



## WP1

# **Analysis of soil erosion state and torrential floods in Western Balkan Countries**

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## Contents

1. Introduction.....	4
2. Analysis state of torrential floods in Bosnia and Herzegovina .....	5
Status of the water resources.....	5
Historical evidence of floods .....	8
Preventions measures for torrential floods.....	10
Flood Risk Management Plans .....	13
Institutional and legal framework in the field of erosion and torrent control .....	15
Literature .....	18



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## 1. Introduction

The territory of Bosnia and Herzegovina (B&H) is predominantly hilly and mountainous, with a significant number of watercourses of different destruction power, as well as significant area affected by erosion processes of all types and intensities. This implies that there are all preconditions for creating new torrents and erosion sites. These preconditions are primarily influenced by the energy of relief, geological and soil characteristics, climatic conditions, as well as the land use and vegetation cover, which all together are creating favourable conditions for the appearance of strong erosion processes and torrential floods that make significant damages. There is hardly any economy branch in which soil erosion and watercourse processes did not cause damage in B&H over a past period of time. The effects are mainly manifested by sediments overflow of settlements, industrial facilities, road communications, reservoirs, hydromelioration systems, as well as negatively influencing water regime in rivers, causing floods withal sorts of consequences. In particular, it should be pointed out that the damage caused by erosion on forest and agricultural land results in a decrease in their production capacity. Loss of land often leads to the destruction of the upper soil horizons that are necessary for the production of food and raw materials for certain industrial branches. Considering all, it can be argued that soil erosion and torrential floods pose a great danger to the further economic and other development of the society.

On the state of erosion in the Socialistic Republic of B&H, the first significant data were given in 1971 by the engineers Sergije Lazarov and Vojislav Lubardić. According to their study, from the total area of the SR of B&H with erosion was affected 40,392 km<sup>2</sup> or 79%, while the total fertilization is 21,387,261 m<sup>3</sup> / year or 417 m<sup>3</sup> / km<sup>2</sup> per year. In total, 927 torrents were recorded, occupying 12,883 km<sup>2</sup> or 25% of the total area. Regarding the categories, 36 watercourses were placed in II category (where torrential watercourses also belong), 223 watercourses in III category, 545 watercourses in IV category and 123 torrents in V category.

The most complete depiction of erosion status in B&H has enabled the Map of Erosion of the Republic of B&H, made in the period 1979 - 1985. The preparation of the erosion map of the SR of B&H, from the preparation phase to the very end lasted from 1979 to 1985. Six years were spent for the field mapping and processing the collected data.

According to the data of the "Cadastre on torrential watercourses and erosion areas in B&H", there were 935 watercourses occupying area of 12,969 km<sup>2</sup> or 25.4% of the total area of B&H, registered and censored. According to the Map of Erosion of the SR B&H, the production of sediments amounts to 16.518.030,89 m<sup>3</sup> / year or 322.59 m<sup>3</sup> / km<sup>2</sup> / year, while the amount of sediments transport is 8.805.286,42 m<sup>3</sup> / year or 193.21 m<sup>3</sup> / km<sup>2</sup> / year. The biggest specific sediments losses have watersheds: Krka, Kupa, Ukrina, Butišnica, Glina do Glinice, Turija, Velika Usora to Mala Usora, Usora until the firth.



Unfortunately, significant amounts of data (e.g. Map on Soil Erosion of B&H) were destroyed during the Bosnian War (Witmer and O'Loughlin, 2009). Today B&H lacks reliable data and is behind on soil/land related research from the last century. The latest research on soil erosion in B&H dates from 1985, when a Map of Soil Erosion of B&H was developed by Lazarević (1985). Unfortunately, that map has not been updated and moreover, data disappeared during the conflict period in Bosnia (Tošić, 2007). Since 2004 parts of the soil erosion map were reconstructed, but only for the territory of Republic of Srpska (RS) (Tošić and Hrkalović, 2009; Tošić et al., 2012). Other entity, the Federation of Bosnia and Herzegovina (FB&H) has not done anything in this regard for the past period. However, based on the available information, preparatory actions for making the mapping soil erosion and creating the cadastre of torrential watercourses are being undertaken.

Efficient flood protection requires correct torrent watershed registration. So far, systematic application of non-invasive measures has been missing, which increases the risk of potential damages and losses. Particularly big problem is created with the expansion of the settlements in some river flooding areas. Damage protection can only be achieved by combining the application of all protection measures: legal-administrative, urban-planning, investment protection measures by building protection systems (passive protection measures), mitigation in accumulation and retentions (active protection), as well as strict application of noninvestment measures, in order to limit the increase and extent of potential damage.

## 2. Analysis state of torrential floods in Bosnia and Herzegovina

### Status of the water resources

Bosnia and Herzegovina is characterized by five types of climate: moderate continental (northern and central), pre-mountain, mountainous, Adriatic and altered Adriatic type. Based on the thirty-year series (1981-2010), the mean annual temperatures ranged between 1.6 °C (Bjelašnica) to 15.2 °C (Mostar). Average temperatures during the winter range from -6.0 °C to 6.2 °C and during the summer from 9.8 °C to 24.7 °C. For the whole area, the annual temperature rise is more than 1.5 °C in the north-western part (Banja Luka) (TNC Report, 2016). On the territory of B&H, annual rainfall is around 1250 l / m<sup>2</sup>. The annual precipitation varies from 792 l / m<sup>2</sup> in the north-eastern part (Semberija-Bijeljina) to 1.707 l / m<sup>2</sup> (Hercegovina-Trebinje). During the summer there is an evident decrease in precipitation. In the past two decades, the sum of annual seasons and the distribution of precipitation are very disturbed, which, with the rise of temperature, causes the problem of drought and flooding. The duration of the solar period (insolation) is on the rise. Average insolation, in the period 1961-2011, in Sarajevo is 1.806, Banja Luka 1.821 and the highest in Mostar is 2.377 hours.

The country is hydrographically both in the Black Sea and Adriatic Sea basins, with the Black Sea basin being 38,719 km<sup>2</sup> (75.7%), and the Adriatic coast 12,410 km<sup>2</sup> (24.3%).

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From the total water quantity, 722 m<sup>3</sup>/s gravitates to the Black Sea basin and 433 m<sup>3</sup>/s gravitates to the Adriatic Sea. Average annual precipitation amounts for the whole B&H are 1,250 l/m<sup>2</sup>. With an area of 51,197 km<sup>2</sup>, the total amount of rainwater is about 64 x 10<sup>9</sup> m<sup>3</sup>, *i.e.* the total drainage is 2,030 m<sup>3</sup>/s. The average runoff in the interior of B&H is 1,200 m<sup>3</sup>/s and the average runoff coefficient is 0,57 (FB&H Water Management Strategy 2010).



Figure 1. Main Basins in Bosnia and Herzegovina  
 (<https://www.fhmzbih.gov.ba/latinica/HIDRO/Hkarakteristike.php>)



According to the watershed areas in B&H, the state of torrential watercourses with all following watercourses is shown in Table 1.

Table 1. Torrential watercourses according to the data from the “Cadastre on torrential watercourses and erosion areas in Bosnia and Herzegovina”, from 1985.

No.	Main watershed area	No of watercourses	Surface of the watershed area (km <sup>2</sup> )	Surface of torrential watershed (km <sup>2</sup> )	% 5:4
1	2	3	4	5	6
1.	Una	96	8.185	1.301	15,8
2.	Vrbas	44	5.400	614	11,4
3.	Bosna	137	10.460	2.909	27,8
4.	Drina	291	7.200	2.546	35,4
5.	Neposredni sliv Save	81	5.029	1.536	30,5
6.	Neretva sa Trebišnjicom	237	11.535	3.782	32,8
7.	Cetina	49	3.320	281	8,8
8.	<b>B&amp;H</b>	<b>935</b>	<b>51.129</b>	<b>12.969</b>	<b>25,4</b>

Table 1 show that the largest number of registered watercourses is in the Drina river basin, followed by Neretva and the immediate Sava river basin.

Table 2. Characteristic indicators of watershed areas in B&H (Framework Water Management Basis of B&H, B&H, Public Utility “Vodoprivreda B&H”, Department of Water Management Sarajevo, Sarajevo 1994)

Basin/watershed	Basin/watershed area in B&H	Length of watercourses longer than 10 km	Specific average flow (q)
	km <sup>2</sup>	km	l/s/km <sup>2</sup>
DirectRiver Sava watershed	5.506	1.693,2	11,4
Una watershed	9.103	1.480,7	26,3
Vrbas watershed	6.386	1.096,3	20,7
Bosne watershed	10.457	2.321,9	15,6
Drina watershed	7.240	1.355,6	17,1
<b>In total Dunav basin</b>			
<b>Black Sea Basin</b>	<b>38.716</b>	<b>7.947,7</b>	<b>18,6</b>
Neretva& Trebišnjica watershed	8.200 + 1.630	886,8	39,7 + 52,5
Krka& Cetina watershed	2.300	177,0	13,5
<b>In totalAdriatic Sea Basin</b>	<b>12.130</b>	<b>1.063,8</b>	<b>34,9</b>
<b>In total B&amp;H</b>	<b>51.129</b>	<b>9.011,5</b>	<b>22,6</b>

In B&H, there are seven river basins cross-border with cantons, entities and other countries: Una and Sana, Vrbas, Bosnia, Drina, Sava, Neretva and Trebišnjica, and Krka and Cetina.



Table 3. Outbound indicators according to main basins/watersheds in B&H

River watershed	Surface of a watershed (km <sup>2</sup> )	Average flow Q <sub>sr</sub> (m <sup>3</sup> /s)	Specific flow q (L/s/km <sup>2</sup> )	Flow of small waters Q <sub>min.mjes. 95%</sub>
Direct River Sava watershed	5.506	63	11,4	1,5
Una watershed in B&H	9.103	240	26,3	41,9
Vrbas watershed	6.386	132	20,7	26,3
Bosne watershed	10.457	163	15,6	24,2
Drina watershed in B&H	7.240	124	17,1	24,1
<b>Black Sea Basin</b>	<b>38.716</b>	<b>722</b>	<b>18,6</b>	<b>118,0</b>
Neretva watershed	8.200	325	39,7	52,3
Trebišnjica watershed	1.630	85,6	52,5	4,2
Cetina watershed in B&H	2.300	31	13,5	1,8
<b>In total Adriatic Sea Basin</b>	<b>12.410</b>	<b>433</b>	<b>34,9</b>	<b>58,3</b>
<b>B&amp;H</b>	<b>51.129</b>	<b>1.155</b>	<b>22,6</b>	<b>176,3</b>

In B&H the specific medium runoff was 1.155 m<sup>3</sup>/s and minimum runoff was 176 m<sup>3</sup>/s (Table 4). Black Sea Basin, where the most of the population is living, was characterized with higher medium runoff, while Adriatic Sea Basin had higher minimum runoff.

Table 4. Specific runoff of medium and minimum level water in B&H (<https://www.fhmzbih.gov.ba/latinica/HIDRO/Hkarakteristike.php>)

Basin	Surface of the basin (km <sup>2</sup> )	Population number (from 1991)	Medium runoff			Minimum runoff		
			m <sup>3</sup> /s	l/s/km <sup>2</sup>	l/s/residence	m <sup>3</sup> /s	l/s/km <sup>2</sup>	l/s/residence
Black Sea	38.719	4.012.266	722	18	0,18	118	3	0,03
Adriatic Sea	12.410	515.360	433	35	0,84	58	4,7	0,11
B&H	51.129	4.527.626	1.155	23	0,25	176	3,5	0,04

## Historical evidence of floods

In B&H, the most severe flood events were recorded at the beginning of January 2010 at the Una, Sana, Vrbas and Bosna rivers. Major flooding in the Drina river basin was caused by extreme rain fall in Montenegro and part of Serbia's watersheds. The River Drina's flow, at the firth into the Sava River, was over 4.000 m<sup>3</sup> / s, which is the largest inflow recorded over the last 50 years (Floods in the Danube River Basin, 2010).



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The most extreme flood in the Sava River watershed occurred in May 2014 with a serious loss of human life, a significant damage to property, land, businesses and consequently economic loss. About 25% of average annual precipitation fell in just a few days.

Floods that have occurred in B&H in the middle of May 2014 have been the worst flooding events in the last 120 years. Disasters events had affected a quarter of the country's territory and around one million of people, accounting for approximately 27% of the total population of B&H from the total of 3.8 million. The total estimated economic damage amounts to more than 4 billion convertible marks or 15% of total gross domestic product of B&H in 2014.

According to the official data of the responsible entity institutions of the BD of B&H, in the floods of 2014, life lost 22 people, and 2 people were registered as missing. Damage to B&H is estimated at more than 2 billion EUR.

Table 5. Summary of major flood events in B&H, 2010-2015 (Source: Flood Prevention and Management, Gap analysis and needs assessment in the context of implementing the EU Floods Directive, September 2015)

Date	Affected areas, municipalities	Extent of damage
Dec.2010	River Drina catchment, Municipalities of Bosanska Krupa, Domaljevac - Šamac, Orašje, Tuzla, Maglaj, Goražde, Foča - Ustikolina, Pale - Prača, Ravno, Čitluk, Čapljina, Stolac, Mostar, Trnovo, Ilidža, Novi Grad, Tomislavgrad, Drvar, Trebinje, Bileća, Nevesinje, Foča, Novo Goražde, Bratunac, Zvornik, Bijeljina	<ul style="list-style-type: none"> <li>• 20,000 people affected, 5,000 houses flooded,</li> <li>• 6,000 people evacuated</li> </ul>
May 2014	Sava tributaries: Una, Sana, Vrbas, Vrbanja, Bosna and Drina and River Sava at Rača	<ul style="list-style-type: none"> <li>• Nearly 15% of GDP lost.</li> <li>• 13,200 km<sup>2</sup> flooded.</li> <li>• Over 1 million people in 46 municipalities affected.</li> <li>• 25 lives lost.</li> </ul>
Aug.2014	Northern and Western BiH. All areas along the Sava, Sava tributaries: Una, Vrbas, Banja Luka, Gračanica, Tuzla, Foča, Višegrad, Zvornik, Žepče, Lukavac, Zenica	<ul style="list-style-type: none"> <li>• Some 200 homes evacuated.</li> </ul>

Analysis of Damage and Flood Destruction 2014 in B&H (Information from the Ministry of Security of B&H):

- 73 municipalities (50%) in B&H were affected by floods,
- 100,000 homes were damaged or destroyed,
- 230 schools and hospitals were damaged or destroyed,

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- 66,080 persons were evacuated,
- 7.176 landslides were activated.
- total damage was estimated at EUR 2 billion.

## Preventions measures for torrential floods

Although there is a significant number of a registered torrential watercourse in B&H, we can freely say that this issue was almost neglected in the previous period. According to the available data on investment in this issue, it can be seen that some measures were taken to deal with the erosion areas and river watersheds, but they were not implemented at a satisfactory level.

Former activities in erosion and torrents protection on the territory of B&H were some work on riverbeds (about 87% of all works). Such activities were most often reconstructions and reparation at the places which were damaged the most during torrential floods. Biological measures were indeed very small although they were found as extremely useful for the state and society because they contribute to landscape quality and improve microclimatic conditions. Such measures were considerably less applied and they are amounted to only about 13% of the investment, with only about 10,000 ha of erosion areas treated for the whole territory of B&H. Such practices did not lead to the conservation and biological adaptation of the watersheds for solving the problem of erosion and therefore increasing land productive and economic functions.

Table 6. Summary of the performed anti-erosion measures in the watersheds at the territory of B&H (Republic of Srpska Water Framework Development Plan - Annex 3)

No.	Watershed	Implemented anti-erosion measures				
		River-bed (m <sup>3</sup> )	Afforestation (ha)	Grassing (ha)	Terracing (ha)	Other biological measures (ha)
1.	Sava – direct watershed	5.332	-	-	-	-
2.	Kupa	-	-	-	-	-
3.	Una	3.364	5	-	-	-
4.	Vrbas	7.977	3	-	-	-
5.	Ukrina	-	-	-	-	-
6.	Bosna	19.565	278	-	-	-
7.	Drina	25.982	109	-	-	-
8.	Krka	11.362	111	-	-	-
9.	Cetina	980	-	-	-	-
10.	Neretva	75.049	1.786	321	246	517
11.	Adriatic basin	7.402	-	-	-	-
	Total	157.013	2.292	321	246	517



Presented quantities of works were carried out on the territory of the whole of B&H and relate to the period up to the mentioned cadastre of torrential watercourses in B&H.

All estimates and projections of the required actions and measures at the global level of the watershed or wider area are formed on the basis of the erosion intensity and fluctuations in flows. The evaluation was done using the table from Gavrilović (1972), which defines the specific amount of required works depending on the average intensity of erosion on the river basin and type of torrent.

When it comes to the necessary investments to address this issue, there are estimates for the entity area of the RS (RS Water Framework Development Framework - Annex 3). The evaluation was also done according Gavrilović (1972). For the 178 watersheds in the RS, 123.545.461 EUR are planned, for each of the separate river watersheds, the estimated costs for a construction works (m<sup>3</sup> / km<sup>2</sup>) and reforestation (ha / km<sup>2</sup>) were calculated.

The average annual investment in the proposed action program amounts to around 6 million EUR annually (6,000,000 EUR / year). This sum encompasses about 4 million EUR for prevention measures (with projects), and 2 million EUR a year is foreseen for the repair of damaged structures and their maintenance. It is evident that 1/3 of the total annual costs are for rehabilitation and maintenance, which in the future if the planned plan will be implemented will have a positive effect on the optimum functioning of the prevention actions and already protection constructions against the torrential floods.

According to the above mentioned estimates, it is possible to conclude that for erosion protection measures it is necessary to have huge investments, because almost no work has been done on the construction of new systems in previous decades. Also, the existing systems were not maintained, they were most often neglected and most do not meet their basic function. However, if estimated financial investments are compared to damages and losses caused by the floods (significant damages are connected with torrential watercourse characters) for example to those that happened in 2014, it is obvious that such large investments are justified for the entire country.

Developing only updated maps of erosion and cadastre of torrent watercourses is not sufficient, it is necessary to create strategic - project documents (according to the RS Water Framework Development Plan - Annex 3), for example:

- Erosion maps of Republic of Srpska entity,
- Population cadastre of RS Entity,
- General, Idea and Main Projects for Proofing Works,
- Cadastre of constructed structures for preventing the regulation of river watersheds,
- Perform repairs to damaged facilities and complete biological and biotechnical works as one of the first activities in the construction of protection systems,



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- Construction of new facilities, technical, biotechnical and biological as a step to be followed by the repair of damaged and demolished anti-erosion facilities.

Within the same document, all the elements directly related to the strategic guidelines and priorities for protection against erosion and torrents have been elaborated in detail, and are reflected through:

- 1) Strategy for conservation, regulation and protection of land affected by erosion
  - Torrent watercourse control measurements;
  - Strategy for the erosion protection of the RS Territory with regard to water-power management.
  - Basic division of measures and actions for the regulation of river watersheds and erosion areas.
  - Concept of river watershed management.
- 2) The economic importance of watersheds management and bringing them into the state where they will meet their economic functions.
- 3) Priorities in management and protection measures in watersheds.
- 4) Financial investments in conservation systems and erosion protection.

For the entity of the FB&HB&H, there are no available estimates for financial investments, nor for the observed torrential watercourses. It is anticipated that such estimates, after creating erosion maps and mapping of torrent flows, will be done in the near future.

The issue of torrential floods and erosion processes in the FB&H water sector did not have the attention that it deserves. Correspondingly in the document "Water Management Strategy of the FB&H 2010 - 2022" the issue of torrential floods was superficially treated on only 3 pages, with mainly data on this issue from the "Framework Water Management Basis of B&H", i.e. the previously made "Cadastre on torrential watercourses and Erosion Areas in B&H ". As part of this document, there are no more detailed plans for carrying out measures on erosion areas and streams, instead it is stated that: "It is necessary to emphasize that the problem of erosion has to be approached more systematically and with high expertise because the dramatic negative consequences". It is difficult to ensure the stability of watersheds and regulation of lowland watercourses, without a holistic approach in water management planning.

One of the most important documents that has been done and directly deals with the problem of land erosion and bubbling basins is "Creating a Hazard Map and Flood Risk Map on the Vrbas River Basin in B&H", which directly addresses these issues through "Book 3 - Dissolution river basins and the formation of a susceptibility model for the occurrence and development of floods, with erosion map in the Vrbas river basin "dating from 2017.

Within this document, the following aspects were addressed:

- erosion status in the Vrbas watershed - map of erosion of the Vrbas watershed,

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- classification of river basins - Register - Cadastre of torrential watersheds
  - sensitivity model for appearance of torrential floods.

Based on the results obtained in this research, it is necessary to continue the follow-up activities in the area of preventive action on potential floods from torrential flows and erosion in the Vrbas River watershed. It is recommended to continue with the following targeted project activities:

- development of hydrological models for chosen watersheds - physically based - spatially - distributive flow models for chosen watersheds and calibration based on selected and well - recorded torrential flood events,
- establishment of monitoring (levels, flow rates and monitoring overflow sediments production) in selected torrential river watersheds (Pilot projects) – Recommendation is to select river Stojković watershed in the Lepenice (Poveliča), watercourse Jošavka in the Vrbanja watershed, Komotinski stream and the Sokolinski stream the first tribes of the Vrbas River,
- Using the obtained results, access the selection of pilot watersheds (Pilot projects), where urgent interventions of river watershed and riverbed will be taken to reduce the risk of next burial events (selection of the most critical points - hot spots), continue with development of sensitivity model for torrential floods occurrence based on field parameters, calibration and validation using monitoring parameters,
- initiate the preparation of project documentation for rehabilitation of river watersheds for the most important river basins,
- continue with mapping innovations for the Vrbas watershed and continue with the updating the cadastre of torrential floods for recommended intervals,
- make the results available to all relevant institutions in the Vrbas river watershed and provide expert interpretation of the results of this project to water sector first to the Public Utility “Vode Srpske” and Sava River Watershed Agency in Sarajevo, to the Vrbas River Watershed Office situated in Banja Luka in the Sava River Basin Region in RS and the Office the Vrbas River at the Sava River Water Agency in Jajce in the FB&H, the Republican Hydro meteorological Institute in Republika Srpska, the Federal Hydro meteorological Institute in the FB&H, the Civil Protection Units in the Vrbas, local communities and cantons in the Vrbas, and other relevant entities in whose jurisdiction it is water, protection against harmful effects of water, protection of people, material and cultural goods.

## **Flood Risk Management Plans**

Recommendations and measures to reduce flood risks are based on the Action Plan for Flood Protection and River Management in BiH for the period 2014 - 2017, which was adopted by the Council of Ministers of BiH. This Action Plan covers major problems and disadvantages (constructive and non-structural measures) related to flood risk

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management in BiH and establishes a strategic framework for coordinated action in this area.

The action plan addresses six key water protection measures together with urgency assessments and cost-pricing. Total estimated funds for the implementation of the Action Plan amounted to 303, 2 million EUR.

The measures implied:

- 1) Reparation of flood, erosion and torrential damage in 2014 on existing watercourses, river basins and canals in affected areas;
- 2) Harmonization of flood protection system in BiH with EU Directive 2007/60 / EC on flood risk assessment and management;
- 3) Development of technical solutions for flood protection, erosion and torrents for settlements and cities that did not have built water protection facilities and construction of new facilities
- 4) Establishment of hydrological forecasting system in BiH
- 5) Strengthening the capacities of the institutions responsible for water management and flood protection in BiH, ensuring an adequate level of coordination and cooperation with other institutions in BiH and ensuring adequate participation in the work of international bodies;
- 6) Water management.

In FB&H, methods of preparing for a flood risk management plan are prescribed by relevant decree on content of the Plan for Protection from Adverse Effects of Waters. Up to now, the FBiH Water Agency organized an elaboration through expert and research institutions for the preliminary flood risk assessment for categories I and II of watercourses in FBiH for a 6 year period and the development of a methodology for the development of hazard and risk maps (for the Rivers Bosna and Neretva, and for some stretches along the Rivers Una and Sana).

In RS, methods of preparing for a flood risk assessment are prescribed in the Action Plan for Sustainable Flood Risk Management in the Danube River Basin with applications on Sava sub river basin in RS 2010-2021, prepared by the International Commission for the Protection of the River Danube. The RS Water Agency organized the elaboration of a preliminary flood risk assessment for watercourses in RS for a 6 year period, which serves as a base for defining flood defence needs.

The system of measures and works prescribed is a complex of protective measures and methods directed to surface deforestation, protection of sloping land, increasing the fertility of eroded surfaces and eliminating erosion-causing reasons.

With the strategy, the conception of RS is clear as part of the state-wide program. The Strategy also foresees administrative bans for the purpose of a comprehensive fight against torrential erosion.

The Flood Risk Assessment is not prepared for the Brčko District (BD). In the BD of BiH, a new Draft Law on Waters of the BD BiH was prepared which is currently in the adoption procedure. The main operational plan for the flood defines of the BD BiH for

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the current year is made by the VBD, and it defines the organization, method and procedure for the defence from flood and ice in the area of BD.

## **Institutional and legal framework in the field of erosion and torrent control**

Complicated organization of the state of B&H has determined the organization in water sector and never the less protection against harmful effects of water. The division of the two entities and one district based on the peace agreement and the Constitution of B&H directly condenses the water management area.

The legal framework in the water sector is in line with the constitutional organization of the country and it is made up of: Annex IV of the General Framework Agreement for Peace in B&H - Constitution of B&H, Constitution of FB&H, Constitution of RS, BD Statute, laws and subordinate acts done at state level, entity level, cantons and municipalities. Directly competent water institutions are the entity ministries and the BD Water Management Department, which through the B&H Council of Ministers is communicating with other sectors (Figure 2).

Legislative framework related to the issue of protection against harmful effects of water and water management in accordance with the Water Framework Directive (WFD) is jurisdiction of the Entities and BD.

The Law on Waters ("Official Gazette of FBiH", No. 70/06) and a series of bylaws required for the implementation of this Law have been adopted in the FB&H. It regulates issues of integral water management in the FBiH, including water protection, water use, protection against water damage and water and other water management. The Water Act classifies all surface water into the water category I (FB&H is the owner of the public water supply of these waters) and water category II (where the owner of a public water asset is a city or municipality, unless otherwise specified by the cantonal regulation). At the canton level, water laws were adopted where the responsibility is transferred to this level of governance. Watercourses in II categories (where belong torrential watercourses) under the Water Act are within the competence of the Canton. The law regulates the issue of the institutional framework in the water sector in the FBiH and the financing of this activity, coordination with RS and BD in drafting water management plans for water areas, co-operation with RS bodies in issues of water authoring and water inspection and other issues. The cantonal water laws are part of the water management competence transferred to the municipalities in FB&H.



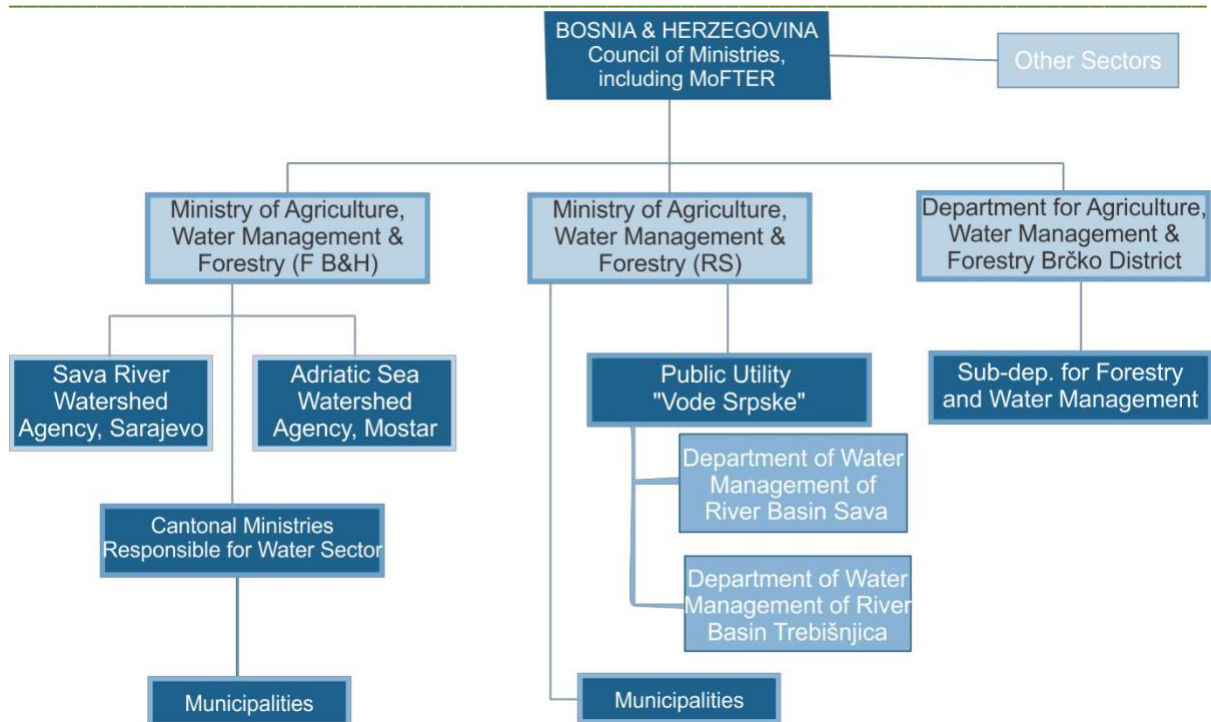


Figure 2. Government institutions and water related agencies in Bosnia and Herzegovina, HEIS 2016

The Law on Waters of the FB&H regulates the issue of water management plans for the Sava River Basin and the Adriatic Sea Basin as well as the implementation of measures and activities aimed at reducing or preventing the endangering of people and material goods against the harmful effects of water and eliminating the consequences of their action. Federal Ministry of Agriculture, Water Management and Forestry ("Official Gazette of the FB&H", No. 7/11) defines the method of implementing active flood and ice protection measures at the time of immediate danger from the occurrence of large ( flood) and eliminating the consequences of the flood. The Ordinance on the Types and Content of Water Protection Action Plans (Official Gazette FB&H, No. 26/09) stipulates the following:

1. Flood risk management plans, including a preliminary flood risk assessment, risk mapping and flood risk maps, in accordance with the provisions of the FPD, by 2017,
2. Plan for the implementation of the active flood defence measures under the competence of the FBiH issued by the relevant federal minister and plans for the implementation of active flood defence measures under the competence of the cantons issued by the competent cantonal ministers.

The Republika Srpska entity has issued the Water Act ("RS Official Gazette", No. 50/06, 92/09 and 121/12) as well as a series of bylaws needed to implement the law. The RS Water Law regulates the way of integrated water management in the RS territory, including water protection, water use, and protection against water damage, water

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management and other water bodies. This law regulates the institutional framework, the way of financing of activities, coordination with the FB&H in water management and other issues related to integrated water management. The Law gives the obligation to adopt management plans for the Sava River Basin and Trebišnjica River Basin.

The RS Flood Defence Plan (RS Official Gazette, No. 6/14) was adopted by the RS Government and it is a basic document for co-ordinating and implementing activities of importance for the protection and rescue of floods.

The Ministry of Agriculture, Forestry and Water Management issues the main operational flood protection plan for each year, and it defines the method of implementing active flood protection measures on constructed waterworks facilities at the time of immediate danger from the occurrence of large (flood) waters.

The Water Law (RS Official Gazette, No. 10/98) is applicable to the BD, as well as a series of bylaws required to implement the law. The Department of Agriculture, Forestry and Water Management of the BD Government authorizes registered and qualified companies to deal with flood protection in areas where there are flood protection structures, in accordance with the BD law.

The main operational plan for the flood defence of the BD B&H for the current year is made by the BD government, and it defines the organization, method and procedure for the defence of flood and ice in the area of BD.

The legal norms regulating the river watershed management system in the FB&H, RS and BD include, in addition to the Water Law provisions, and regulations from other sectors, including the Law on Environmental Protection, Physical Planning, Forests, agricultural land, financial regulations.

As it was already mentioned the legal transposition of the EU Water Framework Directive (WFD) was implemented in B&H by amending the Entity Water Act and the adoption of the FB&H Water Law (Official Gazette of FB&H No. 70/06) and RS Water Law (Official Gazette RS, No. 50/06 and 92/09). Entity Water Laws overruled the key WFD requirements. General legal practice, detailed regulatory tasks for the implementation of the Water Act must be established in secondary legislation. For this reason, detailed material provisions on assessment, monitoring and presentation of water status should be legally enforced in the form of subordinate legislation adopted by the entities and the BD. Relevant data from the progress report for FB&H / BiH in the period from May 2011 to March 2012 are listed in Table 7.



Table 7. EU Water Directive Review (Source: Ministry of Agriculture, Water Management and Forestry (FBIH), 2016).

Directive	Transposed
EU Directives in jurisdiction FMAWMF	
Water Framework Directive (Dir. 2000/60/EC)	91%
Groundwater Directive (Dir. 2006/118/EC)	3%
Floods Directive (Dir. 2007/60/EC)	71%

It is noteworthy that B&H Partner is an EFAS (European Flood Awareness System) system, which informs its partners about hydrological forecasts, and also about flood fluctuations. The EFAS system in BiH is FHMZ and RHMZ RS, while all Water Management Agencies are partners. Regarding the flood water streams (smaller and larger), for the moment, only the Federal Meteorological Institute informs about possible floods in the territory of FB&H.

Based on the EFAS platform and notifications sent to partners, FHMZ provides final information on possible floods and sends them to Civil Protection of the FB&H Water Agencies. According to information from FHMZ, so far it has been successful and about 50% of the announcements concerned flash floods. It should be noted that the EFAS platform, in addition to numerous hydrological models in BiH, is the only hydrological prognosis for buoyant flows.

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