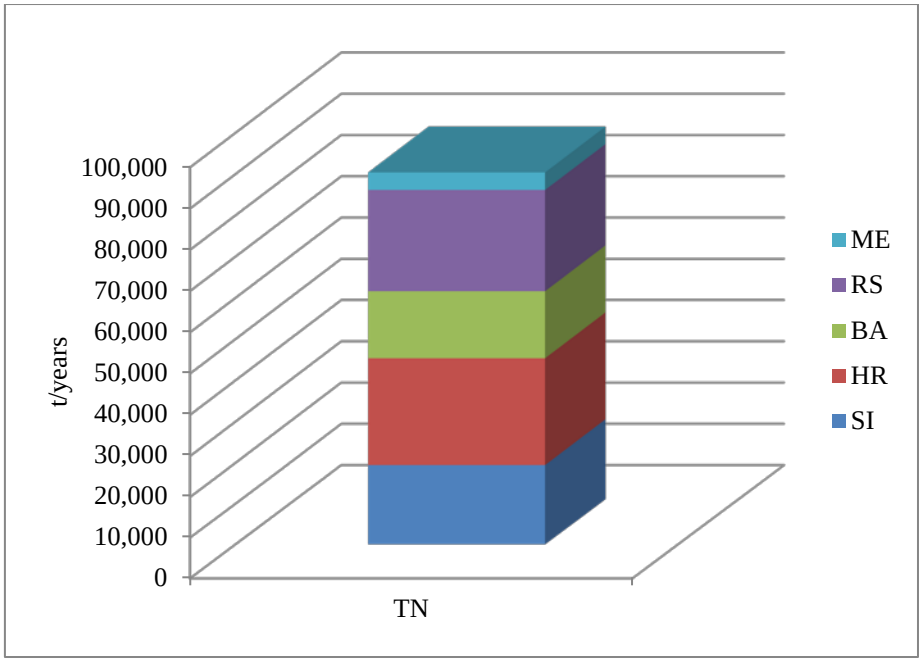


Figure 16: Total amount of nitrogen production via animal manure

Table 25: Total amount of phosphorous production via animal manure

Country	Phosphorus production					
	Cattle	Pigs	Sheep	Polutry	P2O5	TP
	t/years	t/years	t/years	t/years	t/years	t/years
SI	2,045	903	219	711	3,878	1,666
HR	1,731	1,950	934	1,363	5,978	2,568
BA	1,398	220	1,333	1,390	4,341	1,864
RS	1,551	2,134	894	857	5,436	2,335
ME	467	21	396	67	951	409
Total	7,192	5,228	3,776	4,388	20,584	8,842

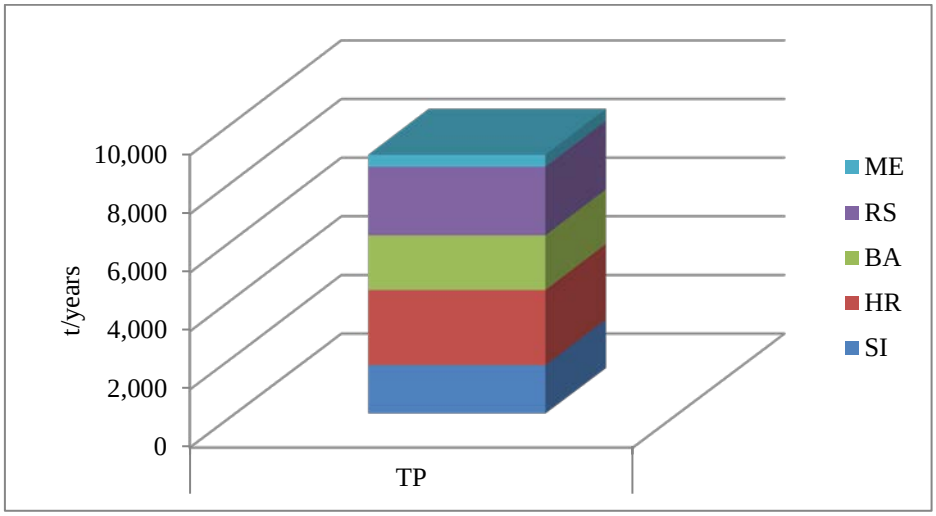


Figure 17: Total amount of phosphorous production via animal manure

3.1.2.2 Assessment of impacts from diffuse pollution sources

The estimation of the diffuse pollution has been calculated by the MONERIS model. The model is an empirical, catchment-scale, lumped parameter and long-term average approach. It can 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. The model has been enhanced and adapted to the specific ICPDR needs by several regional projects accomplished in the basin.

In the 2nd SRBA the results of the model for the Sava River Basin is presented for the period 2009-2012. The results from the MONERIS model are indicated in Map 6 (Nitrogen) and Map 7 (Phosphorus)

According to calculation the total nitrogen (TN) emission is 103,551 t/years (106.67 kg/year ha) while total phosphorus (TP) is 7,309 t/years (752.97 g/years ha).

The emissions TN and TP according to different pathways are indicated in Table 26 and Figure 18.

Table 26: TN and TP emissions according to different pathways

Pathways	Emissions TN	Emissions TP
	t/years	t/years
Atmospheric deposition	1,377	35
Surface runoff	9,530	134
Urban systems	18,462	1,777
Tile drainage	2,071	17
Erosion	1,828	1,160
Groundwater	52,975	938
Point sources	17,308	3,249
Total emissions	103,551	7,309

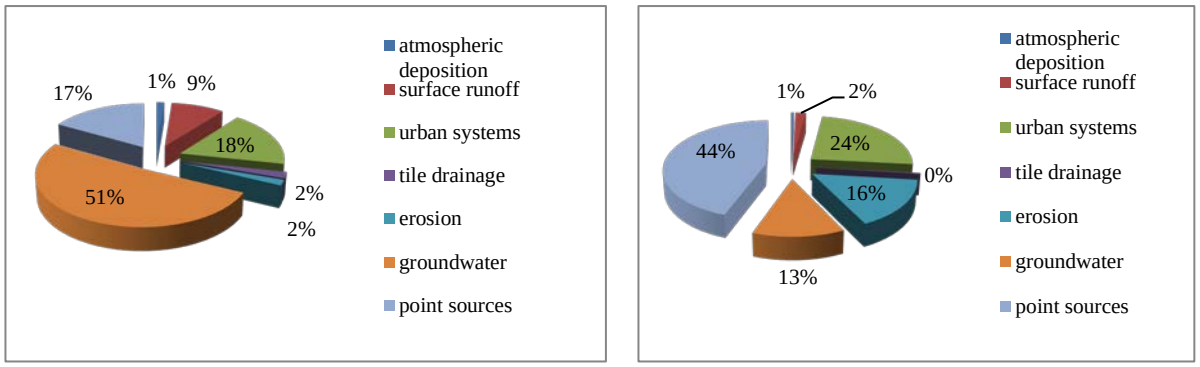


Figure 18: TN and TP emissions according to different pathways

Distribution of the TN emissions per country is indicated in Table 27 and Figure 19 (pathways) and in Table 28 and Figure 20 (sources).

Emissions of TP are presented in Table 29 and Figure 21 (pathways) and in Table 30 and Figure 22 (sources).

Table 27: TN emissions according to different pathways per country

Pathways	Emissions TN					
	t/years					
	SI	HR	BA	RS	ME	AL
Atmospheric deposition	342	439	342	165	87	2
Surface runoff	1,914	3,573	2,267	972	782	22
Urban systems	663	2,243	9,821	5,279	444	12
Tile drainage	227	1,746	55	39	4	0
Erosion	258	355	822	342	51	0
Groundwater	11,788	21,453	13,226	3,316	3,108	84
Point sources	1,773	3,224	2,752	9,412	147	0
Total emissions	16,965	33,033	29,284	19,524	4,624	121
	kg/years ha					
Specific Emissions	14.42	12.82	7.77	12.85	7.11	8.78

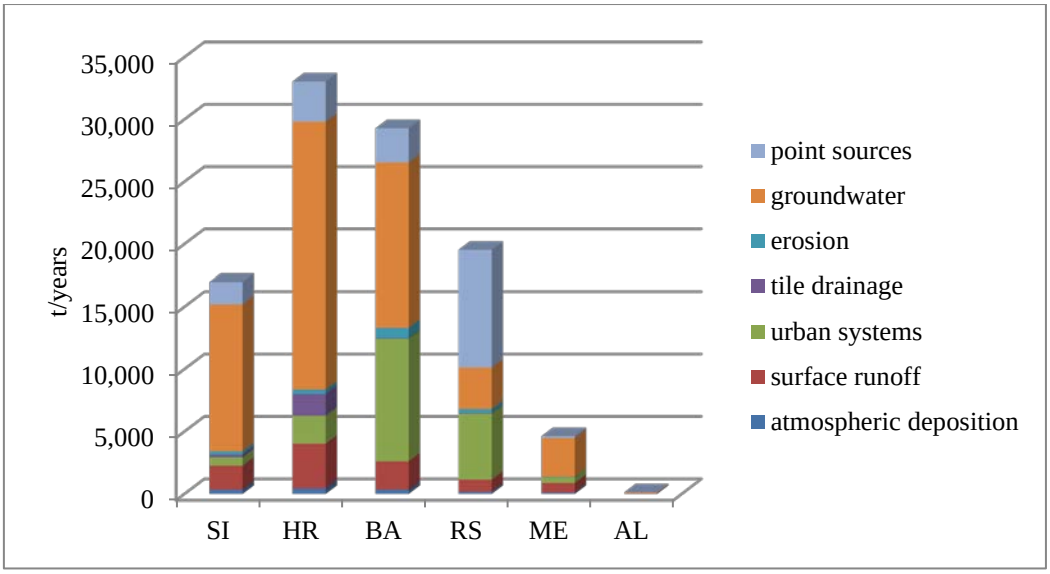


Figure 19: TN emissions according to different pathways per country

Table 28: TN emissions according to different sources per country

Sources	Emissions TN					
	t/years					
	SI	HR	BA	RS	ME	AL
Urban areas	2,417	5,360	12,367	14,498	584	12
Emissions from natural areas	6,822	8,101	9,219	2,741	2,890	92
Background emissions	1,080	2,053	2,762	757	622	13
Agriculture	6,646	17,519	4,936	1,528	528	4
Total emissions	16,965	33,033	29,284	19,524	4,624	121

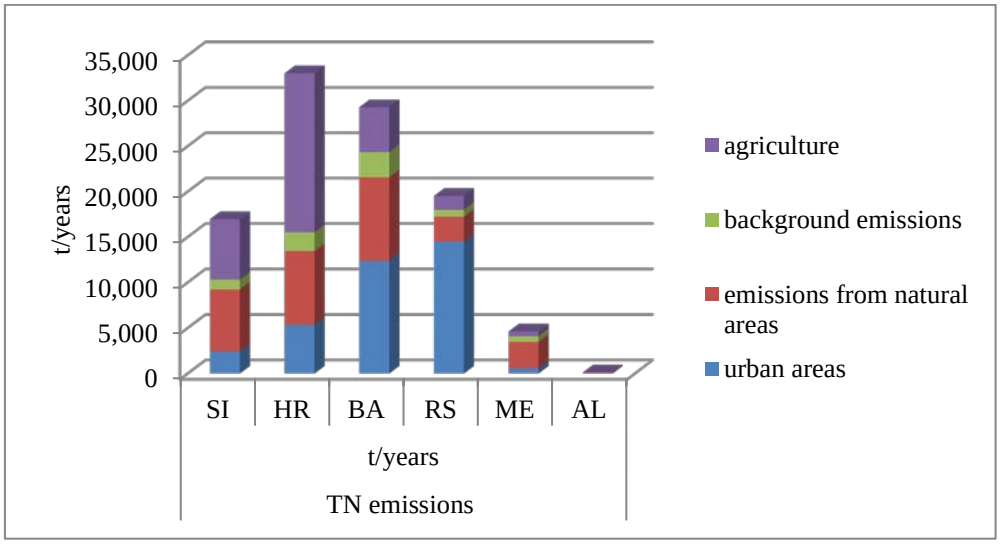


Figure 20: TN emissions according to different sources per country

Table 29: TP emissions according to different pathways per country

Pathways	TP emissions					
	t/years					
	SI	HR	BA	RS	ME	AL
Atmospheric deposition	6	10	10	5	4	0
Surface runoff	28	44	36	13	13	0
Urban systems	70	313	723	636	34	0
Tile drainage	2	11	3	1	0	0
Erosion	187	245	479	219	30	0
Groundwater	187	298	275	93	83	2
Point sources	313	888	639	1,378	30	0
Total emissions	794	1,809	2,165	2,345	194	3
	g/years ha					
Specific Emissions	674.87	701.78	574.08	1,544.15	298.39	190.43

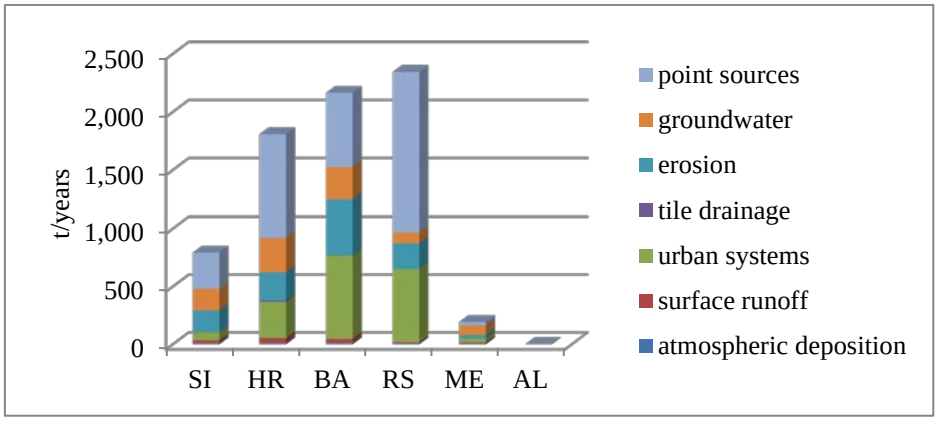


Figure 21: TP emissions according to different pathways per country

Table 30: TP emissions according to different sources per country

Sources	TP emissions					
	t/years					
	SI	HR	BA	RS	ME	AL
Urban areas	383	1,201	1,362	2,015	64	0
Emissions from natural areas	36	52	41	15	7	0
Background emissions	163	249	245	81	86	2
Agriculture	211	307	517	235	37	0
Total Emissions	794	1,809	2,165	2,345	194	3

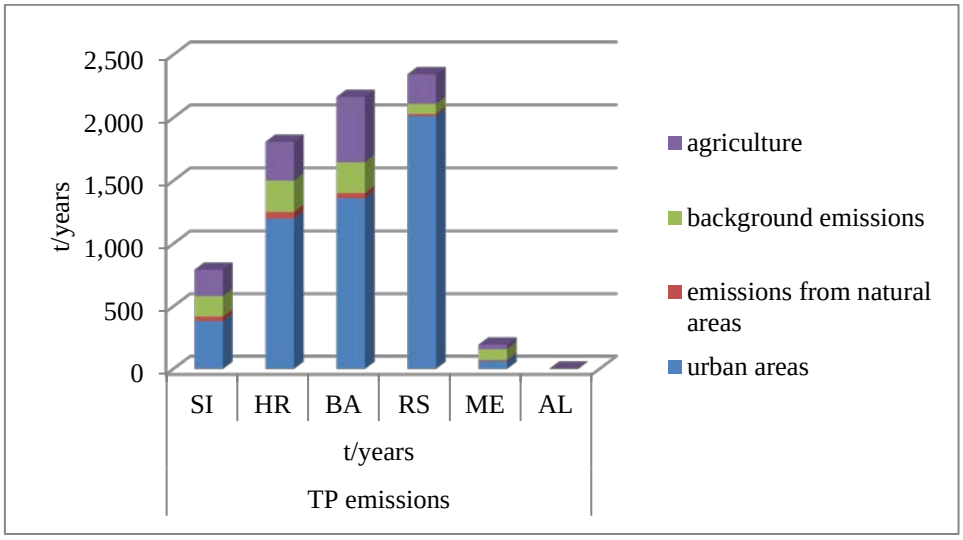


Figure 22: TP emissions according to different sources per country

The calculated loads are 515,549 t/years of TN and 26,249 t/years of TP. The distribution of loads per country is indicated in Table 31 and Figure 23.

Table 31: TP and TN load per country

Country	TN load	TN load
	t/years	
SI	38,669	1,575
HR	143,772	6,347
BA	157,978	7,732
RS	171,275	10,465
ME	3,758	128
AL	96	2
Total load	515,549	26,249

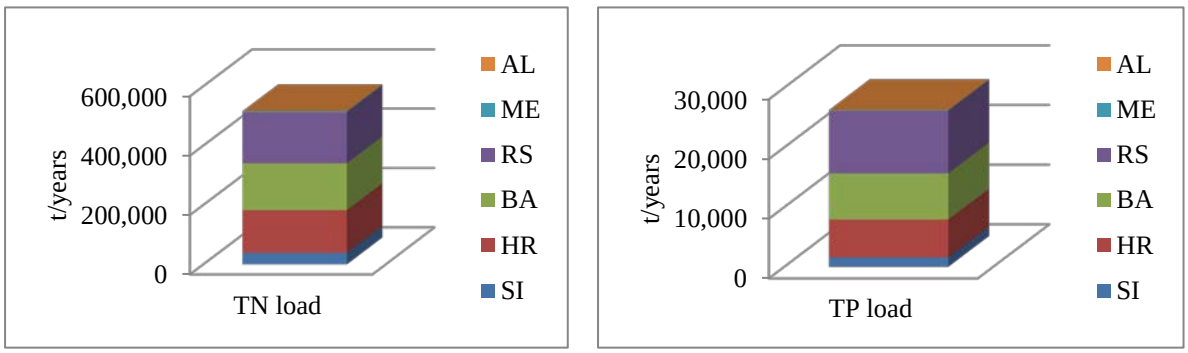


Figure 23: TN and TP load per country

3.1.3 Hazardous substance pollution

Significant sources of hazardous substance pollution are industrial activities, such as energy production (thermo and hydro power stations), mining (coal, lead, zinc, bauxite), production of aluminium oxide, metallurgy, engineering, glass production, chemical industry, pharmaceutical, textile, pulp and paper industry, tannery and leather industries, in addition to animal breeding and the food industry – dairies, breweries, etc. An overview of the discharge of hazardous substances from significant pollution sources into surface water in the Sava River Basin is given in Table 32.

Table 32: Pollution from hazardous substance from point sources

Country	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	Phenols
	kg/a	t/a	t/a	t/a	t/a	t/a	t/a	t/a	t/a
SI	115	0	83	142	1	582	75	7656	104
HR	n/a	n/a	n/a	n/a	n/a	0	0	n/a	n/a
BA	n/a	n/a	1380	983	n/a	21	13629	1656	n/a
RS	2010	n/a	n/a	n/a	n/a	n/a	58	1223	2038
ME	n/a	n/a	n/a	n/a	n/a	n/a	246	1	n/a
Total	2125	0	1463	1125	1	603	14008	10536	2142

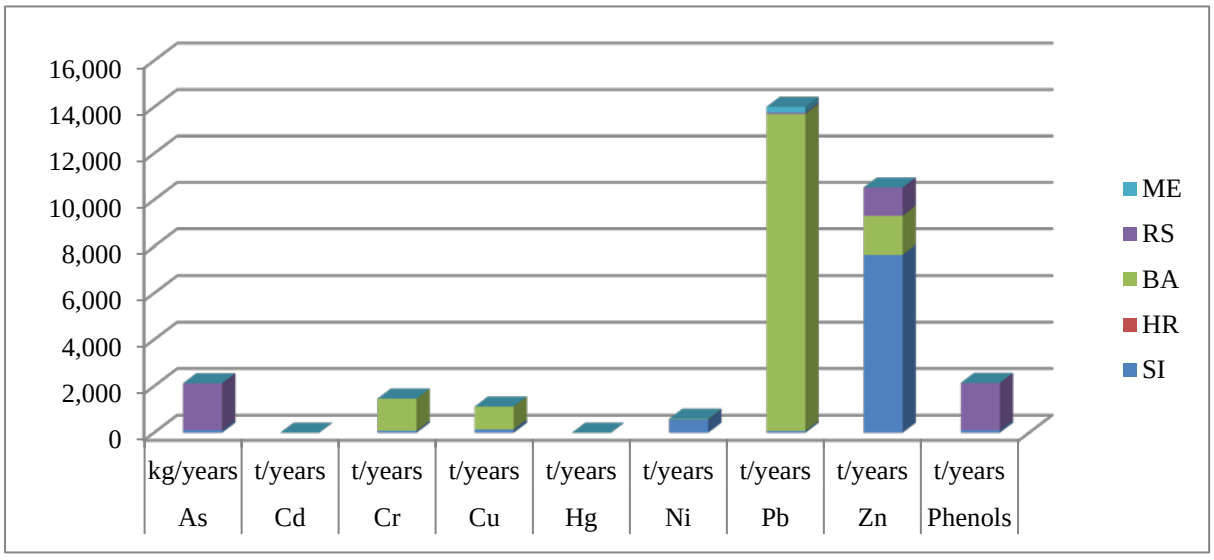


Figure 24: Hazardous substances load from significant industrial pollution sources

3.2 Identification of significant hydromorphological alterations

Four HYMO pressure components have been identified in the Sava River Basin:

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

Further, potential pressures that may result from future infrastructure projects are being dealt with.

3.2.1 Longitudinal continuity interruption

Criteria for longitudinal continuity interruptions (dams, weirs, ramps, sills, etc.) were defined at the ICPDR level. The same criteria were adopted for both Danube and sub-basin (Sava) level as listed below:

- for rithral rivers height > 0.7 m,
- for potamal rivers height > 0.3 m.

Figure 25 and Map 8 provide information on longitudinal continuity interruptions in the Sava River Basin and the overview is indicated in Table 33.

There are 38 barriers in the Sava River Basin: 14 on the Sava River and 24 on its tributaries (Bosut, Ćehotina, Dobra, Drina, Kolubara, Kolpa/Kupa, Lašva, Lim, Lonja, Piva, Pliva, Sotla/Sutla, Spreča, Una, Uvac and Vrbas rivers). Of the 38 barriers 35 are dams, two are ramps and one is classified as »other type of interruption«.

6 barriers are equipped with the fish aid (HPP Arto-Blanca, HPP Krško, Krško Nuclear Power Plant (NEK) and TE-TO Zagreb Cogeneration Plant on the Sava River, HPP Zvornik on the Drina River and TE Veliki Crljeni on the Kolubara River), while the Trebež gate has a sluice with limited connectivity.

Figure 25: Overview of the longitudinal continuity interruptions in the Sava River Basin

Table 33: Overview of the number of river continuity interruptions

Country	Barriers	Passable by fish	River continuity interruptions
SI	15	3	11
HR	6	1	6
BA	9	1	8
RS	8	2	6
ME	2	0	2
Total[10]	38 (40)	7[11]	33

3.2.2 Lateral connectivity interruption

Based on the ICPDR criteria, the lateral connectivity interruptions are presented by disconnected wetlands and former floodplains with potential for reconnection with area larger than 100 ha. Only Serbia uploaded data to the DanubeGIS (Obedska bara wetland). Other countries reported that they have no data relevant for these criteria or they did not deliver data on lateral continuity interruptions.

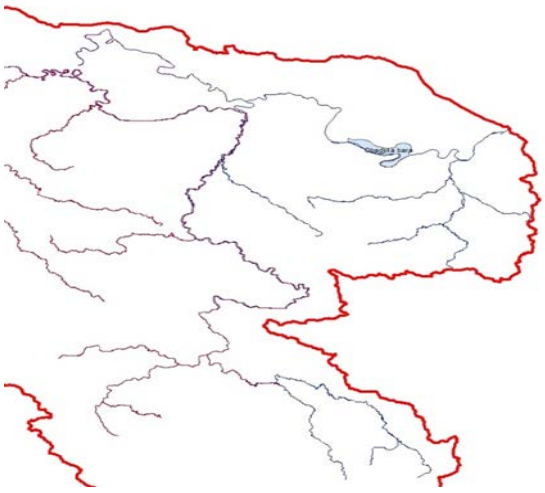


Figure 26: Overview of the lateral continuity interruptions in the Sava River Basin

3.2.3 Hydrological alterations

Hydrological alterations refer to pressures resulting from impoundment, water abstraction and hydropeaking / altered flow regime. Hydrological alterations are of local importance and do not necessarily result in basin-wide trans-boundary effects. However, the cumulative effect of water abstractions may become significant in a trans-boundary context.

[10] Both BA and RS reported on HPP Zvornik and Bajina Bašta, located on the trans-boundary river Drina.

[11] BA and RS include a fish pass at HPP Zvornik, located on the trans-boundary river Drina. Barriers on Sava in Zagreb (HR) and Krško (Sl) are not equipped with fish passes, but are passable by fish.

The main drivers causing hydrological alterations in the Sava River Basin are hydropower generation, agriculture and industry. Water abstraction from rivers corresponds with many anthropogenic purposes and uses. For instance, water is being abstracted to supply drinking water, generate energy, to irrigate agricultural areas or to provide water for industrial processes.

The pressure/impact analysis focuses on three hydrological pressure types, which provoke specific hydrological alterations in rivers and that may impact the water status. In order to assess the significance of those pressures on water status, criteria have been established at the Danube level (also summarized in Table 34).

Slovenia reported 56 km of impoundments caused by 7 dams. 18 hydrological alterations affecting 14 water bodies on the Sava River and tributaries. All reported hydro-alterations relate to all three pressures (impoundment, water abstraction and hydropeaking).

In Croatia, 20.1 km of impoundments create 4 reservoirs. Two HPPs are reported to cause hydropeaking.

There are 9 hydrological alterations in Serbia - one on the Sava River (impoundment by the Iron Gate I reservoir) and others on tributaries. Serbia reported 249.3 km of impoundments caused by 7 dams, a gate and water intake.

There are 8 impoundments in BA.

The length of impoundments per countries is summarized in Table 35 and Figure 27.

Table 34: Hydrological pressure types, provoked alterations and criteria for the pressure/impact assessment in the Sava River Basin

Hydrological pressure	Provoked alteration	Criteria for pressure assessment
Impoundment	Alteration/reduction in flow velocity of the river	Impoundment length during low flow conditions > 1 km
Water abstraction/ Residual water	Alteration in quantity of discharge/flow in the river	Flow below dam < 50% of mean annual minimum flow of a specific time period (comparable with Q_{95})
Hydropeaking	Alteration of flow dynamics/discharge pattern in the river	Water level fluctuation > 1m /day

Table 35: Length of impoundments in the Sava River Basin

Country	Length of impoundments (km)
SI	56.0
HR	20.1
BA	163.0
RS	249.3
ME	46.8
Total	535.2

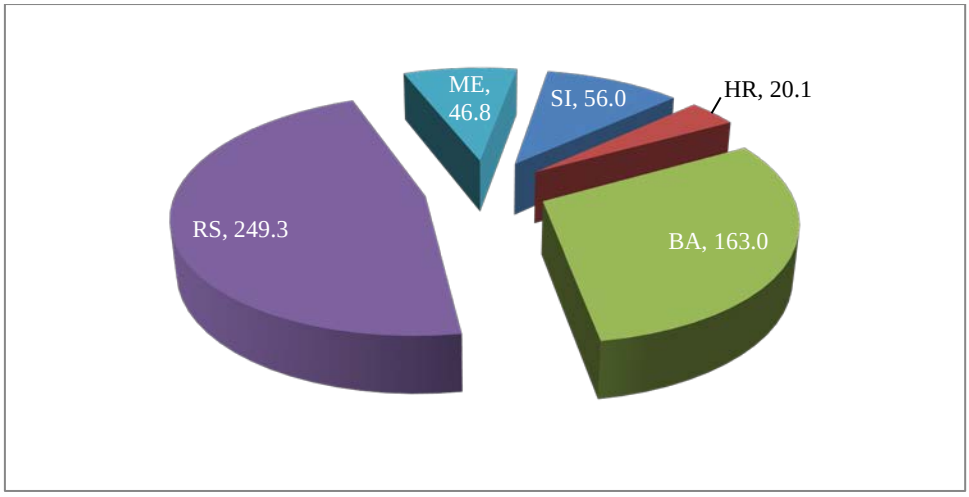


Figure 27: Length of impoundments per country

3.2.4 Morphological alterations[12]

Morphological alteration has been assessed by the countries according the criteria set by the ICPDR. The following morphological conditions have been assessed:

In Slovenia, Croatia and Montenegro the morphological alteration are indicated in three class system as follows:

1-2 Near-natural to slightly altered
3 Moderately altered
4-5 Extensively to severely altered

In Serbia two class system is in place as follows:

1 Near-natural
2-5 Slightly to severely altered

In Bosnia and Herzegovina the morphological alteration are indicated in five class system as follows:

Near-natural
Slightly modified
Moderately modified
Extensively modified
Severely modified

Table 36 and Figure 28 summarized the length of morphological alteration on the Sava River and Table 37 and Figure 29 for the Sava River Tributaries.

[12] The data on morphological conditions for SI, HR and RS originates from the DanubeGIS database. Data for BA and ME are from the 1st Sava RBMP.

Table 36: Length of morphological alterations on the Sava River

Country	Near natural	Slightly modified	Slightly to severely altered	Near-natural to slightly altered	Moderately altered	Extensively modified	Extensively to severely altered	Severally modified	No data
	(km)	(km)	(km)	(km)	(km)	(km)	(km)	(km)	(km)
SI				80.5	82.8		58.3		
HR				14.1	491.8				
BA					338.8				
RS			232.2						
Total			232.2	94.6	574.5		58.3		329.4

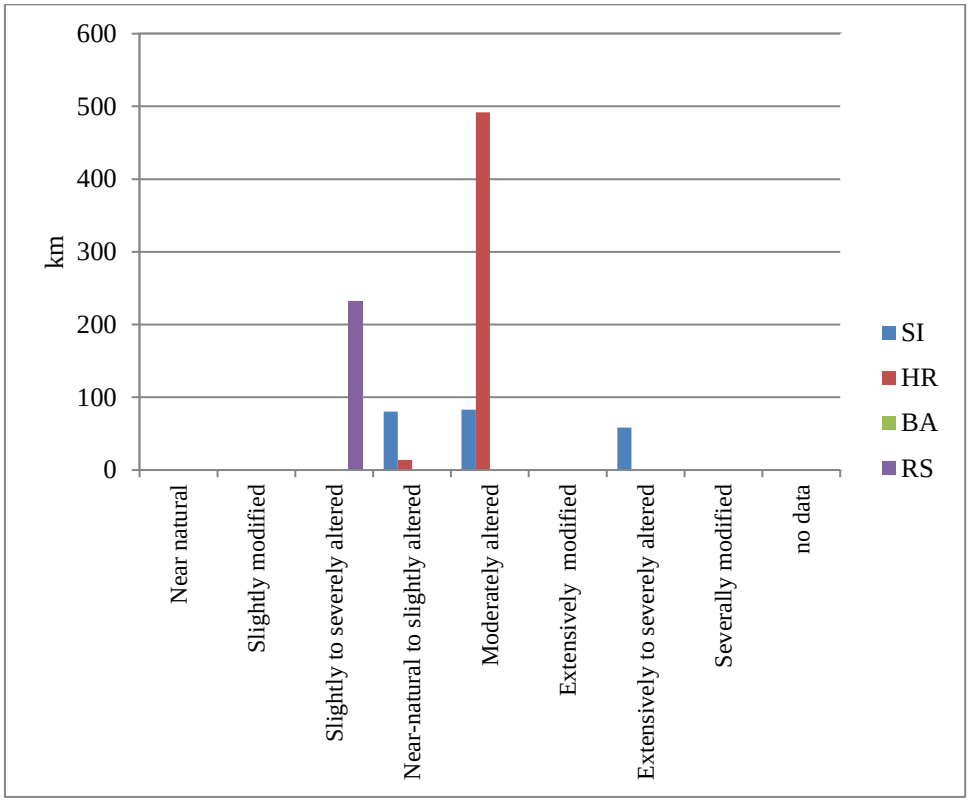


Figure 28: Length of morphological alteration on the Sava River

Table 37: Length of morphological alteration on the Sava River tributaries

Country	Near natural	Slightly modified	Slightly to severely altered	Near-natural to slightly altered	Moderately altered (modified)	Extensively modified	Extensively to severely altered	Severely modified	No data
	(km)	(km)	(km)	(km)	(km)	(km)	(km)	(km)	(km)
SI				118.3					319.7
HR				1219.0	147.3				28.0
BA	475.1	774.8			2.9				52.4
RS	122.3		448.5						
ME				298.0	69.9				
Total	597.4	774.8	448.5	1635.3	217.2	0.0	0.0	0.0	400.1

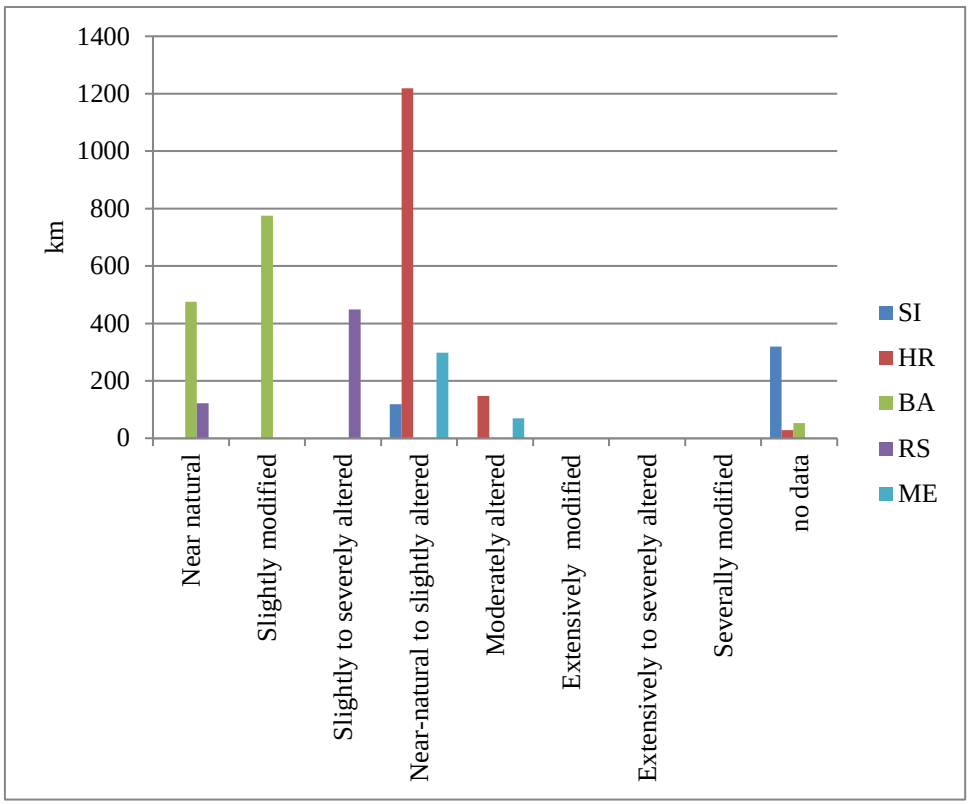


Figure 29: Length of morphological alteration on the Sava River tributaries

3.3 Future infrastructure projects

In addition to the present degradation of the Sava River and its tributaries caused by existing hydromorphological alterations, a number of future infrastructure projects (FIP) are at different stages of planning and preparation. Those projects may provoke significant HYMO pressures on water status, as described above. The Parties reported on the FIPs for which Strategic Environmental Assessment (SEA) and/or Environmental Impact Assessments (EIA) are performed and when it is expected to provoke transboundary effects.

Two dams with main purpose of hydropower production (Brežice and Mokrice) and also flood protection are planned in Slovenia. Both projects affect the Sava River. Strategic environmental assessment has already performed for both projects, while EIA is intended to be done.

Croatia has reported on the planned construction of the Danube-Sava Canal and on reconstruction and improvement of the Sava waterway which is under implementation. The main purpose of both FIPs in Croatia is navigation.

Information for Bosnia and Herzegovina has not been available yet.

Navigation issues comprise rehabilitation of the Sava River Waterway. This activity is recognized by ISRBC as the priority and a feasibility study was performed in 2008 and it is a joint action of BA, RS and HR. A multifunctional approach was used taking into account not only transport but also leisure, water management and environment. Basic documents (reviews) for EIA report were carried out, including proposal of environment protection measures, environmental monitoring program and evaluation of costs for environmental protection.

Serbia has reported on construction of two hydropower plants on the Lim River (HPP Brodarevo 1 and Brodarevo 2).

The list of FIPs is available in Table 38. The exact locations of FIPs is presented in Map 9.

Table 38: List of future infrastructure projects in the Sava River Basin

COUNTRY	National code	EU code	EU WB code	EU River code	NAME	Project status	Year of start of implementation	1st purpose	2nd purpose	Project description	Expected deterioration	Transb. impact	SEA	EIA	Exseptions	Responsible nat. body
SI	HE1	SIHE1	SISI1VT913	SISI1R	Hidroelektrarna Brežice	Implementation of project	2014	Hydropower	Flood protection	Hydropower plant	Yes	No	Alerady done	Alerady done	No	Ministry for infrastructure
	HE2	SIHE2	SISI1VT913	SISI1R	Hidroelektrarna Mokrice	Officialy planned	2016	Hydropower	Flood protection	Hydropower plant	Yes	No	Alerady done	Intended	Yes	Ministry for infrastructure
HR	2001L	HR2001L	HR	HR	Danube-Sava Canal	Planning under preparation	2006	Navigation	Flood protection	Construction of 61,4 km artificial canal (category Vb) from Vukovar to Samac on the Sava River; will shorten the waterway	No	Yes	No	Intended	No	Agency for inland waterways
	2002L	HR2002L	HRDSRI010001, HRDSRI010002, HRDSRI010003, HRDSRI010004, HRDSRN010005, HRDSRN010006	HR2	Reconstruction and Improvement of the Sava waterway in Croatia	Implementation of project	2003	Navigation		Reconstruction of the waterway, and upgrading it to Category IV	No	Yes	No	Alerady done	No	Agency for inland waterways
RS	P108000	RSP108000	RSSA_3	RSS	Sava Waterway Rehabilitation Project	Officialy planned	2016	Navigation		The Project is part of a Program to improve navigability in the Sava River between Belgrade, Serbia and Sisak, Croatia.	No	Yes	Alerady done	Intended	No	Republic of Serbia, Ministry of Transport, Directorate for Inland Waterways
	S5154_HE_Brodarevo_2	RSS5154_HE_Brodarevo_2	RSLIM_4	RSS5154	Projekat izgradnje HE Brodarevo 1 i HE Brodarevo 2	Officialy planned		Hydropower	Not applicable	Hydropower plant 32,4 MW	Yes	Yes	Alerady done	Alerady done	Yes	Republic of Serbia, Ministry of Energy, Development and Environmental Protection
	S5154_HE_Brodarevo_1	RSS5154_HE_Brodarevo_1	RSLIM_4	RSS5154	Projekat izgradnje HE Brodarevo 1 i HE Brodarevo 1	Officialy planned		Hydropower	Not applicable	Hydropower plant 26 MW	Yes	Yes	Alerady done	Alerady done	Yes	Republic of Serbia, Ministry of Energy, Development and Environmental Protection

3.4 Accidental pollution

The environmental disasters caused by the accidental pollution proved repeatedly that inadequate precautionary measures in industrial practice, when faced with a water pollution occasioned by accident, can lead to massively harmful effects, both for human beings and for the environment, as well as having a significant economic impact on entire regions. Effects of waste spill in Romania in 2000 (Baia Mare, Baia Borsa) and resent sludge spill in Ajka alumina plant (HU) in 2010 are two examples of adverse consequences in case of accidental pollution which could be avoided by establishment of effective contingency system.

Among the three principal goals of the FASRB, the accident prevention and control covers the prevention and limitation of hazards and reduction or elimination of adverse consequences of accidents (Article 2c and Article 13). In the field of accidental pollution management, the Parties to the FASRB use the Accident Emergency Warning System (AEWS), which has been developed by the International Commission for the Protection of the Danube River (ICPDR). The system has been implemented by the Parties through the establishment and functioning of the Principal International Alert Centers (PIAC). The AEWS is activated whenever there is a risk of transboundary water pollution and it sends out international messages to countries downstream and upstream in such cases. This helps the national authorities to put relevant environmental protection and public safety measures into action. In the near past no accident pollution has been notified but regular tests of the system have been performed to check its functioning, the cooperation of the PIACs in handling accidental pollution propagating downstream, as well as the 24/7 operability of the PIACs. The results of tests have showed that the PIACs are able to perform their essential tasks within the updated system, while there are some problems regarding the 24/7 preparedness (in BA and RS, in particular).

The Parties to the FASRB have developed the draft Protocol on Emergency Situations to the FASRB which comprises several goals aimed at identification of hazardous activities, their character and possible consequences, prevention, emergency planning and preparedness, adequate alarm and warning system compatible with already existing systems on the wider basin level, assessment of extraordinary impacts, emergency response and mutual assistance of the Parties. The Draft Protocol on Emergency Situations was adopted by ISRBC in 2009 and distributed to the Parties for final review. Final harmonization of the Protocol is expected, depending on readiness of the Parties.

According to the incidents reports from the Danube AEWS the Sava Countries has not focused accidental pollution with transboundary impact recently, but the danger is present because of existing operational industrial sites associated with a major risk of accidental pollution (ARS). In 2015 new inventory of accident risk spots and contaminated sites is under development. Until now only HR has provided new list with 20 ARS in the SRB, while there is no such spots in RS which fulfill the ICPDR criteria. Other countries have not submitted new data yet.

3.5 Invasive species

Alien (non-indigenous, exotic) species are all those taxa that are non-native for particular region, that are introduced by human action. Alien species is considered to be any live specimens of species, subspecies or lower taxon of animals, plants, fungi or micro-organisms introduced outside its natural past or present distribution; it includes any part, gametes, seeds, eggs, or propagules of such species, as well as any hybrids, varieties or breeds that might survive and subsequently reproduce. Invasive alien species (IAS) are species that are established and spread in their new location to an extent that they have a negative impact on biodiversity, human health and the economy. The process of introduction, establishment and further spread of IAS in recipient areas is considered as biological invasion. Biocontamination is used to describe the introduction of alien species which may or may not result in noticeable or measurable effects.

Recently, invasive alien species (IAS) has become an emerging issue in environmental management, including water management. Therefore, the subject should be properly included in important water management documents at all spatial scales, including the River Basin Management planning.

The importance of the problem is illustrated by the current activities on the EU level to provide effective basis for dealing with the issue of the IAS. In that respect a Proposal for a Regulation of the European Parliament and of the Council on the prevention and management of the introduction and spread of invasive alien species has been published (COM 2013 620) with idea to provide such platform.

The introduction of alien taxa not necessarily has consequences to recipient area. Thus, non-indigenous (alien, non-native) taxa could not be considered as a priori invasive and highly harmful to native biodiversity. The potential danger of the IAS strongly depends on the individual characteristics of the species. This should be taken into the consideration when identifying priority actions to be taken.

The Sava River has been defined as a branch of Southern Invasive Corridor, which underline that the river might be under the invasive pressure. This could be illustrated by the fact that 11 non-indigenous aquatic macroinvertebrates were detected along the Sava River (Lucić et al. 2015). Further, out of 74 fish species (including lamprey) identified for the fauna of the Sava River catchment, 15 are considered alien (Simonović et al. 2015).

The dispersal of non-indigenous Ponto-Caspian amphipods (Crustacea: Amphipoda) in Croatian stretch of the Sava River was extensively discussed by Žganec et al. (2009) and the details on the distribution of two species (Chelicorophium curvispinum and Dikerogammarus haemobaphes) were presented. Paunović et al. (2012) confirmed the presence of one more amphipod alien invasive species, D. villosus, in the most downstream stretch of the Sava River, upstream Belgrade. In addition, within the same stretch, the occurrence of spiny-creek crayfish (Orconectes limossus; Crustacea: Decapoda), an invasive decapods species was confirmed during the 2012. Further investigation will provide more details on dispersal and abundance of non-indigenous crustaceans within the Sava River Basin. In that regard, the occurrence of the signal crayfish, Pacifastacus leniusculus (Dana, 1852) (fast spreading non-indigenous invasive North American crayfish) could be expected in the Sava River, since the species was recently discovered in Korana River (Sava Basin) in Croatia (Hudina et al. 2013).

Non-native fish species in the River Sava catchment and their status were recently and partially assessed, where for waters of the most downstream, Serbian section, the Prussian carp was assigned the most invasive alien fish species, followed by brown bullhead.

Non-indigenous macroinvertebrate and fish species that are relevant for the Sava River are presented in Annex II. Also, potential invaders for the Sava River are presented in Annex II.

Based on the number of IAS recorded within the Sava River Basin, it could be concluded that out of 14 non-indigenous macroinvertebrate species recorded within the Sava River Basin, seven are considered as invasive, while 14 out of 16 fish species is considered as invasive. The consideration of alien algae and macrophites (both, aquatic and riparian) in the SRB is important job to be done. Among aquatic, wetland and riparian communities within the basin area, the significant influence of invasive plant species was recorded.

Different tools for the assessment of invasiveness of aquatic taxa (e.g. Fish Invasiveness Scoring Kit (FISK) and Freshwater Invertebrate Invasiveness Scoring Kit (FI-ISK), as well as for the evaluation of pressures caused by biological invasions (e.g. Site BioContamination Index SBC Index and Biopollution Index BPL) are developed and tested. Those systems represent useful and viable tools for decision-makers to be able to rank taxa water bodies in respect to invasiveness and bioinvasion pressure. Further, considerable progress on EU level on the issue of management of IAS (primarily in respect to the development of Proposal for a Regulation of the European Parliament and of the Council on the prevention and management of the introduction and spread of invasive alien species COM 2013 620), provide platform for the identification of measures for prevention of new introductions of alien species and translocation of already introduced non-native taxa.

The preliminary white, gray and black list of alien species is provided in Annex II.

4 Artificial and heavily modified water bodies

4.1 Identification of artificial water bodies (AWBs)

Only **Croatia** reported on two AWBs on the Bosut River (HRDSRN110005) and Lonja River (HRDSRN165010) as indicated in Figure 30. The length is 11,9 km (Bosut River) and 6,2 km (Lonja River).

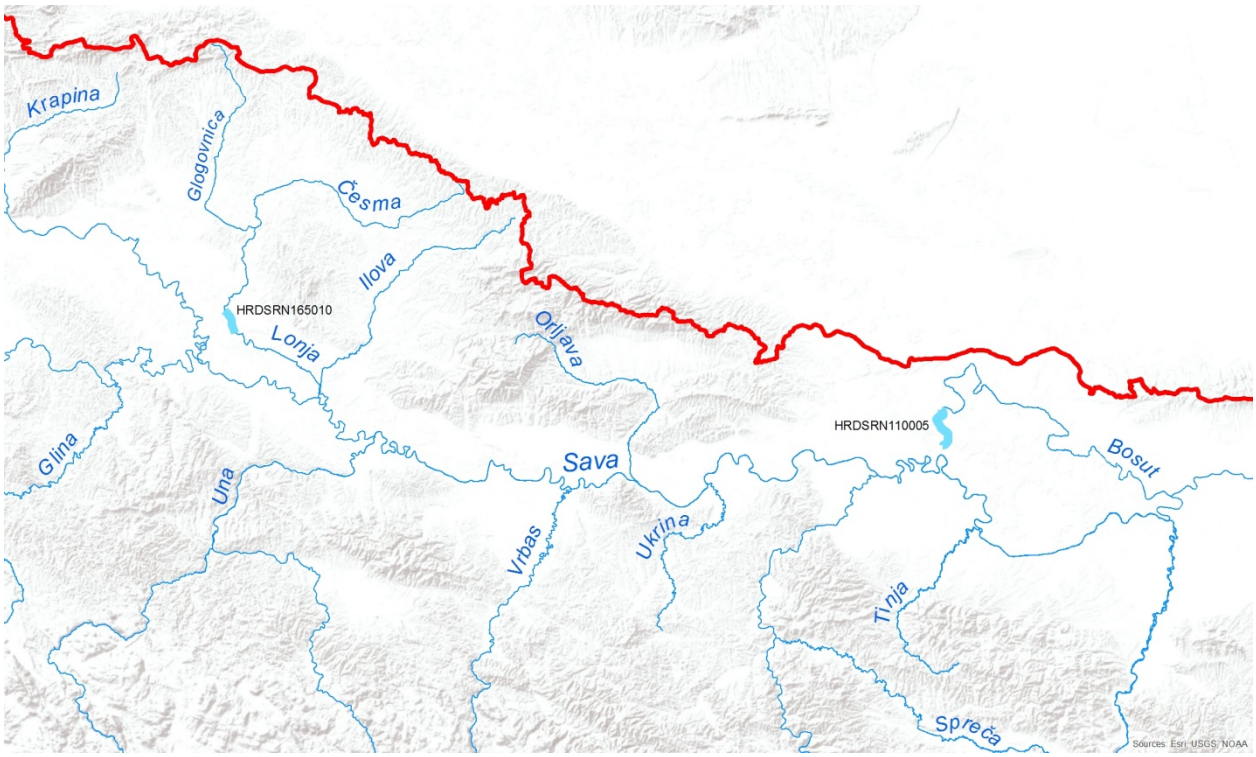


Figure 30: Location of the AWB in HR

4.2 Identification of heavily modified water bodies (HMWBs)[13]

Countries in the SRB have identified heavily modified water bodies. The list of the HMWBs is provided in Table 39 (Sava River), Table 40 (Sava River tributaries) and in Map 10.

[13] Information on HMWBs was taken over from the DanubeGIS, except for Croatia and BA (for which data originates from the 1st Sava RBMP).

The first national RBMP for Croatia specifies candidate water bodies for HMWB, and since unsatisfactory status in terms of hydromorphological indicators has not been confirmed through biological monitoring, they are not mentioned in this document.

Table 39: Description of the heavily modified water bodies for the Sava River

Country	Code of HMWB	Name	Main uses	Significant physical alteration	Reasons for risk to reach GES (expert judgment)	Description for expert judgment used
SI	SISI111VT7	Retention basin HPP Moste	Hydro-power Flood protection	Dams / weirs	Non-passable obstacles (weirs/dams) for migratory species Change of the water category (e.g. change of river to dammed reservoir) Sedimentation (silt and gravel)	Hydropower and flood protection as anthropogenic uses have impacts on migratory species. Another reason of failing to achieve the GES due to changes in hydromorphology is change of the water category.
	SISI1VT170	Sava Mavčiče - Medvode	Hydro-power Flood protection	Dams / weirs	Non-passable obstacles (weirs/dams) for migratory species Change of the water category (e.g. change of river to dammed reservoir) Sedimentation (silt and gravel)	Hydropower and flood protection as anthropogenic uses have impacts on migratory species. Another reason of failing to achieve the GES due to changes in hydromorphology is change of the water category
	SISI1VT713	Sava Vrhovo Boštanj	Hydro-power Flood protection	Dams / weirs	Non-passable obstacles (weirs/dams) for migratory species Change of the water category (e.g. change of river to dammed reservoir) Sedimentation (silt and gravel)	Hydropower and flood protection as anthropogenic uses have impacts on migratory species. Another reason of failing to achieve the GES due to changes in hydromorphology is change of the water category
BA	BA_SA_1*	Sava	Navigation Flood protection Urbanization	Bank reinforcement/ fixation	Gravel exploitation	
	BA_SA_2*	Sava	Navigation Flood protection Urbanization	Bank reinforcement/ fixation	Gravel exploitation	

Country	Code of HMWB	Name	Main uses	Significant physical alteration	Reasons for risk to reach GES (expert judgment)	Description for expert judgment used
	BA_SA_3*	Sava	Navigation Flood protection Urbanization	Bank reinforcement/ fixation	Gravel exploitation	
RS	RSSA_1	Sava from Belgrade to Šabac	Hydropower (impoundment by the Danube Iron Gate 1 reservoir, navigation, flood protection, urbanization	Bank reinforcement/ fixation, both side levees	Change of water category (impoundment)	HPNS Iron Gate I reservoir; flood control dikes on both banks; and many reaches with bank reinforcement.

* *Provisional HMWB*

Table 40: Description of the heavily modified water bodies for the Sava tributaries

Country	Code of HMWB	River name	Geographical description	Main uses	Significant physical alteration	Reasons for risk to reach GES (expert judgment)	Description for expert judgment used
SI	SI14VT93	Ljubljanica	Mestna Ljubljanica	Flood protection Urbanization	Channelisation/straightening Bank reinforcement/fixation	Disruption of lateral connectivity	
BA	BADR_1*	Drina	Podrinje	Hydropower planned Flood protection	Dams/weirs Bank reinforcement	Change of the water category Changed discharge (effects caused by hydropeaking or residual water discharge)	

Country	Code of HMWB	River name	Geographical description	Main uses	Significant physical alteration	Reasons for risk to reach GES (expert judgment)	Description for expert judgment used
	BADR_2*	Drina	HPP Zvornik	Hydropower Flood protection	Dams/weirs	Change of the water category Changed discharge (effects caused by hydropeaking or residual water discharge)	
	BADR_3*	Drina	HPP Tegare	Hydropower-planned Flood protection	Dams/weirs	Change of the water category Changed discharge (effects caused by hydropeaking or residual water discharge)	
	BADR_4*	Drina	HPP B.Bašta	Hydropower Flood protection	Dams/weirs Bank rein-forcement	Change of the water category Changed discharge (effects caused by hydropeaking or residual water discharge)	
	BADR_5*	Drina	HPP Višegrad	Hydropower Flood protection	Dams/weirs	Change of the water category Changed discharge (effects caused by hydropeaking or residual water discharge)	

Country	Code of HMWB	River name	Geographical description	Main uses	Significant physical alteration	Reasons for risk to reach GES (expert judgment)	Description for expert judgment used
	BADR_6*	Drina	HPP Goražde HPP Ustikol.	Hydropower-planned Flood protection	Dams/weirs	Change of the water category Changed discharge (effects caused by hydropeaking or residual water discharge)	
	BADR_7*	HPP Foča HPP B.Bijela		Hydropower-planned Flood protection	Dams/weirs	Change of the water category Changed discharge (effects caused by hydropeaking or residual water discharge)	
	BAVRB_1*	Vrbas	Vrbas-donji tok	Hydropower-planned Flood protection	Bank rein-forcement		
	BAVRB_2*	Vrbas	B.Luka Novoselija	Hydropower-planned Urbanization	Dams/weirs Channelisa-tion Bank rein-forcement	Impoundment with significant reduction of water flow Changed discharge (effects caused by hydropeaking or residual water discharge)	

Country	Code of HMWB	River name	Geographical description	Main uses	Significant physical alteration	Reasons for risk to reach GES (expert judgment)	Description for expert judgment used
	BAVRB_3*	Vrbas	HPP B Niska HPP Krupa	Hydropower-planned Flood protection	Dams/weirs	Change of the water category Changed discharge (effects caused by hydropeaking or residual water discharge)	
	BAVRB_4*	Vrbas	HPP Bočac	Hydropower- Flood protection	Dams/weirs	Change of water category Changed discharge (effects caused by hydropeaking or residual water discharge)	
	BAVRB_5*	Vrbas		Hydropower Urbanization	Dams/weirs		
	BA_VRB_PLIVA_2*	Pliva	Not available				
	BABOS_1*	Bosna	Not available				
	BA_BOS_SPR_2*	Spreča	Not available				
	BADR_PRA_1*	Prača	Not available				
	BALIM_1*	Lim	HPp Mrsovo	Hydropower- Flood protection	Dams/weirs	Change of water category Changed discharge (effects caused by hydropeaking or residual water discharge)	

Country	Code of HMWB	River name	Geographical description	Main uses	Significant physical alteration	Reasons for risk to reach GES (expert judgment)	Description for expert judgment used
	BAUKR_1*	Ukrina		Flood protection Urbanization	Channelization/straightening	Change of water category Impoundment with significant reduction of water flow	
	BAUNA_SA_3*	Sana		Hydropower Urbanization	Dams/weirs	Non-passable obstacles (weirs/dams) for migratory species Impoundment with significant reduction of water flow	
RS	RSDR_1*	Drina	Drina from mouth up to HPP Zvornik dam				
	RSDR_2	Drina	HPP Zvornik Reservoir	Hydropower	Dams	Impoundment by the large dam Change of the water category	
	RSDR_4	Drina	HPP Bajina Bašta Reservoir	Hydropower	Dams	Impoundment by the large dam Change of the water category	
	RSLIM_3	Lim	HPP Potpec Reservoir	Hydropower	Dam	Impoundment by the large dam Change of the water category	

Country	Code of HMWB	River name	Geographical description	Main uses	Significant physical alteration	Reasons for risk to reach GES (expert judgment)	Description for expert judgment used
	RSUV_4	Uvac	HPP Radoinja Reservoir	Hydropower	Dam	Impoundment by the large dam Change of the water category	
	RSUV_5	Uvac	HPP Kokin Brod Reservoir	Hydropower	Dam	Impoundment by the large dam Change of the water category	
	RSUV_6	Uvac	HPP Uvac Reservoir	Hydropower	Dam	Impoundment by the large dam Change of the water category	
	RSBOS	Bosut	Impound-ment	Agriculture	Weirs	Impoundment with significant reduction of water flow	
	RSKOL_1*	Kolubara	Kolubara from mouth to mounth of Tamnava				
	RSKOL_3*	Kolubara	Kolubara from mouth of Turija to Pepeljevca				
	RSKOL_6*	Kolubara	Kolubara through Valjevo				
ME	MEPIV_2*	Piva	HPP Piva	Hydropower			
	MECECH_2*	Ćehotina		Energy-non-hydropower			

* *Provisional HMWB*

Table 41: Length and number of the HMWBs on the Sava River

Country	T of WBs	Length of HMWBs	Perc. of total length	Total No of WBs	No of HMWBs	Perc. of total WBs
	km	km	%			%
SI	220.5	41.2	18.7%	12	3	25.0%
HR	505.9			10		
BA	338.9	338.8	100.0%	3	3	100.0%
RS	232.2	126.4	54.4%	3	1	33.3%

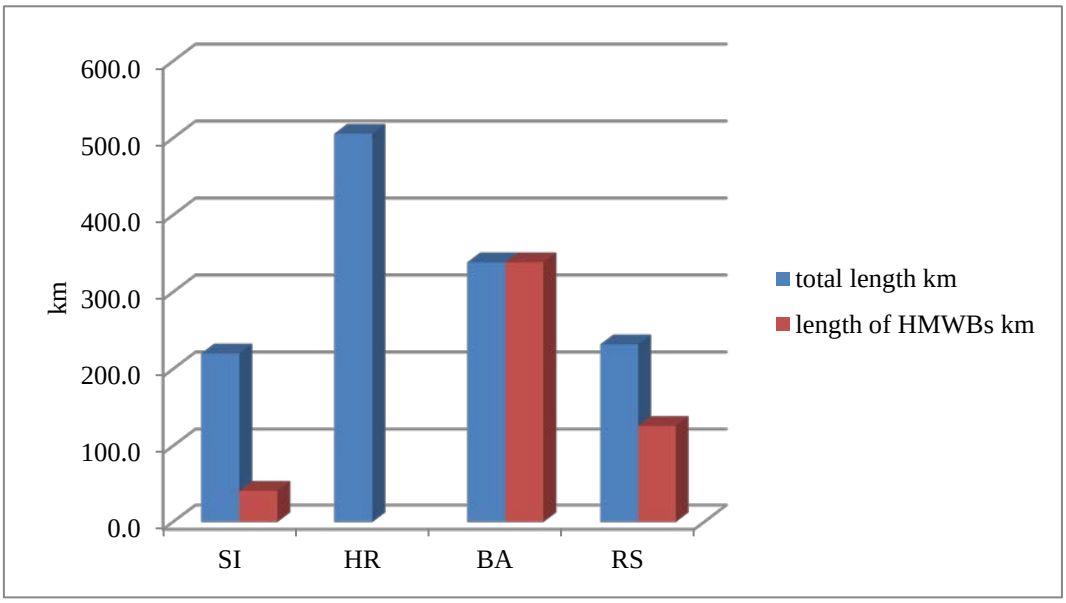


Figure 31: Ratio between the total WBs length and the HMWBs length on the Sava River

Table 42: Length and number of HMWBs on the Sava tributaries

Country	Total lengthof WBs	Length of HMWBs	Perc. of total length	Total No of WBs	No of HMWBs	Perc. of total WBs
	km	km	%			%
SI	438.1	4.6	1.0%	14	1	7.1%
HR	1394.2			50		
BA	2006.3	716.6	35.7%	72	19	26.4%
RS	570.8	309.6	54.2%	22	11	50.0%
ME	368.0	46.8	12.7%	9	2	22.2%

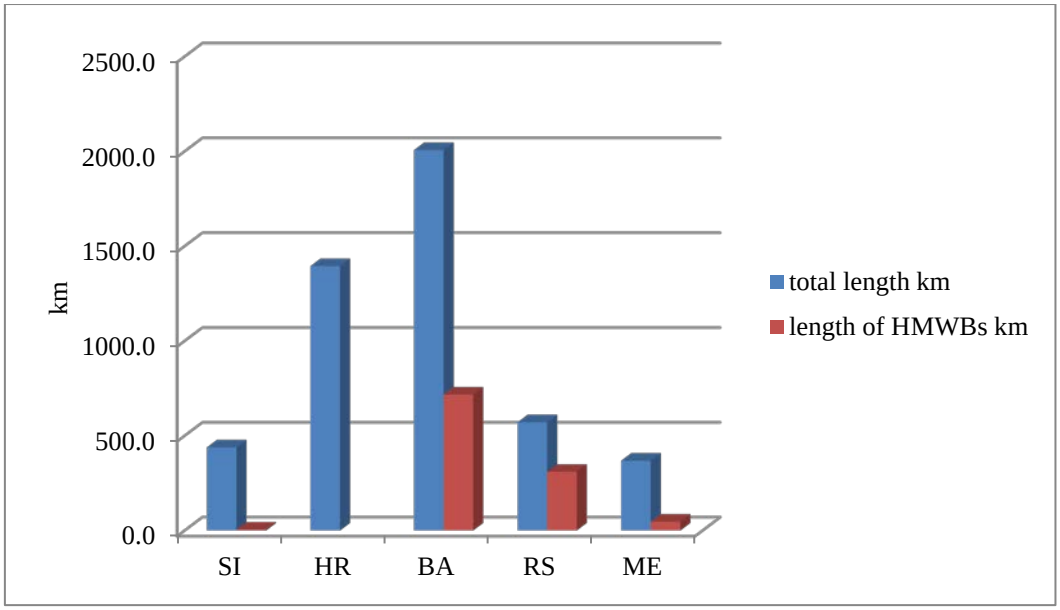


Figure 32: Ratio between the total WBs length and the HMWBs length on the Sava tributaries

4.2.1 Users affecting the HMWBs

Table 43: Drivers for identification of HMWBs on the Sava River

Country	Total No HMWBs	Hydropower	Navigation	Flood Protection	Urbanization
SI	3	3	0	3	0
BA	3	0	3	3	3
RS	1	1	1	1	1
Sum	7	4	4	7	4

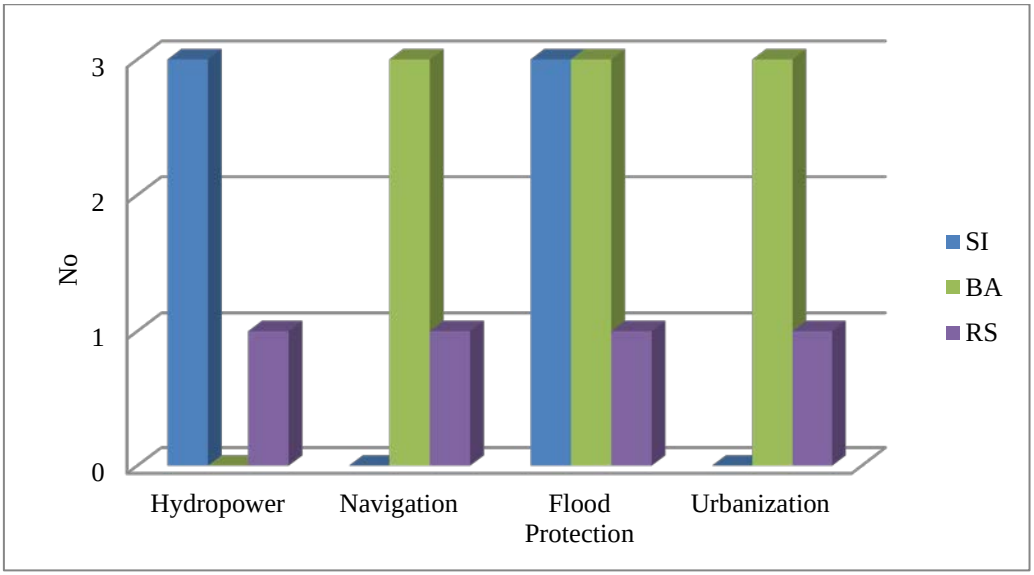


Figure 33: Main users/drivers affecting the HMWBs on the Sava River

Table 44: Drivers for identification of HMWBs on the Sava tributaries

Country	Total No HMWBs	Hydropower	Navigation	Flood Protection	Urbanization
SI	1			1	1
BA	19	14		12	4
RS	11	6			1
ME	2	not available	not available	not available	not available
Sum	33	20	0	13	6

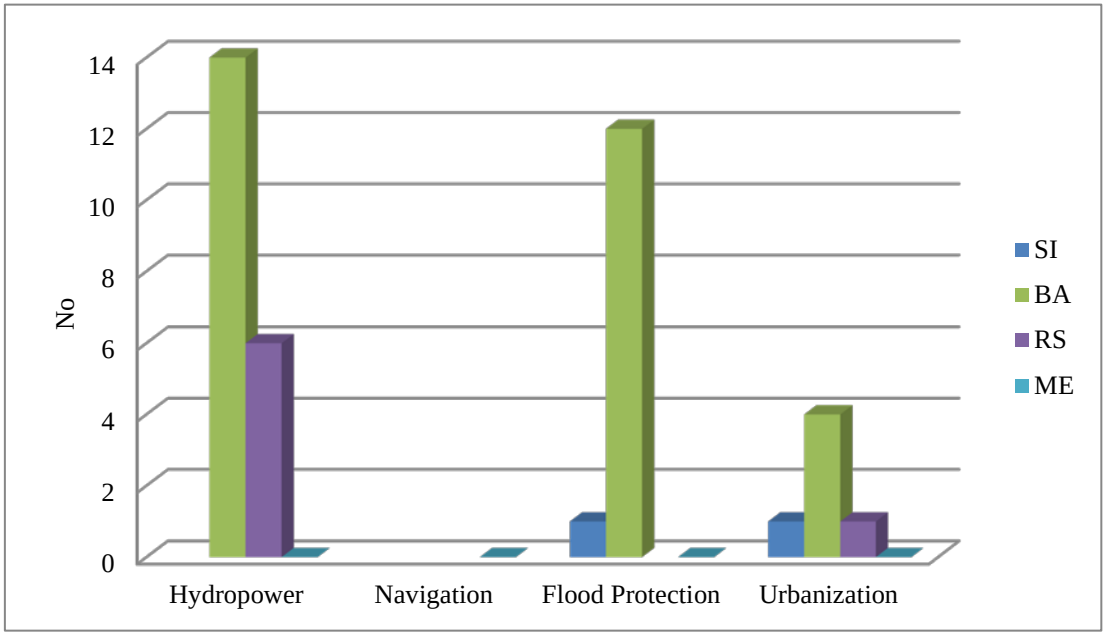


Figure 34: Main users/drivers affecting the HMWBs on the Sava tributaries

4.2.2 Significant physical alterations affecting the HMWBs

Table 45: Physical alterations affecting the HMWBs on the Sava River

Country	Total No HMWBs	Dams weirs dikes	Channelization straightening	Bank reinforcement
SI	3	3		
BA	3			3
RS	1			1
Sum	7	3		4

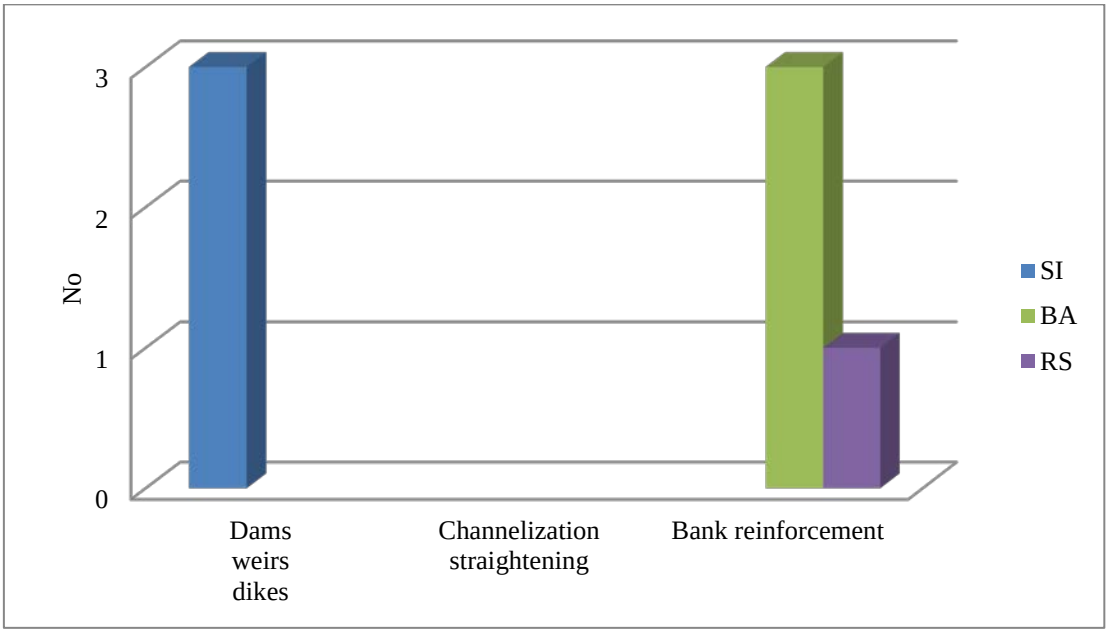


Figure 35: Physical alterations affecting the HMWBs on the Sava River

Table 46: Physical alterations affecting the HMWBs on the Sava tributaries

Country	Total No HMWBs	Dams weirs dikes	Channelization straightening	Bank reinforcement
SI	1		1	1
BA	19	11	1	2
RS	11	6		
ME	2	not available		
Sum	33	17	2	3

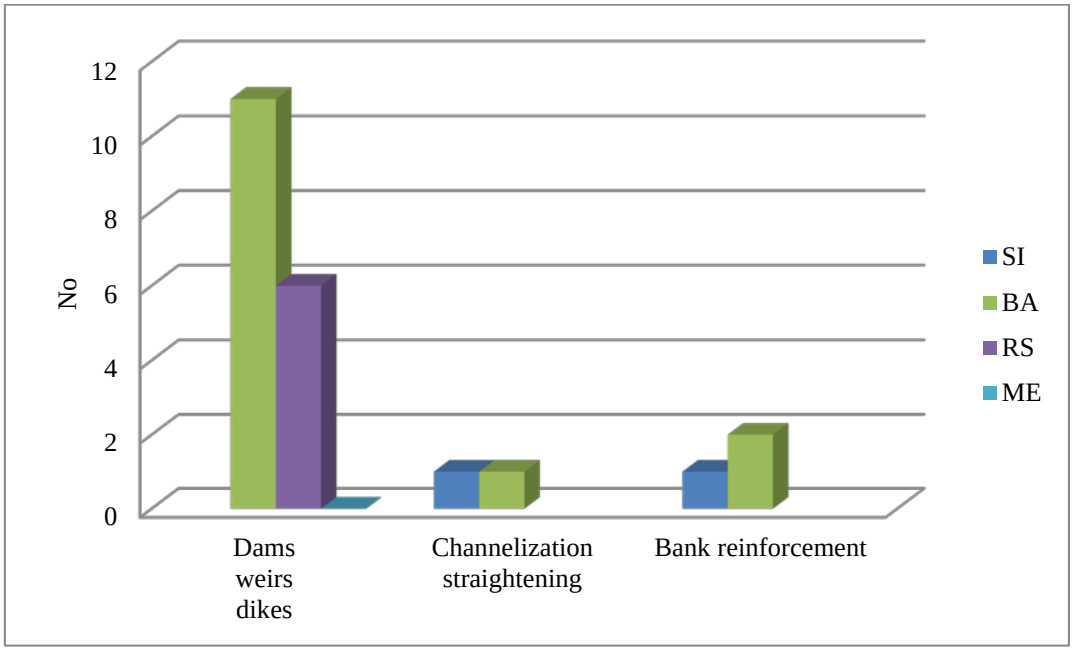


Figure 36: Physical alterations affecting the HMWBs on the Sava tributaries

5 Risk assessment

Following tables and figures illustrate the number and the length of water bodies having the risk of failure to achieve a good chemical and ecological status or ecological potential by 2021. In addition the assessment of risk due to ongoing pressures from organic pollution, hazardous substances, nutrient pollution, hydromorphological alterations and those likely persist in the future is also provided for the Sava River and the Sava River tributaries.

5.1 Risk assessment of the Sava River[14]

The risk assessment has been provided at national level taking into account the ongoing pressures (organic, hazardous substances and nutrient pollution and hydro-morphological alteration), persisting from the past and the pressures which may emerge in future. The summary table (Table 47) and associated figures (37-42) indicate the number, length and percentage of the Sava River water bodies while Table 48 and associated figures (43- 48) for the Sava tributaries water bodies which are not at risk, at risk or unknown risk. The risk assessment of the Sava River and its tributaries per countries is available in Annex III.

Table 47: Summary of the risk assessment of the Sava River

Risk		Not at risk	At risk	Unknown
RiskChemicalStatus	No of WBs	12	13	3
	Length of WBs	222	738	339
	Percentage	17%	57%	26%
RiskEcologicalStatus	No of WBs	6	19	3
	Length of WBs	100	860	339
	Percentage	8%	66%	26%
PressureOrganicPollution	No of WBs	20	5	3
	Length of WBs	705	254	339
	Percentage	54%	20%	26%
PressureHazardousSubstances	No of WBs	14	11	3
	Length of WBs	327	632	339

[14] Information necessary for risk assessment of water bodies originates from Danube GIS.

Risk		Not at risk	At risk	Unknown
	Percentage	25%	49%	26%
PressureNutrientPollution	No of WBs	19	6	3
	Length of WBs	631	329	339
	Percentage	49%	25%	26%
PressureHydromorphologicalAlterations	No of WBs	9	16	3
	Length of WBs	148	919	232
	Percentage	11%	71%	18%

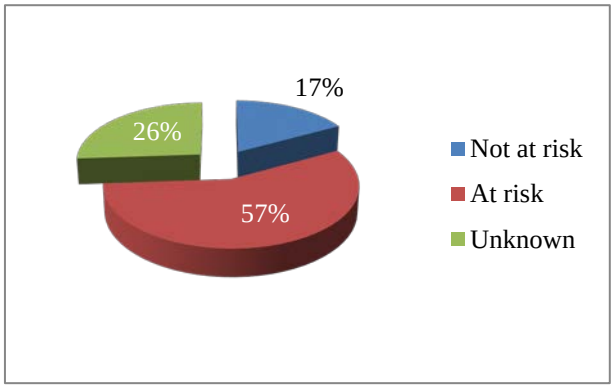


Figure 37: Risk category associated with Chemical Status for the Sava River

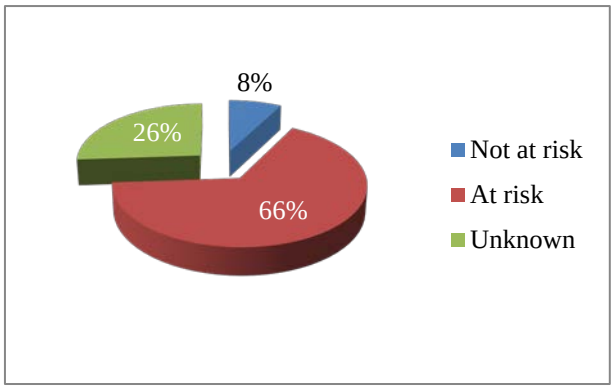


Figure 38: Risk category associated with Ecological Status for the Sava River

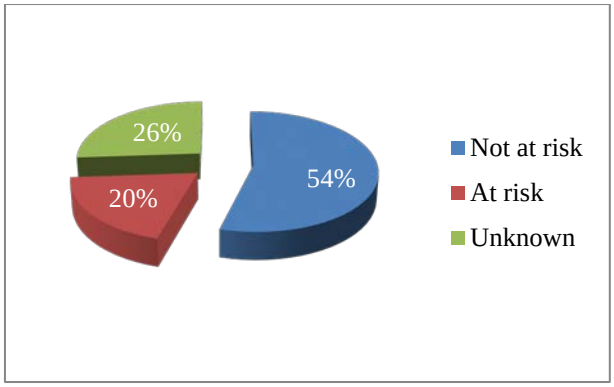


Figure 39: Risk category due to ongoing pressure from Organic Pollution for the Sava River

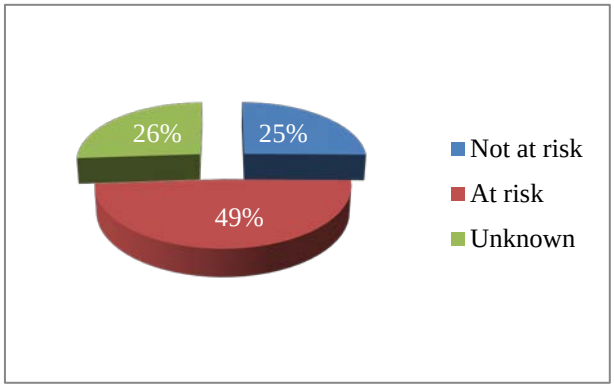


Figure 40: Risk category due to ongoing pressure from Hazardous Substances likely persist for the Sava River

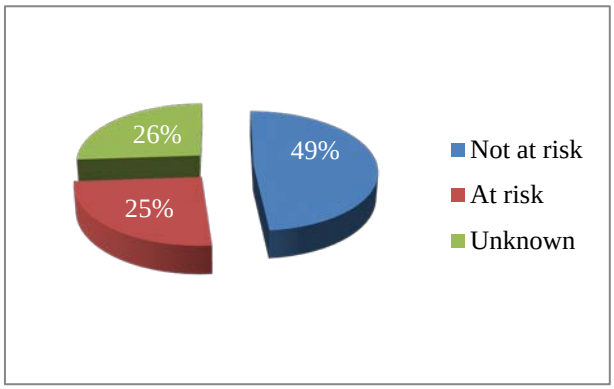


Figure 41: Risk category due to ongoing pressure from Nutrient Pollution likely persist for the Sava River

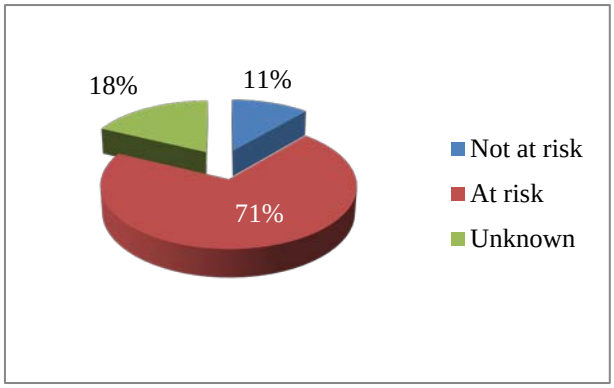


Figure 42: Risk category due to ongoing pressure from Hydromorphological Alterations likely persist for the Sava River

5.2 Risk assessment of the Sava River tributaries

Table 48: Summary of the risk assessment of the Sava River tributaries

Risk		Not at risk	At risk	Unknown
RiskChemicalStatus	No of WBs	36	50	81
	Length of WBs	878	1525	2376
	Percentage	18%	32%	50%
RiskEcologicalStatus	No of WBs	33	53	81
	Length of WBs	1147	1256	2376
	Percentage	24%	26%	50%
PressureOrganicPollution	No of WBs	56	30	81
	Length of WBs	1753	650	2376
	Percentage	37%	14%	50%
PressureHazardousSubstances	No of WBs	36	50	81
	Length of WBs	878	1525	2376
	Percentage	18%	32%	50%
PressureNutrientPollution	No of WBs	52	34	81
	Length of WBs	1684	719	2376
	Percentage	35%	15%	50%
Pressure Hydromorphological Alterations	No of WBs	102	37	28
	Length of WBs	2936	1164	679
	Percentage	61%	24%	14%

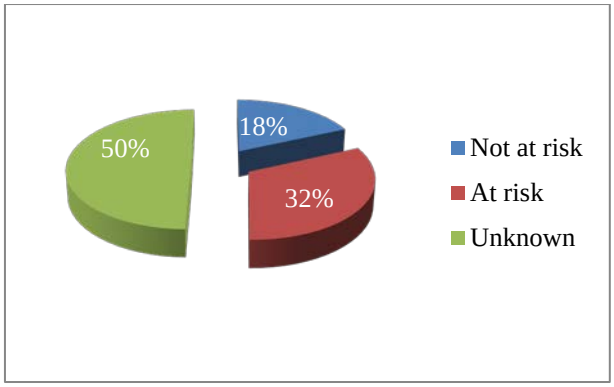


Figure 43: Risk category associated with Chemical Status for the Sava River tributaries

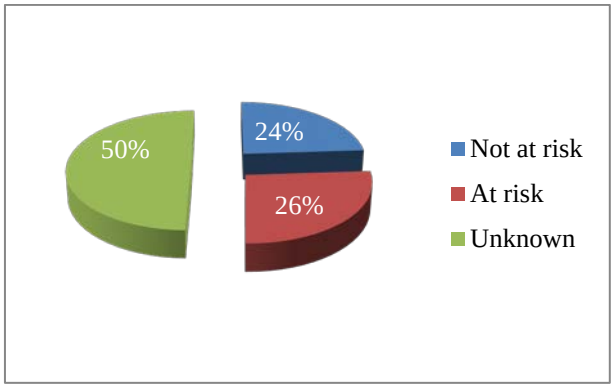


Figure 44: Risk category associated with Ecological Status for the Sava River tributaries

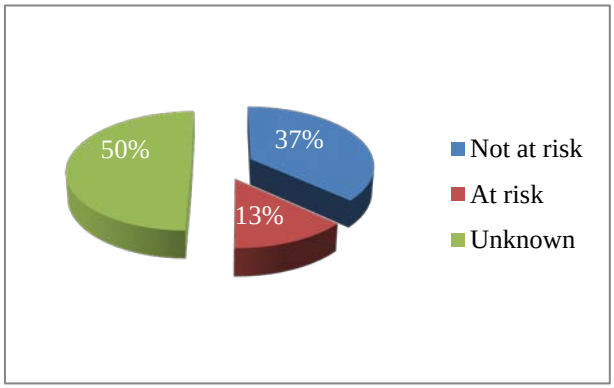


Figure 45: Risk category due to ongoing pressure from Organic Pollution for the Sava River tributaries

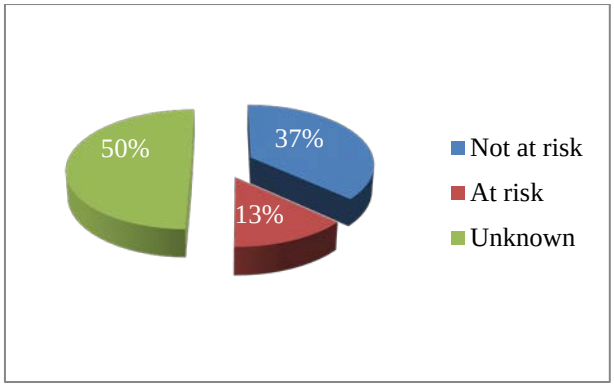


Figure 46: Risk category due to ongoing pressure from Hazardous Substances likely persist for the Sava River tributaries

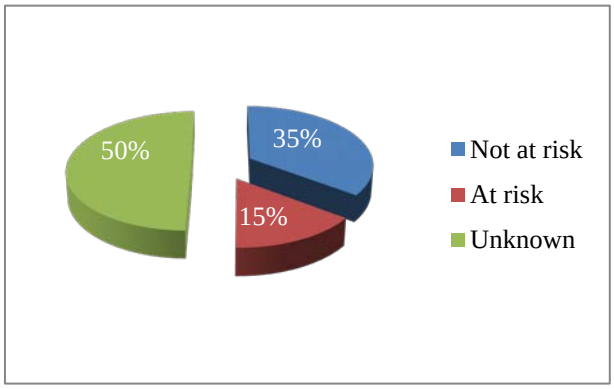


Figure 47: Risk category due to ongoing pressure from Nutrient Pollution likely persist for the Sava River tributaries

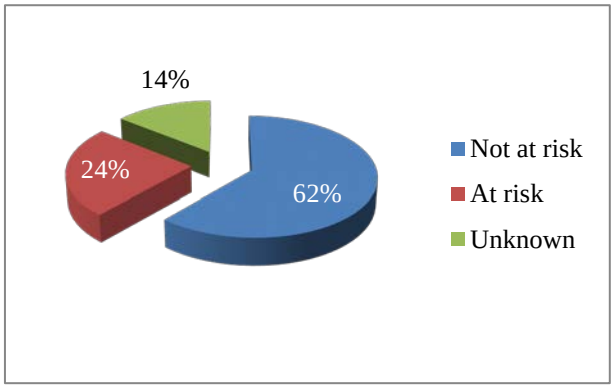


Figure 48: Risk category due to ongoing pressure from Hydromorphological Alterations likely persist for the Sava River tributaries

5.3 Risk assessment of groundwater bodies[15]

The risk assessment has been made at national level taking into account quality and quantity of groundwater. Table 50 and Figures 49 and 50 present the quality and quantity status of important groundwater bodies related to size and Table 51 and Figure 51 related to number of groundwater bodies. The status of the groundwater bodies is presented as good and poor. In cases where there is no data available due to lack of information the status is indicated as No data.

Tables 52 and 53 with associated figures 52, 53 and 54 present the risk of failure to reach environmental objectives related to size and number of groundwater bodies.

The risk of the groundwater bodies is indicated as Yes (at risk) Possible (at risk) and No (not at risk). In cases where there is no data available due to lack of information the risk is indicated as No data.

Table 49: Status of the GWBs in the Sava River Basin related to size in km^2

	Size	Risk			Risk		
		Quality			Quantity		
		Good	Poor	No data	Good	Poor	No data
	km^2	km^2	km^2	km^2	km^2	km^2	
SI	11980	11871	109		11980		
HR	25752	12744		13008	5972		19781
BA	12050			12050			12050
RS	7357			7357			7357
ME	6300			6300			6300
Total	63439	24615	109	38715	17952	0	45487
% of total size		38,8%	0,2%	61,0%	28,3%	0,0%	71,7%

[15] Information on risks on groundwater originates from the Sava RBMP Background paper No.2 Groundwater bodies in the Sava River Basin (http://www.savacommission.org/dms/docs/dokumenti/srbmp_micro_web/backgroundpapers_final/nnno_2_background_paper_gwbs_in_the_sava_rb.pdf).

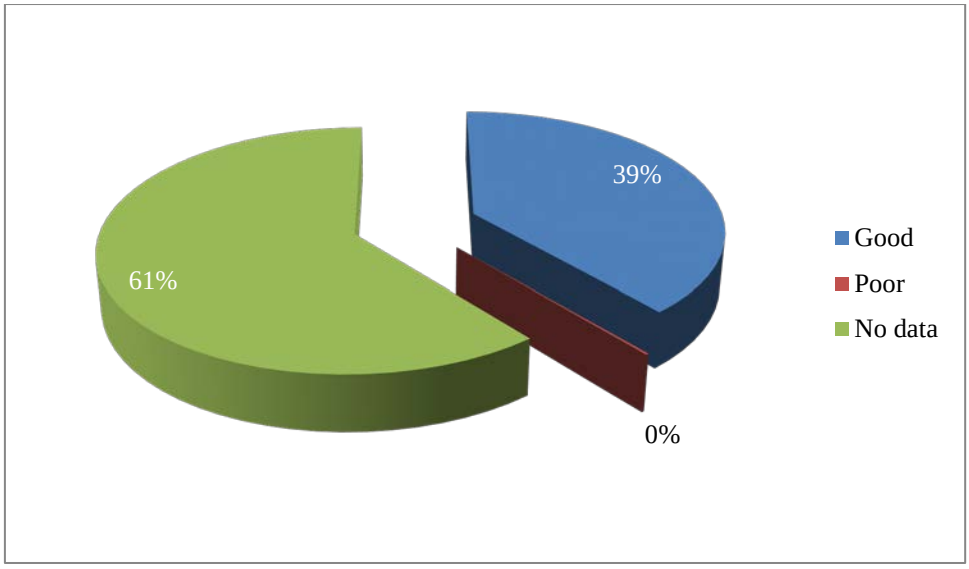


Figure 49: Quality status of important GWBs in the Sava River Basin related to size in km^2

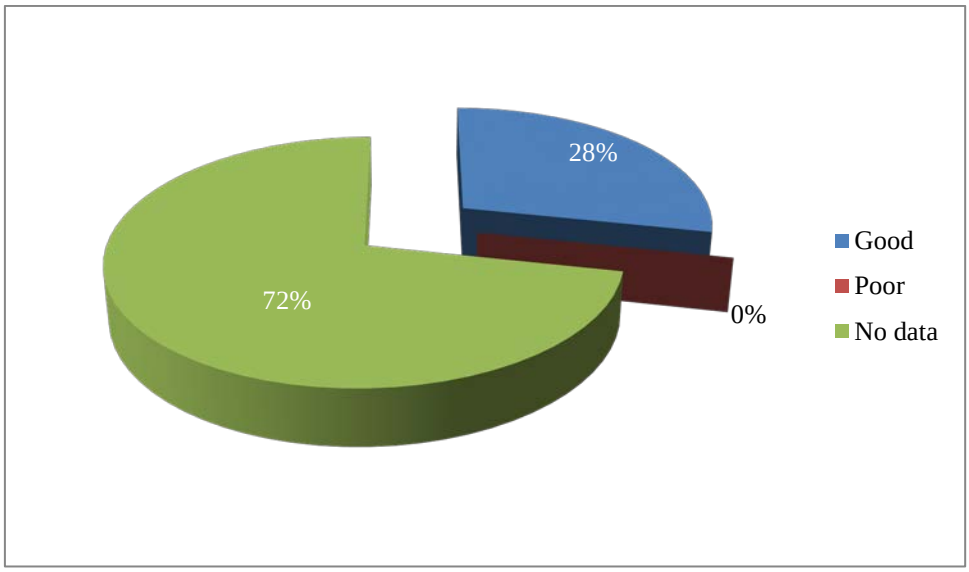


Figure 50: Quantity status of important GWBs in the Sava River Basin related to size in km^2

Table 50: Status of the GWBs in the Sava River Basin related to number of GWBs

	No of WBs	Risk			Risk		
		Quality			Quantity		
		Good	Poor	No data	Good	Poor	No data
SI	11	10	1		11		
HR	14	7		7	5		9
BA	7			7			7
RS	5			5			5

	No of WBs	Risk			Risk		
		Quality			Quantity		
		Good	Poor	No data	Good	Poor	No data
ME	4			4			4
Sava River Basin	41	17	1	24	16	0	25

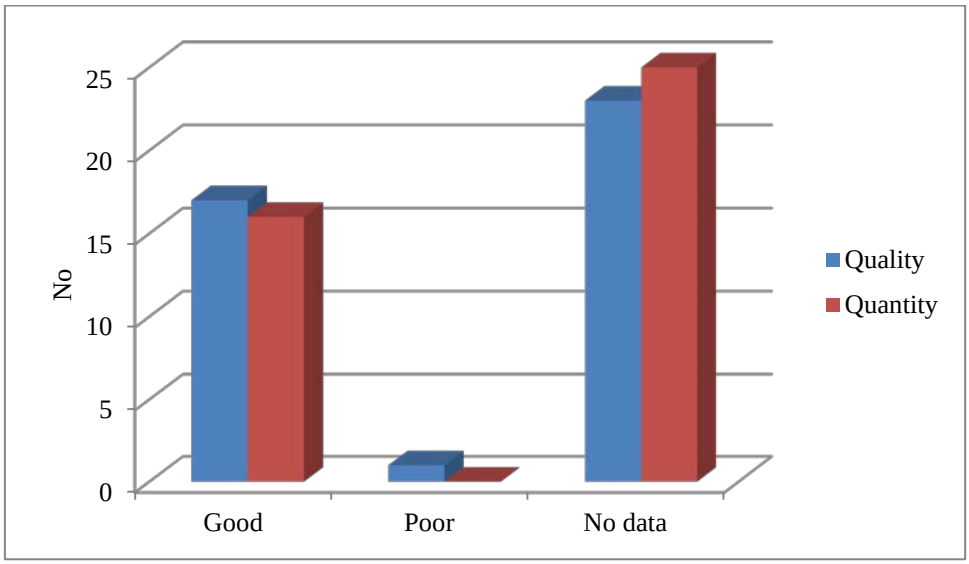


Figure 51: Quality and quantity status of important GWBs in the Sava River Basin related to number of GWBs

Table 51: Risk assessment of the GWBs related to size in km^2

	Size	Risk				Risk			
		Quality				Quantity			
		Yes	Possible	No	No data	Yes	Possible	No	No data
	km^2	km^2	km^2	km^2	km^2	km^2	km^2	km^2	km^2
SI	11980	109		11871					11980
HR	25752		988	16966	7799		988	23738	1027
BA	12050		12050					12050	
RS	7357		2357	4999			3935	3422	
ME	6300			6300					6300
Total	63439	109	15395	40136	7799	0	4922	39210	19307

	Size	Risk				Risk			
		Quality				Quantity			
		Yes	Possible	No	No data	Yes	Possible	No	No data
	km²	km²	km²	km²	km²	km²	km²	km²	km²
% of total size		0.2%	24.3%	63.3%	12.3%	0.0%	7.8%	61.8%	30.4%

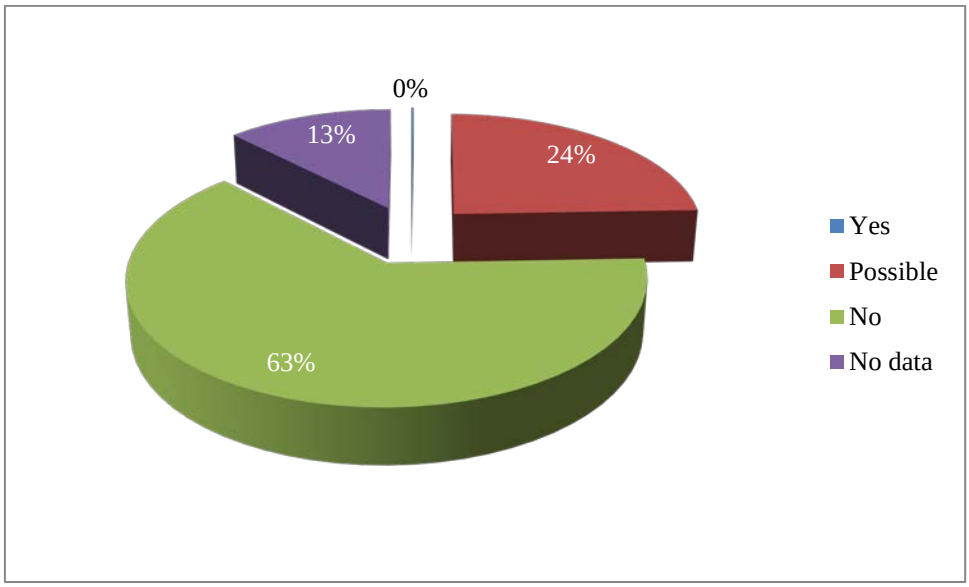


Figure 52: Risk assessment of the quality (chemical) status of important GWBs

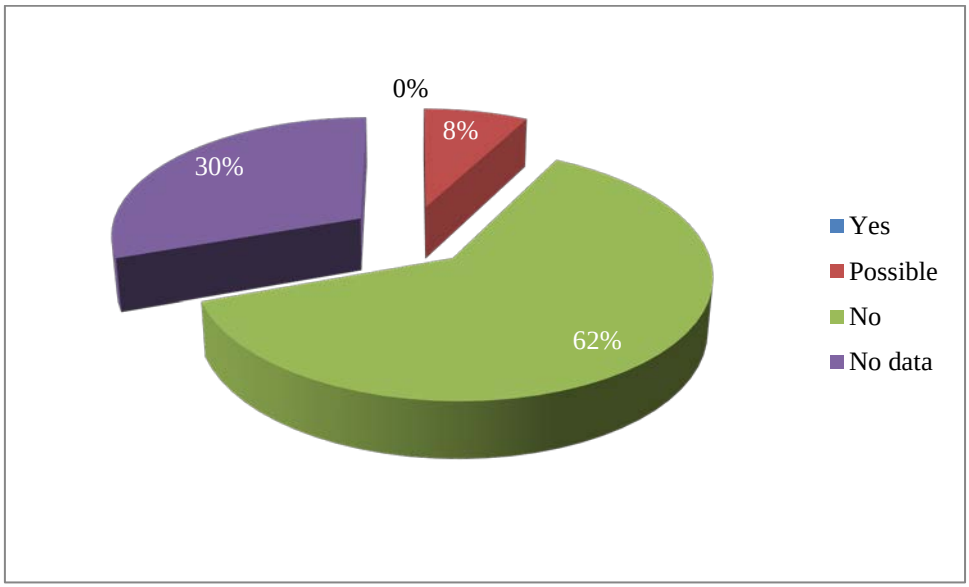


Figure 53: Risk assessment of the quantity status of important GWBs

Table 52: Status of the risk assessment of the GWBs related to number of the GWBs

	No of WBs	Risk				Risk			
		Quality				Quantity			
		Yes	Possible	No	No data	Yes	Possible	No	No data
SI	11	1			10				11
HR	14		1	10	3		1	12	1
BA	7		7					7	
RS	5		2	3			2	3	
ME	4			4				4	
Sava River Basin	41	1	10	17	13	0	3	26	12

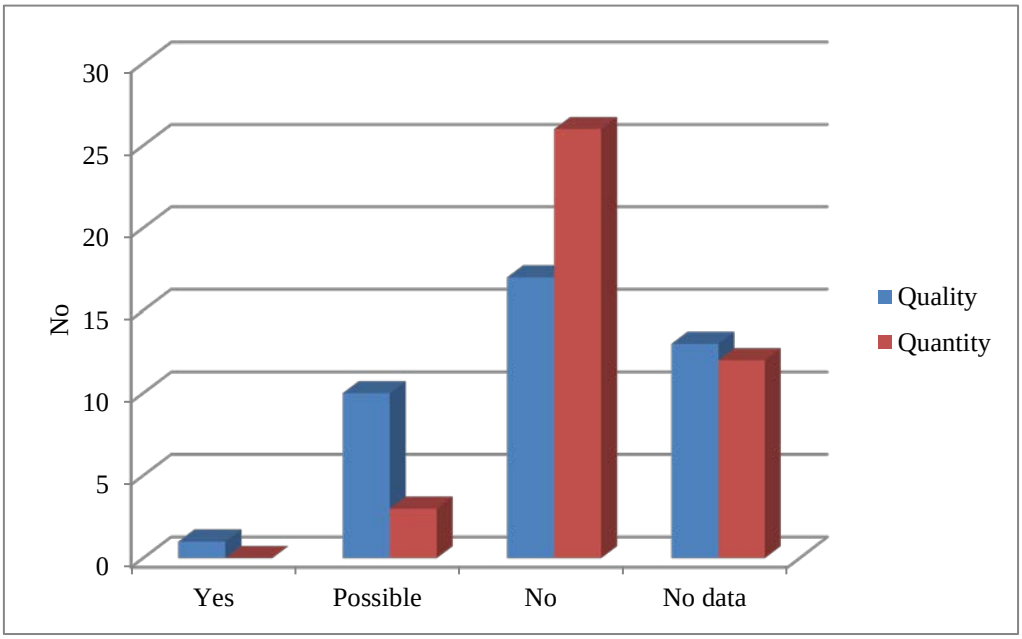


Figure 54: Risk assessment of the quality and quantity status of important GWBs related to number of GWBs

6 Water quality monitoring

6.1 National monitoring stations for water quality

Total number of quality monitoring stations in the Sava River Basin is 92 (23 in BA, 16 in HR, 7 in RS, 29 in SI and 17 in ME).

Slovenia and Croatia have reported on establishment of the monitoring programme in line with the principles of the EU WFD while the other Sava countries are in development phase. To meet the requirements of both the EU WFD and the Danube River Protection Convention the monitoring station for surface waters consists of following elements:

- Surveillance monitoring I (SM 1): Monitoring of surface water status
- Surveillance monitoring II (SM 2): Monitoring of specific pressures
- Operational monitoring (OM)
- Investigative monitoring

The overview of the monitoring stations is provided in Map 11: Surface water quality monitoring network.

6.2 Transnational monitoring network (TNMN)

According to the Convention on cooperation for the protection and sustainable use of the Danube River (DRPC), the Parties to the FASRB cooperate in the field of monitoring and assessment. For this aim, they:

- harmonize or make comparable their monitoring and assessment methods, in particular in the field of river quality,
- develop concerted or joint monitoring systems applying stationary or mobile measurement devices, communication and data processing facilities,
- elaborate and implement joint programmes for monitoring the riverine conditions in the Danube catchment area concerning both, the water quantity and quality, sediments and riverine ecosystems, as a basis for the assessment of transboundary impacts.

The operation of the Trans-National Monitoring Network (TNMN), functioning since 1996, is aimed to contribute to implementation of the DRPC. Water quality data from the monitoring programme are regularly gathered by the Danube/Sava countries, merged at Central Point at Slovak Hydrometeorological Institute, processed by using the agreed procedures and provided to the ICPDR information system. The TNMN builds on the national surface water monitoring networks.

Basic data on TNMN stations is given in Table 53 and Map 11.

Table 53: Basic data on the TNMN monitoring stations in the Sava River Basin

Country	River	Town/Location	TNMN Code	y-coord.	x-coord.	Distance (km)	Altitude (m)	Catchment (km^2)	DEFF Code	Loc. Profile
SI	Sava	Jesenice	SI2	45.860484	15.692461	729	135	10878	L1330	R
HR	Sava	Jesenice	HR6	45.86291	15.687995	729	135	10834	L1220	LR
HR	Sava	Upstream Una Jasenovac	HR7	45.484	16.369	525	87	30953	L1150	L
BA	Sava	Gradiška	BA5	45.141	17.255	457	86	39150		M
BA	Sava	Rača	BA11	44.891	19.335	190	80	64125		M
HR	Sava	Račinovci	HR8	45.251	16.953	254	85	62890	L1060	LMR
RS	Sava	Jamena	RS13	44.878	19.084	195	78	64073	L2470	L
RS	Sava	Sremska Mitrovica	RS14	44.966	19.608	136	75	87996	L2480	L
RS	Sava	Šabac	RS15	44.770	19.704	104	74	89490	L2490	R
RS	Sava	Ostružnica	RS16	44.732	20.317	17	0	37320	L2500	R
BA	Una	Kozarska Dubica	BA6	45.200	16.849	16	94	9130		M
BA	Una	Novi Grad	BA12	44.988	16.295	70	137	4573		M
BA	Vrbas	Razboj	BA7	45.050	17.458	12	100	6023		M
BA	Bosna	Modriča	BA8	44.961	18.313	24	99	10500		M
BA	Bosna	Usora	BA13	44.664	18.074	78	148	7313		M
BA	Drina	Foča	BA9	43.344	18.833	234	442	3884		M
BA	Drina	Badovinci	BA10	44.779	19.344	16	90	19226		M
ME	Lim	Gradac/HS	ME 1	43.394	19.150					
	Ćehotina	Dobrakovo/HS	ME 2	43.134	19.775					

6.3 Monitoring of groundwater

The number of monitoring stations is indicated in Table 54. Slovenia and Croatia have developed the groundwater monitoring programmes on the basis of the requirements of EU WFD. There is a lack of information on national monitoring network established in BA and ME.

Table 54: Number of monitoring stations and range of density of stations in the Sava River Basin

Country	No. of monitoring stations		Range of density of GW monitoring network (km^2/station)	
	Quantitative monitoring	Chemical surveillance monitoring	Quantitative monitoring	Chemical surveillance monitoring
SI	73	70	6-654	14-479
HR	630*	379*	3-472	4-1299
BA	NA	NA	NA	NA
RS	71*	38*	20-532	109-1594
ME	NA	NA	NA	NA

**Number of monitoring stations in RS and HR includes both state monitoring stations (programmes) and other monitoring stations (such as drinking water wells and springs).*

7 Protected areas

The countries reported three types of protected areas:

- Water related bird protection areas;
- Water related habitat protection areas and;
- Other water relevant nature protection areas (Preliminary Natura 2000 areas and other water relevant protected areas).

Table 55 and Figures 55 and 56 summarize the surface of protected areas in the Sava countries. They are also indicated in Map 12.

Table 55: Water relevant protection areas per country

	SI	HR	BA	RS	ME	Sum
	km²	km²	km²	km²	km²	km²
Area of SRB	11,734	25,373	38,349	15,147	6,930	97,533
Bird	241	2,997				3,238
Habitat	3,483	4,984				8,467
Other		2,116	1,061	602	447	4,226
Not protected	8,010	15,276	37,288	14,545	6,484	81,602

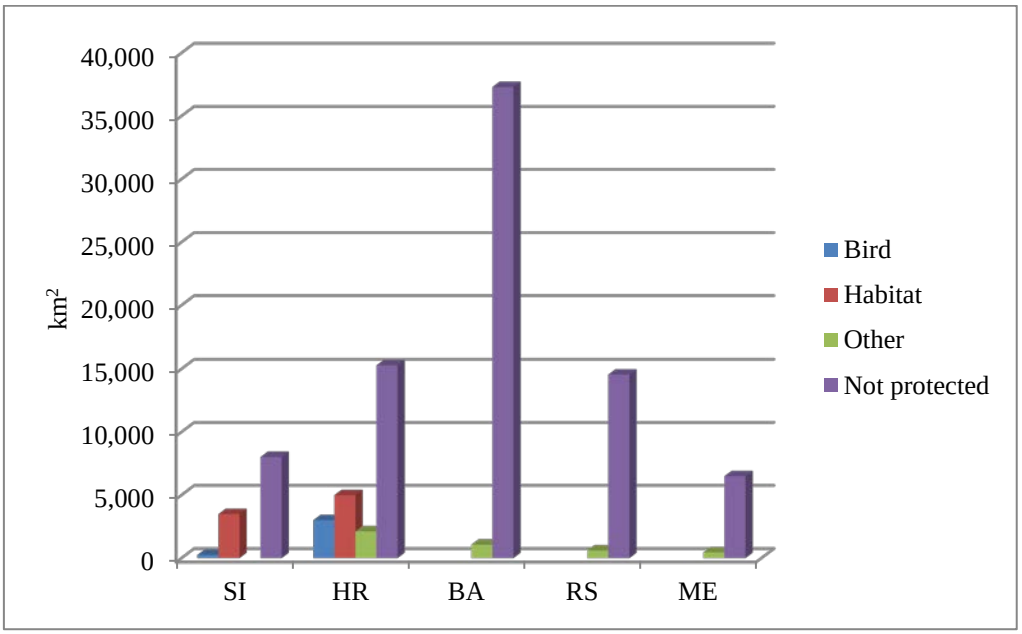


Figure 55: Water relevant protected areas per country

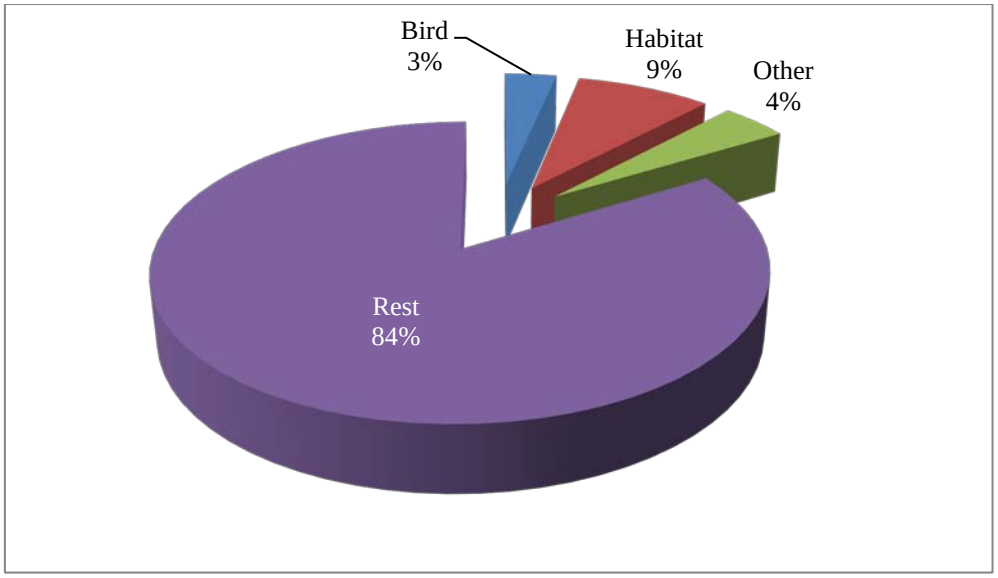


Figure 56: Water relevant protected areas

Slovenia and Croatia delineated all areas identified in the EU WFD or other related directives (2008/25/EC, Govedič et al. 2007, 92/43/EEC).

In non-EU countries related national legislation is not fully harmonized with the EU standards. In Serbia, the Decree on Ecological Network (Official Gazette of the RS, 102/2010) identifies the sites and international ecological corridors in Republic of Serbia where Sava river is included and regulates the issue of management and financing of Ecological network and protection measures which includes protection measures for natural and semi natural elements of corridors specify improvement of ecological corridors within civil engineering areas and apply technical-technological solutions for smooth movement of species with regard to the spots of ecological corridors crossing with elements of infrastructure systems forming the barriers for species migration. In Bosnia and Herzegovina by-laws related to identification of bird and habitat protection areas are still missing. In FBiH the Regulation on Natura 2000 – Protected areas in Europe (Official Gazzette of the FBiH, 43/11) has been adopted in 2011. List of Natura 2000 sites in Bosnia and Herzegovina has been proposed within the project „Support to Implementation of the Birds and Habitats Directives in Bosnia and Herzegovina (2012-2015)“, but none of the sites has been officially designated yet.

8 Data gaps and uncertainties

8.1 Surface water bodies

Data gaps and uncertainties identified in this analysis can be summarized as follows:

- Lack of monitoring data;
  There is lack of chemical and biological monitoring data and not all required quality data are monitored due to limited funds for reference years. Lack of information on accident risk spots and contaminated sites could be identified because the data have not been systematically collected in the past and database has not been established yet. Sediment and invasive species is monitored only periodically in some countries for the purposes of specific projects. There is a lack in the number of monitoring sites for biological elements in particular and the assessment of the biological status is not reliable.
  There is also lack of data on urban wastewater discharges and on industrial and diffuse pollution sources.
- Assessment methods not complied with the EU WFD;
  It could be observed that the situation is not clear regarding the assessment of biological and chemical elements. For example assessment methods are not available for some of the biological elements (mainly phytoplankton and fish), while in assessment of chemical status a number of priority substances are not analyzed.
- Transboundary WBs not harmonized;
  There is problem of different delineation on the transboundary river sections e.g. Sava (HR/BA) Sotla/Sutla (SI/HR), Kupa/Kolpa (SI/HR), Una (BA/HR), Drina (BA/RS), Bosut (HR/RS) and Ćehotina, Tara, Piva (all BA/ME).
- Gaps in socio-economic data.
  Data on socio-economic data have been estimated for the Sava River Basin because most of the data are available for the whole country and they have been calculated for the basin.

8.2 Groundwater bodies

Data gaps and uncertainties that have been identified for groundwater bodies are the following:

- The monitoring results used for the assessment of the chemical and quantitative status of GWBs in some parts of the Sava River Basin are limited or not available. In this regard it would be necessary to adapt the existing monitoring programmes to meet the EU WFD requirements set out in Art. 8 of the EU WFD. In Croatia the groundwater monitoring has been adapted to the EU WFD requirements in the period of 2nd national RBM plan. It is designed that it can detect trends in pollutants. Operational monitoring of the chemical status was not implemented due to the initial determination of states grouped groundwater in the first cycle national RBM plan;
- The process of bilateral negotiations has already started between Slovenia, Croatia and Bosnia and Herzegovina but not with Serbia. In order to better understand the groundwater system and better manage the shared resource it would be necessary to develop the joint conceptual models for transboundary GWBs and establish joint monitoring programmes and data exchange.

There is not information that any of the gaps and uncertainties identified above have been eliminated.

9 Economic analysis

9.1 Basic data

The EU WFD under Article 5 and Annex III stipulates an economic analysis of water use by demonstrating the main economic characteristics and importance of the water therein and demonstrating the economic capacity of different economic sectors. It provides the river basin's economic profile in terms of general socio-economic indicators and main characteristics of water users and water services in the Sava River Basin.

The socio-economic analysis begins with a global overview of productive activities in the Sava River Basin. The analysis developed in this section should present a general view of different sectors of the economic activity pertaining to the part of the country lying in the Sava River Basin, valuing the evolution of the Gross Value Added (hereinafter called: GVA), Gross Domestic Product - overall/per capita (hereinafter called: GDP), population and employed persons – per economic sector, generated by each sector and its general tendencies. The analysis ends with analysis of water use, according to the economic activities in the Sava River Basin.

The reference year for the data collected is 2012.

The population of the Sava River Basin is 8,640,000 which represents 48 % of the total population of all countries. Particularly, the population of the Sava River Basin in Bosnia and Herzegovina is 88 % of the total population in that country, in Croatia 50 %, in Serbia 26 %, in Slovenia 52 % and in Montenegro 31%.

Economic activities developed in the Sava River Basin, generate more than **2,495**,000 employed people. That is 29 % of all inhabitants in the Sava River Basin and 47 % of all employed people in the countries.

Table 56: Population and number of employees in the Sava River Basin per country (in 1,000s)

Country	Total population whole country	Population in the Sava River Basin	Share of total population (%)	Employees in whole country	Employees in the Sava River Basin	Share of employees in whole country (%)
1	2	3	4(3/2)	5	6	7(6/5)
SI	2,055	1,069	52%	817	507	62%
HR	4,269	2,135	50%	1,395	725	52%
BA	3,836	3,376	88%	814	798	98%
RS	7,187	1,869	26%	2,228	423	19%
ME	620.6	192	31%	167	42	25%
Total	**17,968**	**8,640**	**48%**	**5,421**	**2,495**	**46%**

As for employment, the industry and other activities sector (construction, wholesale and retail trade, hotels and restaurants, transport, storage and communication, financial intermediation, real estate, renting and business activities) remain the greatest producers of jobs. 36% of all employed people in the Sava River Basin work in the other activities sector, 25% work in the industry sector, 27% work in the public sector, 11% work in the agriculture and 1% work in the energy sector.

Table 57: Number of employees in the Sava River Basin per sector and country (in 1,000s)

Country	Employed people in the Sava River Basin by sectors					Total of employees in the Sava River Basin
	Agriculture	Industry	Energy	Other activities	Public services	
SI	46	127	5	228	101	507
HR	87	145	15	334	145	725
BA	128	192	8	184	287	798
RS	13	148	13	127	123	423
ME	9	9	1	11	13	42
Total	282	620	41	883	669	2,495

Of all employed people in the Sava River Basin, the number of employees in agricultural sector is the highest in Bosnia and Herzegovina, as well as industry and public sector as shown in Figure 58. Number of employees in the industry sector in Slovenia and Croatia is almost the same.

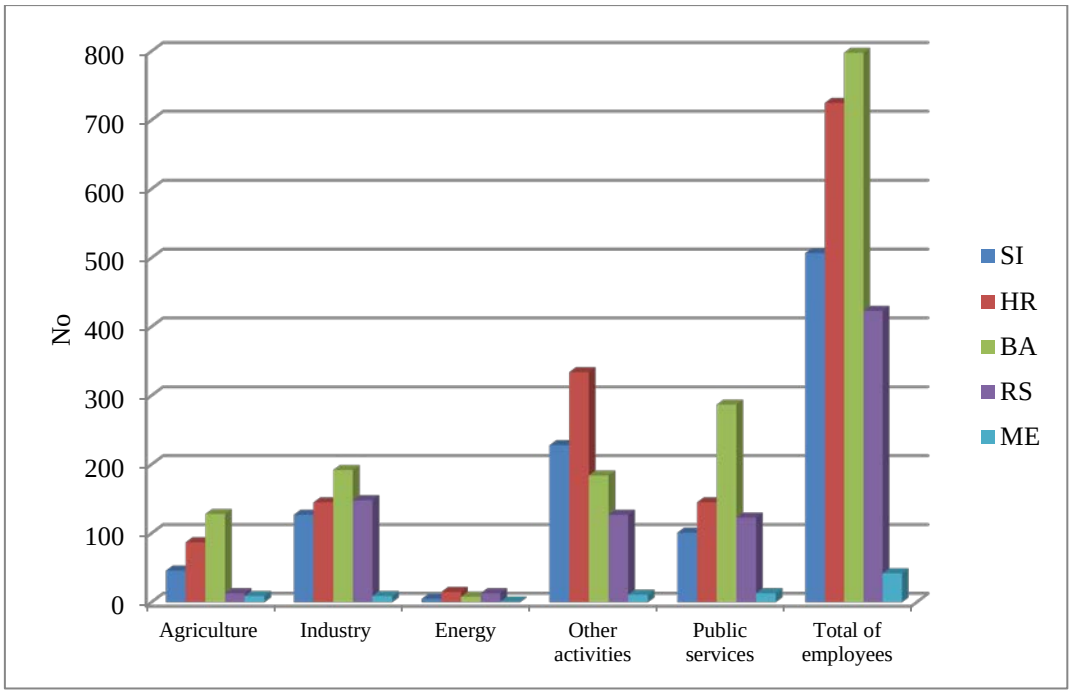


Figure 57: Number of employees in the Sava River Basin by sector and country (in 1,000s)

Main economic activities in the Sava River Basin in year 2010 are given in Table 58 and Figure 58. The total GVA of the Sava River Basin is 46,134 million euros. The sector that contributes the most to the total GVA in value and in growth is the other activities sector (52 %). Industry is the second greatest sector and it represents 21 % of the total GVA in the Sava River Basin. It is followed by the public service sector with 17 %, the agricultural sector holding 6 % and, finally, the energy sector with 4 % of the total GVA in the Sava River Basin.

Table 58: GVA by sectors and country in the Sava River Basin (in million EUR)

Country	GVA by sectors					In whole, the Sava River Basin
	Agriculture	Industry	Energy	Other activities	Public services	
SI	224	2,682	335	5,700	2,235	11176
HR	1,341	4,407	575	9,773	3,066	19,163
BA	1,051	1,156	631	6,622	1,051	10,511
RS	585	899	225	2,249	540	4,497
ME	71	126	39	370	181	787
Total	**3,271**	**9,271**	**1,805**	**24,713**	**7,073**	**46,134**

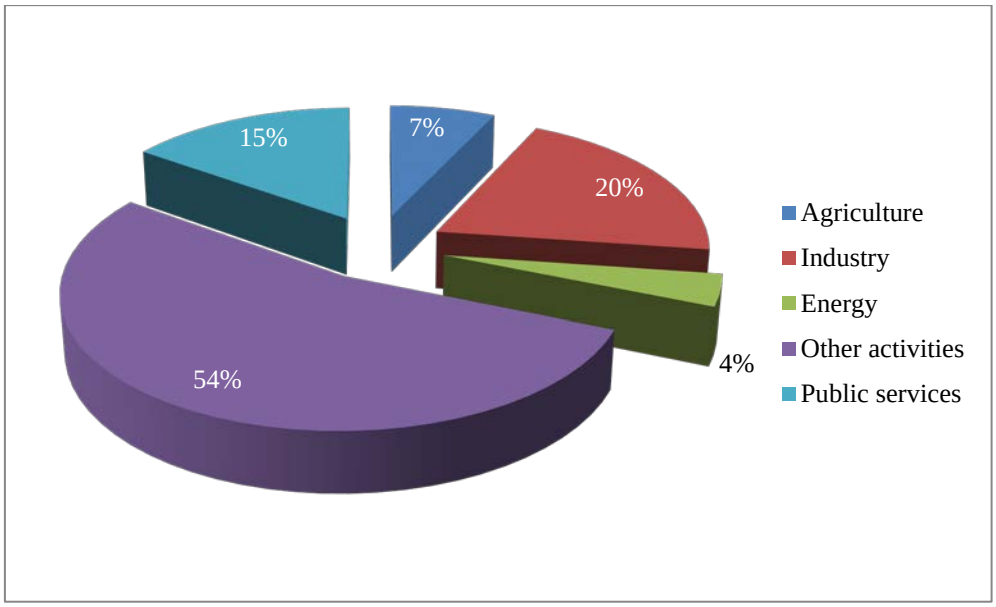


Figure 58: Main economic activities in the Sava River Basin - GVA (2005)

GDP for the Sava River Basin was calculated on basis of the regional data provided. Share of the GDP in the Sava River Basin reaches a very significant 50 % of the GDP of all countries. Table 59 shows the GDP of each country separately.

Table 59: GDP and GPD per capita for the Sava River Basin and each country

Country	GDP for the whole country	GDP in Sava River Basin	Share of whole countries GDP	GDP per capita for the whole country	GDP per capita in Sava River Basin
	(million EUR)	(million EUR)	(%)	(EUR/capita)	(EUR/capita)
SI	35,988	21,233	59%	17,497	19,870
HR	43,502	23,926	55%	10,190	11,209
BA	13,158	9,869	75%	3,430	2,923
RS	31,683	7,921	25%	4,408	4,239
ME	3,181	859	27%	5,126	4,464
Total	**127,512**	**63,807**	**50%**	**8,130**	**7,385**

The importance of economic activities in the Sava River Basin is obvious, as e.g. in the part of Slovenia belonging to the Sava River Basin where GDP reaches 59 % respectively, of the total country GDP and also in Croatia where GDP reaches 55 % of the total Croatian GDP.

As a measure for the general productivity of each of the analyzed sectors, the GVA/employed person variable has been calculated and shown in Figure 59. It gains a much greater value in the energy sector (especially in Montenegro and Slovenia), far away from the one gained in the public service and the agriculture sector.

Table 60: Productivity according to the economic activities in the Sava River Basin (in 1000 EUR)

Country	GVA/employed person by sectors				Public services
	Agriculture	Industry	Energy	Other activities	
SI	5	21	67	25	22
HR	15	30	38	29	21
BA	8	6	79	36	4
RS	45	6	17	18	4
ME	8	14	39	34	14

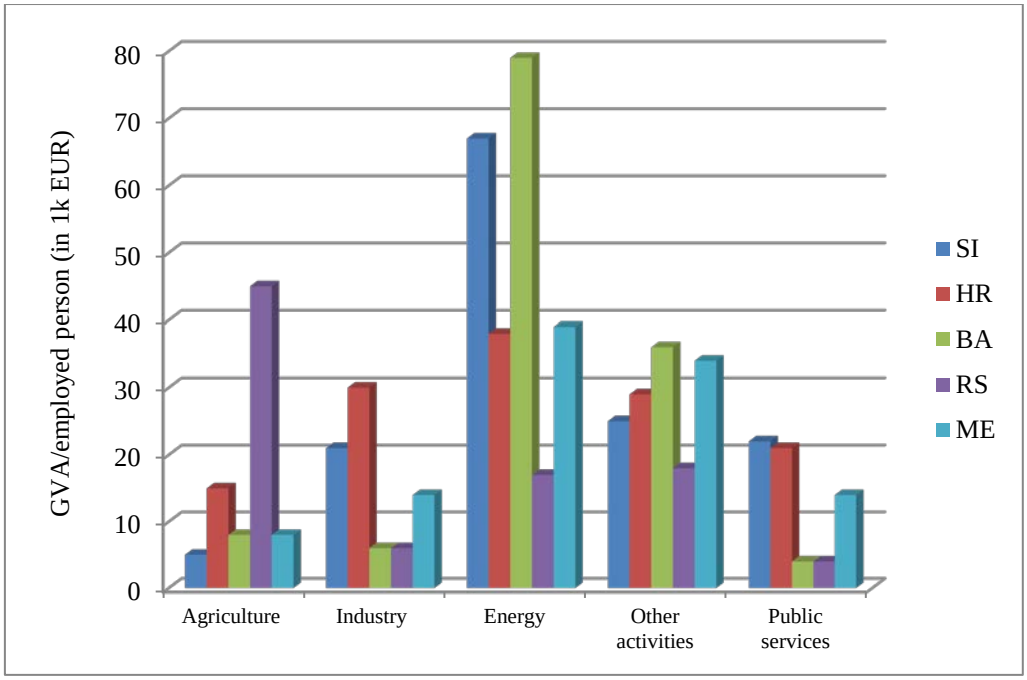


Figure 59: Productivity according to the economic activities in the Sava River Basin

9.2 Water use[16]

Generally, water use refers to use of water by households, industry, agriculture, for energy production, environmental protection, etc. including so called in-stream uses such as fishing, recreation, transportation, etc.

The overview of various types of water uses in the Sava River Basin is given in the following table.

Table 61: Estimation of total water use in the Sava River Basin

Name of the Country	Public Water Supply	Industry	Thermal and nuclear plant	Irrigation	Other agricultural	Total water use	Per Capita Use - Public Water Supply
	million m^3						l/person/d
SI	82	43	540	7	123	795	218
HR	113	57	205	3	201	580	140
BA	330	147	63	6	66	612	268
RS	233	40	1722	14	68	2077	328
ME*	2	1	2	0	0	5	22

[16] Data for economic analysis originates from the first Sava RBMP

Name of the Country	Public Water Supply	Industry	Thermal and nuclear plant	Irrigation	Other	Total water use	Per Capita Use - Public Water Supply
					agricultural		
	million m^3						l/person/d
Total Sava River Basin	760	288	2532	30	458	4069	238
Percentage	19%	7%	62%	1%	11%	100%	

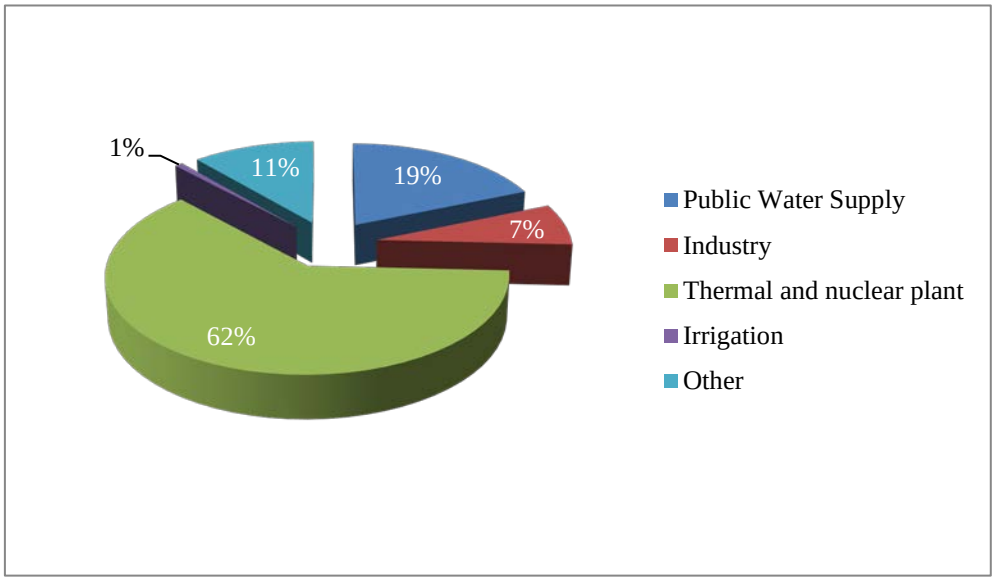


Figure 60: Estimation of total water use in the Sava River Basin

10 Integration issues

10.1 Floods

The Sava River Basin countries undertake coordinated sustainable flood protection at the Sava River Basin level. This coordination has been firmly confirmed and strengthen by entering into force of the Protocol on Flood Protection to the FASRB, on November 27, 2015. The Protocol defines framework for cooperation and implementation of the activities aimed at creating the conditions for sustainable flood protection in the Sava River Basin. The Protocol emphasises the importance of coordinated measures, works and activities for the reduction of flood risks throughout a river basin, and operation in accordance with "no harm rule" principle. In order to contribute to reduction of adverse consequences of floods, especially for human health and life, the environment, cultural heritage, economic activity and infrastructure associated with floods, the countries in the Sava River Basin agree to cooperate on:

- Preparation of the Program for development of the Flood Risk Management Plan in the Sava River Basin;
- Undertaking of Preliminary Flood Risk Assessment (PFRA);
- Preparation of flood maps;
- Development of Flood Risk Management Plan in the Sava River Basin (Sava FRMP);
- Establishment of the Flood forecasting, warning and alarm system in the Sava River Basin (Sava FFWS);
- Exchange of information significant for sustainable flood protection;
- Implementation of all measures and activities of mutual interest, originating from the abovementioned planning documents or activities, or other mutually agreed measures and activities.

In implementation of the above commitments, the Sava countries cooperate on the basis of the EU Floods Directive, in coordination with the EU WFD and taking into account good practices of cooperation in the field of flood protection in the Sava River Basin.

So far, a joint report on PFRA[17] in the Sava River Basin was prepared in 2014, under coordination of ISRBC. It has been based on information from the Parties on the results of national PFRA and designation of the areas of potentially significant flood risk (ASPFRs). The spatial information on ASPFRs identified in the Sava River Basin is available at the Sava GIS geoportal: http://savagis.org/ . The report also gives an overview of the most significant floods that had occurred in the past, their characteristics and consequences. Special attention was paid to the catastrophic flood event from May 2014, due to its specific nature and disastrous consequences. Floods in the Sava River Basin usually occur in autumn and spring. Autumn floods, typically caused by heavy rainfall, are of shorter duration and can have very high extreme flows. Spring floods are the result of snow melt; they last longer and usually do not have large maximum discharges. The May 2014 flood was caused by days of extensive rainfall on pre-saturated soil over a large portion of the Sava River Basin within Croatia, Bosnia and Herzegovina and Serbia. This combination caused flash floods, erosion and landslides along small watercourses, but also disastrous flooding along the Sava River main course and its right tributaries. The Sava flood wave had surprisingly quick rise for such a large river (only 4 days) and lasted till the beginning of June. New historical maximums were reached on mid and lower Sava, as well as on its tributaries (Bosna, Vrbas and Kolubara). In Croatia, 38,000 people were affected and around 15,000 inhabitants evacuated. In Bosnia and Herzegovina floods affected about 1.0 million people,of whom 90,000 were evacuated. In Serbia floods affected 1.6 million people and about 32,000 people were evacuated from their homes. The floods caused 3 casualties in Croatia, 25 in Bosna and Herzegovina

[17] http://www.savacommission.org/dms/docs/dokumenti/documents_publications/publications/other_publications/pfra/preliminary_flood_risk_assessment_in_the_sava_river_basin_20140701.pdf .

and 51 in Serbia. Total economic damage in all three countries has been estimated to 3.6 billion EUR. More info on this flood event can be seen in the join report of ICPDR and ISRBC[18].

Lessons learnt from the May 2014 floods, as well as experience gained from the cooperation of the Sava countries under the ISRBC shall be utilized for preparation of the common Sava FRMP. The Plan shall define common goals of flood risk management and should focus on measures for achievement of those goals that may have positive transboundary effects, as well as on measures for mitigation of potential negative transboundary effects. The subject of the Sava FRMP will be only those APSFRs which are identified along the Sava River and its tributaries and designated as of basin-wide importance. The cooperation of the Sava countries in flood risk management planning must focus on reducing the adverse consequences on flooding for human health, the environment, cultural heritage and economic activity. The focus may also be on reducing the likelihood of flooding and/or on using non-structural measures, including flood forecasting and raising awareness of flooding, in general on measures with positive transboundary impact, which encourage international cooperation. According to the EU WFD, the key issue in integration of flood risk management in the RBM planning is to recognise the links between flood risk management and the factors influencing water quality, such as hydromorphological alterations and changes in longitudinal and lateral connectivity. Therefore, the measures to achieve the objectives of flood risk management in the Sava FRMP will be carefully considered taking into account the principles of better environmental options, disproportionate costs and overriding public interest. All flood risk management activities shall be planned and carried out in line with Article 9 of the EU Floods Directive, which requires taking appropriate steps to coordinate the application of the EU Floods Directive with the EU WFD, focusing on opportunities for improving efficiency, information exchange and for achieving common synergies and benefits with regard to the environmental objectives of the EU WFD.

The Sava FRMP shall be prepared as the Component 1 of the project "Improvement of Joint Actions in Flood Management in the Sava River Basin", approved by the Western Balkans Investment Framework (WBIF) in 2014 and financed and implemented by the World Bank.

The Protocol also prescribes the establishment of a coordinated or joint Flood Forecasting, Warning and Alarm System in the Sava River Basin. Through development of the Sava FFWS, the Sava countries will ensure a timely exchange of meteorological and hydrological data, analyses and information important for flood protection, especially the timely forecast of high waters. The Sava FFWS will be based on a common platform, allowing a wide range of external data and models to be integrated. This concept, which allow integration of meteorological, hydrological and hydraulic models, is particularly important for the Sava countries, where different models are in use. Development of a joint Sava FFWS was launched in June 2016, as the Component 2 of the WBIF project and the fully operational system shall be handed over to the beneficiaries for their use by September 2018.

A key document which enables timely exchange of meteorological and hydrological data "Policy on the Exchange of Hydrological and Meteorological Data and Information in the Sava River Basin"[19], was signed by relevant organizations of the Parties and Montenegro in July 2014. Based on that agreement, ISRBC developed the Sava Hydrologic Information System (www.savahis.org) in 2015. Sava HIS provides a tool for collecting storing, analysing and reporting a sufficiently high quality processed and real-time hydrological and meteorological data.
Several important documents and reports dealing with impact of climate change in the Sava River Basin have been produced. The project "Building the link between flood risk management planning and climate change assessment in the Sava River Basin" (2013) dealt with compilation of various existing climate change scenarios for the region, their expected impacts on water cycle and more

[18] http://www.savacommission.org/dms/docs/dokumenti/documents_publications/publications/other_publications/sava_floods_report.pdf (ICPDR & ISRBC, 2015)

[19] http://www.savacommission.org/dms/docs/dokumenti/documents_publications/basic_documents/data_policy/dataexchangepolicy_en.pdf

specifically on frequency and magnitude of extreme flood events. This study examined the meteorological-climatological aspects and impacts of climate change on flood events, and preliminary identified possible adaptation measures. The most recent document dealing with climate change in the region is "Water & Climate Adaptation Plan for the Sava River Basin" (WATCAP, World Bank, 2014). One of the key conclusions of the WATCAP is that the climate within the Sava River Basin is changing and the basin will be vulnerable to the consequences in the future due in part to socio-economic factors, a general migration of the population away from agricultural areas towards cities, but also due to the past legacy that provided poor environmental management. WATCAP assessed different climate adaptation strategies, as a result from several case studies, which are transposed to the several sectoral guidance notes. WATCAP proposed a packages of short-term, medium-term and long-term mitigation measures for flood protection in the Sava River Basin in the time of changing climate, with a rough estimation of the costs which, for the long-term measures are estimated to 2 billion EUR.

Due consideration in future activities should be dedicated to rising of public awareness as well as to improving emergency operations. It needs to be highlighted that the focus should put on the efforts to strengthen regional cooperation using primarily existing platforms like ISRBC to coordinate regional actions in flood and river basin management.

10.2 Navigation

Navigation is a significant pressure from an ecological point of view. Navigation causes pollution, as well as river works aimed at the improvement of navigation conditions impair downstream conditions (e.g. bed-load transport, morpho-dynamic development of the channel network, groundwater regime, etc). The legal framework for navigation and environmental issues in the Sava river basin includes international conventions between countries as well as the relevant EU legislation, policies and action plans.

An integrated planning approach is necessary for the improvement of navigation and river system protection in the Sava River Basin which include the environment, water management, transport, river engineering, ecology, spatial planning, tourism, economics, as well as the involvement of stakeholders.

Recognising the potential conflict between the development of inland waterway transport and the EU WFD implementation, ISRBC has collaborated with the Danube Navigation Commission, and the ICPDR in a cross-sector discussion process, which led to the adoption of the *Joint Statement on Guiding Principles on the Development of Inland Navigation and Environmental in the Danube River Basin*.

The *Joint Statement* summarises principles and criteria for environmentally sustainable inland navigation on the Danube and its tributaries, including the maintenance of existing waterways and the development of future waterway infrastructure.

The *Joint Statement* is a guiding document:

- For the development of the `Programme of Measures´ requested by the EU WFD;
- For the maintenance of current inland navigation;
- For planning and investments in future infrastructure and environmental protection projects.

In order to facilitate and ensure the application of the Joint Statement and to lift its principles to the European level, a Manual on Good Practices in Sustainable Waterway Planning was developed by the ICPDR and relevant stakeholders in the Danube region within the framework of the EU project PLATINA in 2010 (see ICPDR 2010). Like the Joint Statement, the Manual also mainly focuses on structural measures (river engineering project) for the development of inland waterways. The basic philosophy is the integration of environmental objectives into the project design, thus preventing legal environmental barriers and significantly reducing the amount of potential compensation measures. The Manual proposes the following essential features for integrated planning:

- Identification of integrated project objectives comprising inland navigation aims, environmental needs and the objectives of other uses of the river reach such as nature protection, flood management and fishery,
- Integration of relevant stakeholders in the initial scoping phase of a project,
- Implementation of an integrated planning process to translate environmental and inland navigation objectives into concrete project measures thereby creating win-win results, and
- Conduct of comprehensive environmental monitoring prior, during and after project works, thereby enabling an adaptive implementation of the project when necessary.

The Parties of the FASRB have signed a Protocol on Prevention of the Water Pollution Caused by Navigation to the FASRB aiming to contribute to achieving the environmental and nature-protection objectives in using inland waterways.

10.3 Hydropower

Hydropower has been identified in the first implementation report of the EU WFD as one of several causes of hydromorphological alterations and there is a risk that significant water system degradation and biodiversity loss will continue in the future if infrastructure developments are implemented without fully taking the EU WFD requirements into account.

There are 20 hydropower plants in the Sava River Basin with installed capacity exceeding 10 MW. In Slovenia, most of the plants are located on the Sava River, while in the other Sava countries the plants have been built on major tributaries (Drina, Vrbas, etc.). There are a large number of small and micro hydropower plants in Slovenia. The total installed capacity of the plants is 2,449 MW with yearly production of 6,445 GWh/year.

Hydropower is one of the main hydromorphological driving forces identified in the risk analyses. It is therefore essential to organize a broad discussion process in close cooperation with the hydro-power sector and all relevant stakeholders with the aim of agreeing on guiding principles on integrating environmental principles into the use of existing hydropower plants, including a possible increase of their efficiency, as well as in the planning and construction of new hydropower plants. At present, a stakeholder dialogue and the development of guiding principles on hydropower generation and the EU WFD is under preparation at the ICPDR. The aim of this activity is to facilitate a dialogue between the hydropower and environmental sector in order to achieve a common understanding of the topic with the objective of developing common guiding principles on hydropower development and the EU WFD, as stated in the Danube Declaration 2010. The key challenge is to get the key players from water and energy sectors from all countries in the basin on board as active and broad participation is considered to be a prerequisite for achieving a joint understanding of challenges and for achieving a joint agreement. The main outcomes of this ICPDR activity will be a Status Report on Hydropower in the Danube region and Guiding Principles on Hydropower Development in the Danube region. As all FASRB signatories have also adopted the Danube Declaration, the guiding principles under development should be considered for application within ISRBC.

The recently published Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the European Union Strategy for the Danube Region is accompanied by an Action Plan, which includes actions and examples for projects to be implemented during the implementation of the strategy. Chapter 2 “To Encourage More Sustainable Energy” includes, inter alia, the following two measures directly addressing hydro power generation:

- “To develop a pre-planning mechanism for the allocation of suitable areas for new hydro power projects”. This pre-planning mechanism and its criteria would pave the way for new hydropower plants by identifying the best sites and balancing economic benefits and water protection. It should also take into account climate change impacts (e.g. lower or higher water levels). This should be based on a dialogue between the different competent authorities, stakeholders and NGOs. The licensing process could be streamlined in areas deemed suitable.

- "To develop a comprehensive action plan for the sustainable development of the hydropower generation potential of the Danube River and its tributaries (e.g. Sava, Tisza and Mura Rivers)". This plan would pave the way for the coordinated and sustainable development of new power stations in the future and the retrofitting of existing power stations such that the environmental impact and the impact on the transportation function of the rivers (navigation) is minimised. The options for using hydropower to respond to fluctuations in the electricity demand should be explored – using dams to maintain a high water level in preparation for the demand peak.

These activities which are part of the Danube Strategy will offer an important framework for ISRBC to achieve the goals regarding sustainable hydropower.

10.4 Agriculture

Agriculture is one of important cause of the deterioration of the status of water bodies according to the EU WFD. The pressure generated from the agricultural sector affects both surface and groundwater bodies in terms of quality and quantity. Water quality is negatively affected by the presence of pesticide residues, nutrients from fertilizers, and sediments from soil erosion. With regard to water quantity, on average, 44 % of total water abstraction in Europe is used for agriculture.

Changes to farming practices will take time to deliver environmental benefits, so action on improving agricultural management via regulatory, voluntary and incentive schemes must begin now in order to meet the EU WFD objectives. The EU WFD will have implications for farming practices and land management as well as water management. Farmers will need to manage their land carefully to meet the EU WFD requirements.

The pressures on water caused by agricultural practices are as follows:

- Pollution - a distinction can be made between point sources of pollution such as direct spillage from a farm slurry store into a river and diffuse sources such as the application of nitrogen and phosphorous or pesticides to agricultural land;
- Alterations of hydrological regimes - activities such as irrigation, drainage and land reclamation can cause the disturbance of the natural water balance or magnify the effects of pollution;
- Hydromorphological modification - the intensification of farming practices and inappropriate grazing regimes have contributed to the loss of wetlands and floodplains, resulting in hydromorphological modification of surface water. Such modifications aggravate various extreme events such as floods;
- Soil erosion - soil erosion and the delivery of contaminants to water influences the quality of surface water, groundwater, and freshwater ecosystems and human health. 52% of total P inputs are derived from erosion in some Danube basin countries according to the Danube River Basin Management Plan.

In the Sava River Basin the agricultural area comprises 42.36% of the total basin area. Of the 97,713,200 km^2 of the basin area, 6,162.43 km^2 (6.3%) comprises non-irrigated arable land; around 6% comprises pasture, 17% comprises complex cultivated areas, 12% comprises land primarily used for agriculture with significant areas of natural vegetation and 2% comprises natural grassland[20].

The most significant agricultural activities are, in order of importance: corn and wheat production, oil plant production (soy and sunflower), orchards and vineyards. Another major agricultural activity is livestock production, where small production units predominate, especially for cattle, pigs, sheep, goats and horses. Poultry production on the other hand is characterized by large-scale production units.

[20] Sava River Basin Analysis Report 2009.

The agricultural sector contributes around 11% of the total national exports of Croatia (1.4 billion of USD) and around 25% for Serbia (2.24 billion of USD). The Gross Value Added of agriculture in the total GDP of the Sava countries is 1.5% in Slovenia, 7% in Croatia, around 10% for Bosnia and Herzegovina and Montenegro and around 20% in Serbia. For the entire basin the value is 6%. Agriculture in total employs less than 4% of the working population in Bosnia and Herzegovina and around 24% in Serbia. For the entire basin the average is 11%.

More than 85% of the total agricultural area in the basin is owned by small farmers. The average size of the arable land of each owner is around 2 ha, the economic importance of the agricultural sector is high.

Livestock manure is rich in nutrients, especially nitrogen. The total number of livestock in the Sava countries is presented in Background paper No. 9 of the Sava RBMP. Since precise data on the number of animals per national share of the Sava River Basin is not available, the total number of livestock for a country was divided by the percentage of each country's territory which belongs to the Sava River Basin (SI – 52.8%, HR – 45.2%, BA – 75.8%, SR – 17.4% and ME – 49.6%) and then multiplied by the input numbers.

ANNEXES

Annex I: Land Cover classes

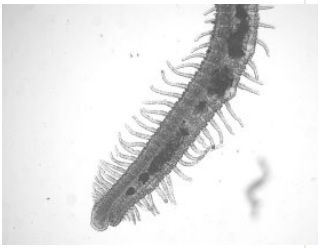
Table A.I-1: Comparison of land cover/use according to Corine 2000, 2006 and 2012

Land cover/use	1st Sava RBM Plan		2nd Sava RB Analysis			
	Corine 2000		Corine 2006 (v.18.5, dated 02/2016)		Corine 2012 (v.18.5, dated 02/2016)	
	Area (km^2)	Share (%)	Area (km^2)	Share (%)	Area (km^2)	Share (%)
Discontinuous urban fabric	1,708.65	1.75	1,906.62	1.96	1,913.93	1.96
Industrial or commercial units	169.31	0.17	197.15	0.20	203.48	0.21
Road and rail networks and associated land	27.48	0.03	48.13	0.05	56.39	0.06
Airports	32.19	0.03	35.47	0.04	35.96	0.04
Mineral extraction sites	133.71	0.14	114.76	0.12	127.06	0.13
Dump sites	20.02	0.02	27.41	0.03	27.42	0.03
Construction sites	8.16	0.01	12.46	0.01	12.80	0.01
Green urban areas	37.8	0.04	31.75	0.03	32.10	0.03
Sport and leisure facilities	24.68	0.03	33.51	0.03	34.31	0.04
Non-irrigated arable land	6,162.43	6.32	7,184.21	7.37	7,194.43	7.38
Permanently irrigated land	0.28	0	N/A	N/A	N/A	N/A
Vineyards	63.49	0.07	73.97	0.08	73.18	0.08
Fruit trees and berry plantations	123.9	0.13	90.76	0.09	99.08	0.10
Pastures	5,875.41	6.03	5,371.54	5.51	5,352.15	5.49
Complex cultivation patterns	16,990.64	17.43	15,981.22	16.40	15,981.99	16.40
Land principally occupied by agriculture, with significant areas of natural vegetation	12,068.44	12.38	11,512.23	11.81	11,476.41	11.78

Land cover/use	1st Sava RBM Plan		2nd Sava RB Analysis			
	Corine 2000		Corine 2006 (v.18.5, dated 02/2016)		Corine 2012 (v.18.5, dated 02/2016)	
	Area (km^2)	Share (%)	Area (km^2)	Share (%)	Area (km^2)	Share (%)
Broad-leaved forest	29,596.93	30.37	29,588.46	30.36	29,546.51	30.32
Coniferous forest	5,384.24	5.42	5,437.58	5.58	5,431.00	5.57
Mixed forest	9,376.86	9.62	9,760.86	10.01	9,758.85	10.01
Natural grasslands	23,636.11	2.38	2,588.12	2.66	2,589.98	2.66
Moors and heathland	295.41	0.3	182.82	0.19	182.83	0.19
Sclerophyllous vegetation	0.4	0	N/A	N/A	N/A	N/A
Transitional woodland-shrub	5,874.04	5.92	5,750.73	5.90	5,802.52	5.95
Beaches, dunes, sands	25.57	0.03	19.45	0.02	19.43	0.02
Bare rocks	200.37	0.21	218.34	0.22	218.41	0.22
Sparsely vegetated areas	449.5	0.46	564.26	0.58	564.37	0.58
Burnt areas	2.36	0	0.27	0.00	2.37	0.00
Glaciers and perpetual snow	0.34	0	0.36	0.00	0.36	0.00
Inland marshes	81.26	0.08	89.63	0.09	91.36	0.09
Water courses	375.62	0.39	376.24	0.39	377.96	0.39
Water bodies	233.88	0.24	255.56	0.26	247.10	0.25
Annual crops associated with permanent crops			0.79	0.00	0.79	0.00
Total	97,462.48	100	97,462.48	100	97,462.48	100

Annex II: Invasive species

Table A.II-1: Preliminary White, Gray and Black Lists of alien taxa for the Sava River

	Taxonomic group	Species	White	Gray	Black	Note	
1.	Turbellaria	*Dugesia tigrina*	X			Local and rare findings in the Sava River	
2.	Annelida	*Hypania invalida*	X			Recorded in the Sava River, but effects on native community, habitat and ecosystems are assessed as minor	
3.	Annelida	*Branchiura sowerbyi*	X			Recorded in the Sava River, but effects on native community, habitat and ecosystems are assessed as minor	
4.	Mollusca	*Corbicula fluminalis*	X			Local and rare findings in the Sava River	

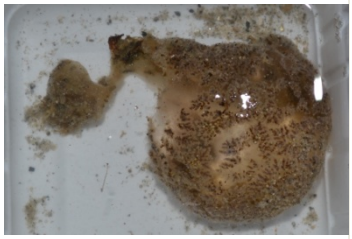
	Taxonomic group	Species	White	Gray	Black	Note	
5.	Mollusca	*Corbicula fluminea*			X		
6.	Mollusca	*Dreissena polymorpha*			X		
7.	Mollusca	*Sinanodonta woodiana*			X		
8.	Mollusca	*Physella acuta*	X				
9.	Crustacea	*Dikerogammarus villosus*			X		
10.	Crustaces	*Dikerogammarus haemobaphes*		X			

	Taxonomic group	Species	White	Gray	Black	Note	
11.	Crustacea	*Chelicorophium curvispinum*			X		
12.	Crustacea	*Chelicorophium robustum*		X			
13.	Crustacea	*Orconectes limosus*			X	Found only in the lower stretch, but spreading is expected	
14.	Crustacea	*Pacifastacus leniusculus*			X	Found only in the Corana River (Hudina et al. 2013), but spreading is expected	
15.	Fish	*Pseudorasbora parva*			X		
16.	Fish	*Hypophthalamichthys molitrix*			X		

	Taxonomic group	Species	White	Gray	Black	Note	
17.	Fish	*Ctenopheryngodon idella*			X		
18.	Fish	*Arstichthys nobilis*			X		
19.	Fish	*Oncorhynchus mykiss*			X		
20.		*Salvelinus fontinalis*	X				
21.	Fish	*Salvelinus alpinus*	X				
22.	Fish	*Ameiurus nebulosus*			X		
23.	Fish	*Ameiurus melas*			X		
24.	Fish	*Lepomis gibbosus*			X		

	Taxonomic group	Species	White	Gray	Black	Note	
25.	Fish	*Neogobius melanostomus*			X		
26.	Fish	*Neogobius gymnotrachelus*			X		
27.	Fish	*Neogobius fluviatilis*			X		
28.	Fish	*Neogobius kessleri*			X		
29.	Fish	*Perccottus glenii*			X		
30.	Fish	*Gasterosteus aculeatus*			X		

Table A.II-2: Potential invaders for the Sava River

	Taxonomic group	Species	Note	
1.	Bryozoa	*Pectinatella magnifica*	Highly invasive, found in the Danube side arm in 2011 (Szekeres et al. 2013) and recently spread along the significant stretch (Zorić et al. *in press*)	
2.	Mollusca	*Dreissena rostriformis bugensis*	Highly invasive, found in the Danube River (Graf et al. 2008)	
3.	Mollusca	*Potamopyrgus antipodarum*	Highly invasive, found in the Danube River (Graf et al. 2008)	
4.	Crustacea	*Eriocheir sinensis*	Highly invasive, found in the Danube River (Paunović et al. 2004)	

Annex III: Risk Assessment

Table A.III-1: Risk of chemical status for the Sava River per country

Chemical status		Not at risk	At risk	Unknown
SI	No of WBs	12	0	0
	Length of WBs	221.5	0.0	0.0
	Percentage	100%	0%	0%
HR	No of WBs	0	10	0
	Length of WBs	0.0	505.9	0.0
	Percentage	0%	100%	0%
BA	No of WBs	0	0	3
	Length of WBs	0.0	0.0	338.9
	Percentage	0%	0%	100%
RS	No of WBs	0	3	0
	Length of WBs	0.0	232.2	0.0
	Percentage	0%	100%	0%
Summary	No of WBs	12	13	3
	Length of WBs	222	738	339
	Percentage	17%	57%	26%

Table A.III-2: Risk of ecological status for the Sava River per country

Ecological status		Not at risk	At risk	Unknown
SI	No of WBs	5	7	0
	Length of WBs	90.6	130.9	0.0
	Percentage	41%	59%	0%
HR	No of WBs	1	9	0
	Length of WBs	9.5	496.4	0.0
	Percentage	2%	98%	0%
BA	No of WBs	0	0	3
	Length of WBs	0.0	0.0	338.9
	Percentage	0%	0%	100%
RS	No of WBs	0	3	0
	Length of WBs	0.0	232.2	0.0
	Percentage	0%	100%	0%
Summary	No of WBs	6	19	3
	Length of WBs	100	860	339
	Percentage	8%	66%	26%

Table A.III-3: Risk of organic pollution for the Sava River per country

Ecological status		Not at risk	At risk	Unknown
	No of WBs	10	2	0
	Length of WBs	187.4	34.2	0.0
SI	Percentage	85%	15%	0%
	No of WBs	8	2	0
	Length of WBs	412.2	93.7	0.0
HR	Percentage	81%	19%	0%
	No of WBs	0	0	3
	Length of WBs	0.0	0.0	338.9
BA	Percentage	0%	0%	100%
	No of WBs	2	1	0
	Length of WBs	105.8	126.4	0.0
RS	Percentage	46%	54%	0%
	No of WBs	20	5	3
	Length of WBs	705	254	339
Summary	Percentage	54%	20%	26%

Table A.III-4: Risk of hazardous substances pollution for the Sava River per country

Ecological status		Not at risk	At risk	Unknown
	No of WBs	12	0	0
	Length of WBs	221.6	0.0	0.0
SI	Percentage	100%	0%	0%
	No of WBs	0	10	0
	Length of WBs	0.0	505.9	0.0
HR	Percentage	0%	100%	0%
	No of WBs	0	0	3
	Length of WBs	0.0	0.0	338.9
BA	Percentage	0%	0%	100%
	No of WBs	2	1	0
	Length of WBs	105.8	126.4	0.0
RS	Percentage	46%	54%	0%
	No of WBs	14	11	3
	Length of WBs	327	632	339
Summary	Percentage	25%	49%	26%

Table A.III-5: Risk of nutrient pollution for the Sava River per country

Ecological status		Not at risk	At risk	Unknown
	No of WBs	11	1	0
	Length of WBs	195.8	25.7	0.0
SI	Percentage	88%	12%	0%
	No of WBs	8	2	0
	Length of WBs	434.8	71.1	0.0
HR	Percentage	86%	14%	0%
	No of WBs	0	0	3
	Length of WBs	0.0	0.0	338.9
BA	Percentage	0%	0%	100%
	No of WBs	0	3	0
	Length of WBs	0.0	232.2	0.0
RS	Percentage	0%	100%	0%
	No of WBs	19	6	3
	Length of WBs	631	329	339
Summary	Percentage	49%	25%	26%

Table A.III-6: Risk of hydromorphological alteration for the Sava River per country

Ecological status		Not at risk	At risk	Unknown
	No of WBs	7	5	0
	Length of WBs	133.4	88.1	0.0
SI	Percentage	60%	40%	0%
	No of WBs	2	8	0
	Length of WBs	14.1	491.8	0.0
HR	Percentage	3%	97%	0%
	No of WBs	0	3	0
	Length of WBs	0.0	338.9	0.0
BA	Percentage	0%	100%	0%
	No of WBs	0	0	3
	Length of WBs	0.0	0.0	232.2
RS	Percentage	0%	0%	100%
	No of WBs	9	16	3
	Length of WBs	148	919	232
Summary	Percentage	11%	71%	18%

Table A.III-7: Risk of chemical status for the Sava River tributaries per country

Chemical status		Not at risk	At risk	Unknown
SI	No of WBs	14	0	0
	Length of WBs	438.1	0.0	0.0
	Percentage	100%	0%	0%
HR	No of WBs	18	32	0
	Length of WBs	379.7	1,014.5	0.0
	Percentage	27%	73%	0%
BA	No of WBs	0	0	72
	Length of WBs	0.0	0.0	2,006.3
	Percentage	0%	0%	100%
RS	No of WBs	4	18	0
	Length of WBs	60.5	510.3	0.0
	Percentage	11%	89%	0%
ME	No of WBs	0	0	9
	Length of WBs	0.0	0.0	369.8
	Percentage	0%	0%	100%
Summary	No of WBs	36	50	81
	Length of WBs	878	1,525	2,376
	Percentage	18%	32%	50%

Table A.III-8: Risk of ecological status for the Sava River tributaries per country

Ecological status		Not at risk	At risk	Unknown
SI	No of WBs	10	4	0
	Length of WBs	357.9	80.2	0.0
	Percentage	82%	18%	0%
HR	No of WBs	20	30	0
	Length of WBs	727.6	666.6	0.0
	Percentage	52%	48%	0%
BA	No of WBs	0	0	72
	Length of WBs	0.0	0.0	2,006.3
	Percentage	0%	0%	100%
RS	No of WBs	3	19	0
	Length of WBs	61.3	509.5	0.0
	Percentage	11%	89%	0%
ME	No of WBs	0	0	9
	Length of WBs	0.0	0.0	369.8
	Percentage	0%	0%	100%
Summary	No of WBs	33	53	81
	Length of WBs	1,147	1,256	2,376
	Percentage	24%	26%	50%

Table A.III-9: Risk of organic pollution for the Sava River tributaries per country

Ecological status		Not at risk	At risk	Unknown
	No of WBs	14	0	0
	Length of WBs	438.1	0.0	0.0
SI	Percentage	100%	0%	0%
	No of WBs	32	18	0
	Length of WBs	978.2	416.0	0.0
HR	Percentage	70%	30%	0%
	No of WBs	0	0	72
	Length of WBs	0.0	0.0	2,006.3
BA	Percentage	0%	0%	100%
	No of WBs	10	12	0
	Length of WBs	336.8	234.0	0.0
RS	Percentage	59%	41%	0%
	No of WBs	0	0	9
ME	Length of WBs	0.0	0.0	369.8
	Percentage	0%	0%	100%
	No of WBs	56	30	81
	Length of WBs	1,753	650	2,376
Summary	Percentage	37%	14%	50%

Table A.III-10: Risk of hazardous substances pollution for the Sava River tributaries per country

Ecological status		Not at risk	At risk	Unknown
SI	No of WBs	14	0	0
	Length of WBs	438.1	0.0	0.0
	Percentage	100%	0%	0%
HR	No of WBs	18	32	0
	Length of WBs	379.7	1,014.5	0.0
	Percentage	27%	73%	0%
BA	No of WBs	0	0	72
	Length of WBs	0.0	0.0	2,006.3
	Percentage	0%	0%	100%
RS	No of WBs	4	18	0
	Length of WBs	60.5	510.3	0.0
	Percentage	11%	89%	0%
ME	No of WBs	0	0	9
	Length of WBs	0.0	0.0	369.8
	Percentage	0%	0%	100%
Summary	No of WBs	36	50	81
	Length of WBs	878	1,525	2,376
	Percentage	18%	32%	50%

Table A.III-11: Risk of nutrient pollution for the Sava River tributaries per country

Ecological status		Not at risk	At risk	Unknown
	No of WBs	13	1	0
	Length of WBs	433.5	4.6	0.0
SI	Percentage	99%	1%	0%
	No of WBs	24	26	0
	Length of WBs	809.2	585.0	0.0
HR	Percentage	58%	42%	0%
	No of WBs	0	0	72
	Length of WBs	0.0	0.0	2006.3
BA	Percentage	0%	0%	100%
	No of WBs	15	7	0
	Length of WBs	441.0	129.8	0.0
RS	Percentage	77%	23%	0%
	No of WBs	0	0	9
ME	Length of WBs	0.0	0.0	369.8
	Percentage	0%	0%	100%
	No of WBs	52	34	81
	Length of WBs	1,684	719	2,376
Summary	Percentage	35%	15%	50%

Table A.III-12: Risk of hydromorphological alteration for the Sava River tributaries per country

Ecological status		Not at risk	At risk	Unknown
	No of WBs	11	3	0
	Length of WBs	379.2	58.9	0.0
SI	Percentage	87%	13%	0%
	No of WBs	34	16	0
	Length of WBs	983.8	410.5	0.0
HR	Percentage	71%	29%	0%
	No of WBs	50	16	6
	Length of WBs	1,250.2	647.7	108.4
BA	Percentage	62%	32%	5%
	No of WBs	0	0	22
	Length of WBs	0.0	0.0	570.8
RS	Percentage	0%	0%	100%
	No of WBs	7	2	0
ME	Length of WBs	323.0	46.8	0.0
	Percentage	87%	13%	0%
	No of WBs	102	37	28
	Length of WBs	2,936	1,164	679
Summary	Percentage	61%	24%	14%

MAPS

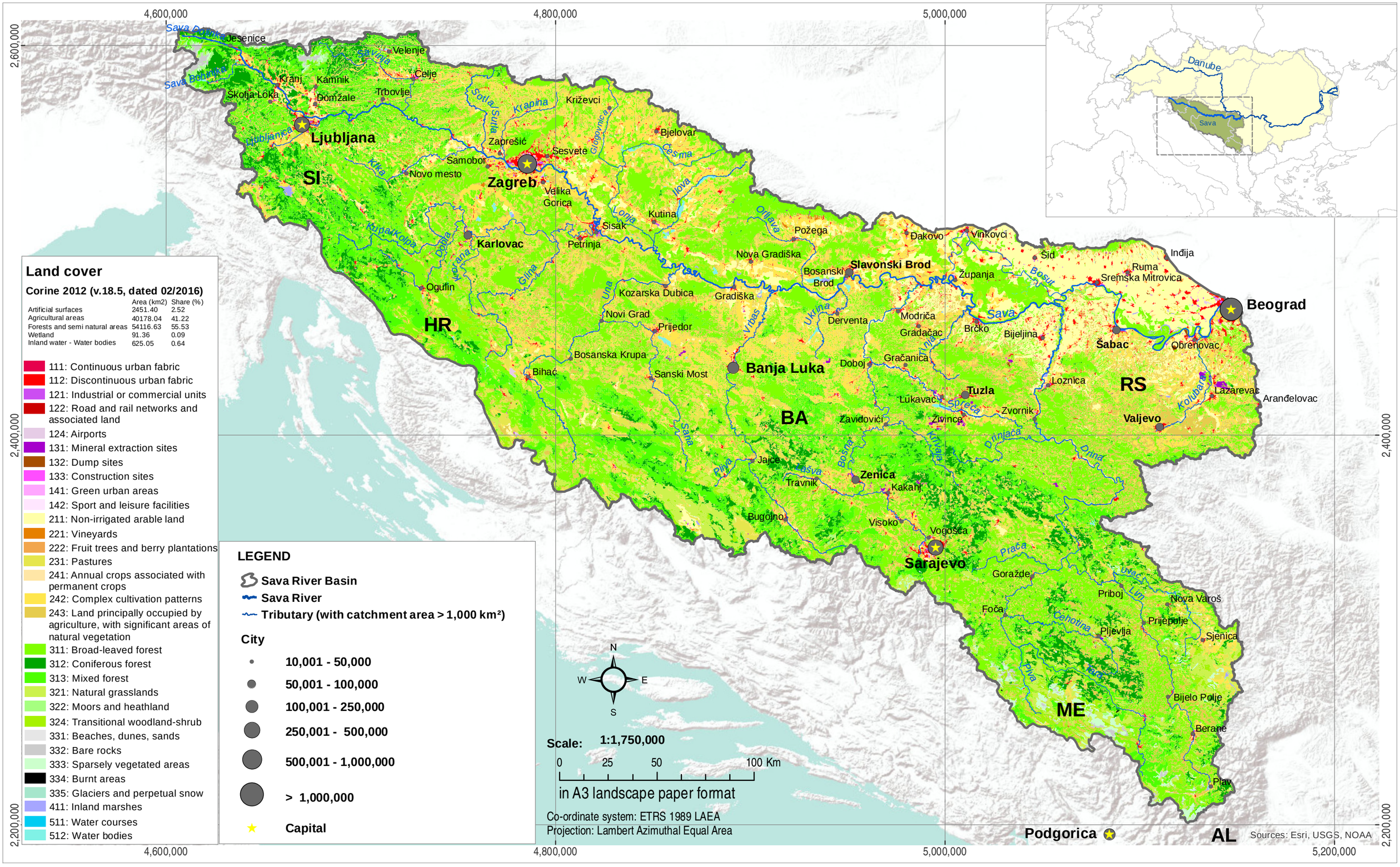
MAP 1: Sava River Basin Overview

INTERNATIONAL SAVA RIVER BASIN COMMISSION

This product is based on national information provided by the Parties to the FASRB (SI, HR, BA, RS) and ME.
The borders between the countries cooperating in preparation of the Sava River Basin Analysis have not been finally determined.
The content and maps of this report do not prejudice the determination or demarcation of the borders in any way.

2ND SAVA RIVER BASIN ANALYSIS
Processed and compiled by the Secretariat of the ISRBC, December 2016

MAP 2: Land Cover



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MAP 3: Ecoregions

INTERNATIONAL SAVA RIVER BASIN COMMISSION

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Processed and compiled by the Secretariat of the ISRBC, December 2016

MAP 4: Location and boundaries of surface water bodies

INTERNATIONAL SAVA RIVER BASIN COMMISSION

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MAP 5: Location and boundaries of ground water bodies

INTERNATIONAL SAVA RIVER BASIN COMMISSION

LEGEND

- Groundwater body
- Overlapping groundwater bodies
- VTPodV_1001 — National code for a groundwater body

Remark: codes of trans-boundary groundwater bodies are underlined on the map

Monitoring stations density

Chemical
- < 100 km² / station
- 100 - 500 km² / station
- > 500 km² / station
- No monitoring

Quantity
- < 50 km² / station
- 50 - 200 km² / station
- > 200 km² / station
- No monitoring

- Sava River Basin
- Sava River
- Tributary (with catchment area > 1,000 km²)
- State border

City
- 50,001 - 100,000
- 100,001 - 250,000
- 250,001 - 500,000
- 500,001 - 1,000,000
- > 1,000,000
- Capital

N W E S

Scale: 1:1,750,000

0 25 50 100 Km

in A3 landscape paper format

Co-ordinate system: ETRS 1989 LAEA
Projection: Lambert Azimuthal Equal Area

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MAP 6: Nutrient Pollution from point and diffuse sources – Nitrogen

INTERNATIONAL SAVA RIVER BASIN COMMISSION

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MAP 7: Nutrient Pollution from point and diffuse sources – Phosphorus

INTERNATIONAL SAVA RIVER BASIN COMMISSION

LEGEND

MONERIS 2015 (v.sava, dated 12/11/2015)

This map illustrates phosphorus emissions entering the surface water bodies from catchment areas. The emissions were calculated according to long-term average hydrological conditions over the period of 2009-2012 using the most recent available data within the same period.
Calculation was implemented using the MONERIS model.

Long term average (2009-2012) total phosphorusemissions (gP/ha/year)

- < 200
- 200 - 300
- 300 - 500
- 500 - 750
- 750 - 1.000
- 1.000 - 5.000
- > 5.000

- Sava River Basin
- Sava River
- Tributary (with catchment area > 1,000 km²)
- State border

City

- 50,001 - 100,000
- 100,001 - 250,000
- 250,001 - 500,000
- 500,001 - 1,000,000
- > 1,000,000
- Capital

N W E S

Scale: 1:1,750,000

0 25 50 100 Km

in A3 landscape paper format

Co-ordinate system: ETRS 1989 LAEA

Projection: Lambert Azimuthal Equal Area

Sources: Esri, USGS, NOAA

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MAP 8: River and habitat continuity interruptions

INTERNATIONAL SAVA RIVER BASIN COMMISSION

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MAP 9: Future infrastructure projects

INTERNATIONAL SAVA RIVER BASIN COMMISSION

LEGEND

Future Infrastructure Projects

- Hydropower
- Navigation
- Sava River Basin
- Sava River
- Tributary (with catchment area > 1,000 km²)
- State border

City

- 10,001 - 50,000
- 50,001 - 100,000
- 100,001 - 250,000
- 250,001 - 500,000
- 500,001 - 1,000,000
- > 1,000,000
- Capital

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MAP 10: Heavily modified surface water bodies

INTERNATIONAL SAVA RIVER BASIN COMMISSION

LEGEND

Heavily modified surface water bodies

- Natural
- Artificial
- Heavily Modified
- Unknown
- Virtual river segments

- **Sava River Basin**
- **Sava River**
- **Tributary (with catchment area > 1,000 km²)**
- **State border**

City

- **10,001 - 50,000**
- **50,001 - 100,000**
- **100,001 - 250,000**
- **250,001 - 500,000**
- **500,001 - 1,000,000**
- **> 1,000,000**
- **Capital**

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MAP 11: Surface water quality monitoring network

LEGEND

Surface water quality monitoring network

- Operational Monitoring stations (OM)
- Surveillance Monitoring stations (SM1*)
- Surveillance Monitoring stations (SM2**)

** Surveillance Monitoring 1 provides an assessment of the overall surface water status in the SRB*

*** Surveillance Monitoring 2 provides an assessment of long- term trends of specific pollutants and of loads of substances transferred downstream the Sava*

- **Sava River Basin**
- **Sava River**
- **Tributary (with catchment area > 1,000 km²)**
- **State border**

City

- **50,001 - 100,000**
- **100,001 - 250,000**
- **250,001 - 500,000**
- **500,001 - 1,000,000**
- **> 1,000,000**
- **Capital**

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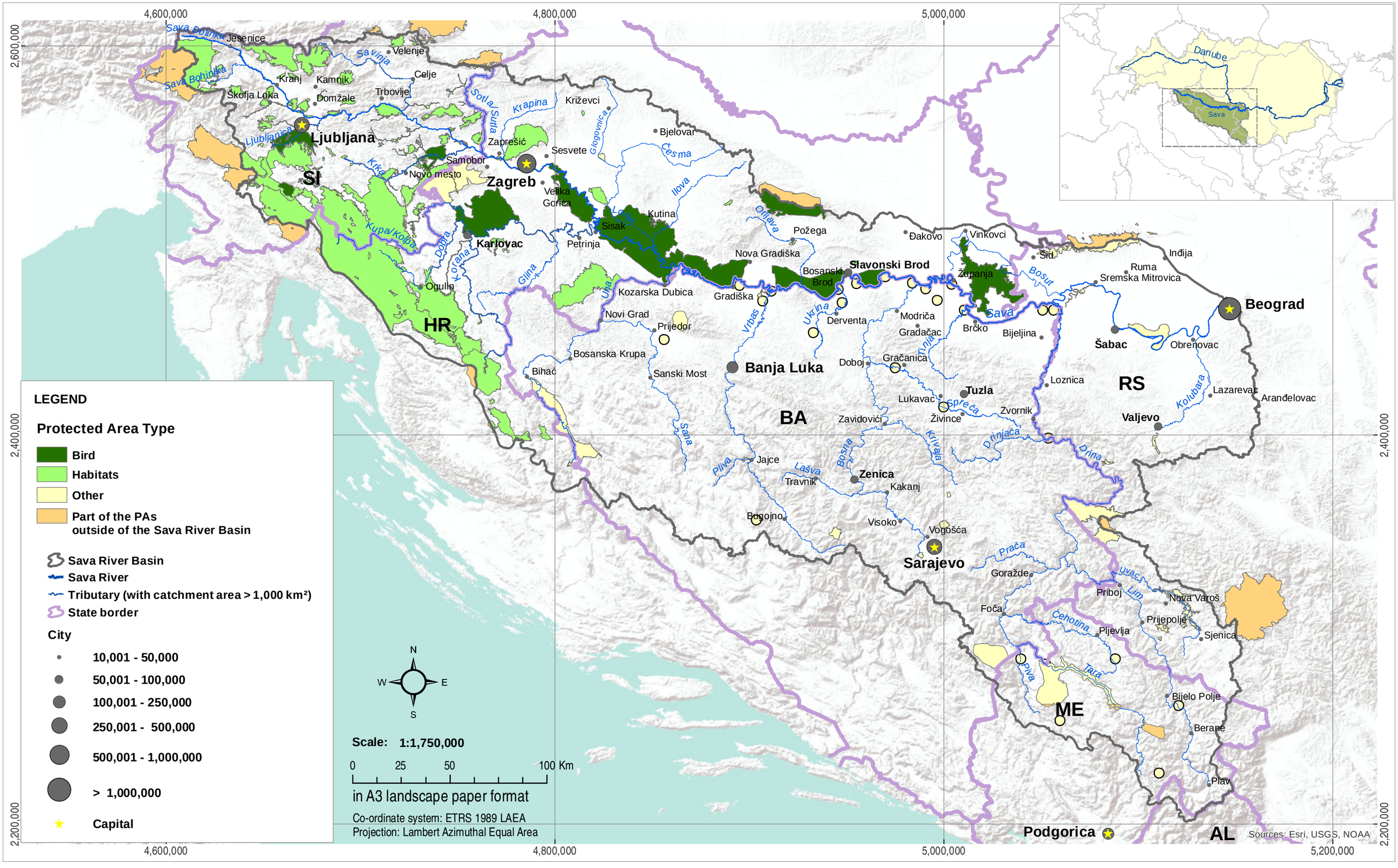
MAP 12: Protected areas

INTERNATIONAL SAVA RIVER BASIN COMMISSION



LEGEND

Protected Area Type

- Bird
- Habitats
- Other
- Part of the PAs outside of the Sava River Basin

- Sava River Basin
- Sava River
- Tributary (with catchment area > 1,000 km²)
- State border

City

- 10,001 - 50,000
- 50,001 - 100,000
- 100,001 - 250,000
- 250,001 - 500,000
- 500,001 - 1,000,000
- > 1,000,000
- Capital

N W E S

Scale: 1:1,750,000

0 25 50 100 Km

in A3 landscape paper format

Co-ordinate system: ETRS 1989 LAEA
Projection: Lambert Azimuthal Equal Area

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