Information for Western Balkan countries

Project title: Development of master curricula for natural disasters risk management in Western Balkan countries

Acronym: NatRisk

Project number:
573806-EPP-1-2016-1-RS-EPPKA2-CBHE-JP

Lead Organisation of work package 1: BOKU

Participating Organisation:
UNI, MU, KPA, UPKM, UNSA, VSUP, TCASU, UNIME, OE, UNID, RGU, TUC

Work package	Title
1	Analysis of natural disasters needed to be managed in Western Balkan region
Activity	Title
1.1	Report on natural disasters in WB

"This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein"

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1 Natural disasters in the Western Balkans

Information about natural disasters in Western Balkan regions is indispensable for developing master curricula for risk management in these countries. According to work package 1.1 (WP 1.1) a partnership between BOKU and all partners from the Western Balkans is foreseen to close the knowledge gap about natural disasters. In the following three sub-chapters information, which should be provided by the partners to BOKU, are described.

1.1 Identification of natural disasters

Analysis of natural disasters needed to be managed in Western Balkan countries should be delivered.

1.1.1 Types of extreme events

Natural disasters, which have occurred in Western Balkan countries, should be described qualitatively and/or quantitatively. Table 1 may assist to define the documented extreme events. Please outline any natural disasters that occurred in your country, also in case if any information of the following table are not available. The resulting data set should provide information as far as possible into the past. Comparable documentations, which have already been established in your countries, can also be used instead of Table 1.

Table 1: Identification of extreme events

Process type	Date	Catchment area / Region	Municipality	Fatalities	Overall losses (€)	Additional information
1.Geological disasters						
Landslides						
Svrake landslide	14.05.2014.	Sarajevo				
Kosova landslide	14.05.2014.	Maglaj				Regional road M17, Volume 500000 m^3
Željezno Polje landslide	14.05.2014.	Zepce				Occurred after heavy rainfall, landslide comined with surface erosion
Boškovići landslide	14.05.2014.	Zvornik				Landslide depth 3,0m to 8,0m; Area 0,113 km^2
Tičići Landslide	From 1970 - now	Kakanj				Soil creeping. Landslide includes the total length of 1600 meters with total width of 1000 meter
Kamberovića slope landslide		Zenica				Total landslide length : 550 m Total landslide width: 480 m Landslide depth: from 1,5 to 4,5 m

Hotonj - Poljine landslide area		Sarajevo				Total landslide length : 200 m Total landslide width: 60 m Landslide depth: from 1,0 to 4,0 m
Strupina Landslide	14.05.2014.	Maglaj				Near the regional road Žepče - Maglaj Near the stream Mlatoševički Slope inclination : α = from 5 to 8 [˚] Total landslide width: 300 m Landslide depth: from 3,0 to 10,0 m
Earthquakes	Date	Catchment area / Region	Fatalities		Overall losses (€)	
	07.04.1905	Petrovac, Monte negro				M=5,0; Io=7 o
	01.08.1907.	Pocitelj				M=5,7; Io=7 -8o
	25.12.1908.	Vlasenica				M=5,3; Io=6 -7o
	12.03.1916.	Bihac				M=5,0; Io=7o
	1923	Tihanija				M=6,5
	06.02.1923.	Jajce				M=5,0; Io=7o
	15.03.1923.	Imotski				M=6,2; Io=8-9o
	14.02.1927.	Ljubinje				M=6,0; Io=8o
	17.12.1940.	Derventa				M=5,1; Io=7o
	31.12.1950.	Drugovici				M=5,7; Io=8o
	11.06.1962	Tresavica				M=6,0; Io=8o
	07.03.1967.	Srebrenica				M=5,1; Io=7o
	27.10.1969.	**Banja Luka**	15 casualties and 1117 people have been severely injured.		$ Mill 50.000	**M=6,6; Io=9o**
	25.08.1970.	Gacko				M=5,0; Io=7o
	29.10.1974.	Lukavac				M=5,0; Io=7o
	06.01.1905	Krupanj (Serbia)				M=5,3; Io=7o
	08.10.1909.	Petrinja (Croatia)				M=6,0; Io=9o
	13.04.1964.	Slavonski Brod (Croatia)				M=5,7; Io=8o
	07.09.1970.	Knin (Croatia)				M=5,3; Io=8o
	15.04.1979.	**Ulcinj (Monte Negro)**	101 casualties and 100,000 people became homeless 1,487 objects were damaged, nearly half of which consisted of households and another forty percent consisting of churches and other sacred properties. Only thirty percent of the 1,487 objects damaged were destroyed.		$ 31 billion after inflation	**M=6,9; Io=5o**

2.Hydrological disasters						
Floods	**Date**	**Catchment area / Region**	**Municipality**	**Fatalities**	**Overall losses (€)**	**Additional information**
	April 2001.	Cantons: Posavina, Tuzla, Zenica-Doboj, Central Bosnia Canton	Orašje, Zenica, Doboj, Tuzla, Travnik	caused enormous damage to agriculture, on the buildings, equipment, roads and civil engineering structures and infrastructure	25.000.000,00	fell between 50 and 100 liters of water per 1 m^2
	March/April 2004.	Cantons: Central Bosnia Canton, Una-Sana Canton, Herzegovina-Neretva Canton			13.000.000,00	13.455,95 ha of agricultural area has been affected by the floods
	January/June /December 2010	Cantons: Tuzla Canton, Posavina Canton, Bosanian-Podrinje Canton, Zenica-Doboj Canton, Herzegovina-Neretva Canton			44.000.000,00	Considerable damage to material goods (housing, public utilities and other facilities, infrastructure facilities, and agricultural soil, etc.).
	April/May 2014.	Cantons: Zenica-Doboj Canton, Tuzla Canton, Posavina Canton, Sarajevo Canton, Una-Sana Canton, Central Bosnian Canton	45 municipalities in areas of these cantons.	Loses 5 human lifes caused enormous damage to agriculture, on the buildings, equipment, roads and civil engineering structures and infrastructure 29.131 citizens were temporarily evacuated and 8.358 animals died.	500.000.000,00	flow of Bosna River at the mouth was approximately 3,500 m^3/s (average annual flow at the site is 180 m^3/s), while on the Sava River on the section of Bosanski Samac - Orasje registered flows of 5,500 m^3/s and even up to 6,007 m^3/s (Average annual discharge at this stage is from 1000 to 1100 m^3/s)

3. Meteorological disasters						
Droughts	**Date**	**Catchment area / Region**	**Municipality**	**Fatalities**	**Overall losses (€)**	**Additional information**
	August 2000	South-East FBH Hercegovina				great damage to agriculture
	2003	South-East FBH Hercegovina			Over 200 mil	great damage to agriculture

	2007	South-East FBH Hercegovina				great damage to agriculture
	2011	South-East FBH Hercegovina				great damage to agriculture
	2012	South-East FBH Hercegovina			Over 600 mil	great damage to agriculture
	2013	South-East FBH Hercegovina				great damage to agriculture
	2015	South-East FBH Hercegovina			Over 400 mil	Duration: Over three months

4. Wild Fire

Wild Fire	**Date**	**Catchment area / Region**	**Municipality**	**Fatalities**	**Overall losses (€)**	**Additional information**
	16-17.02. 2017					
		USC (Una-Sana Canton)				
		Turija	City of Bihać	undergrowth	none	
		Zaradostovo	Bužim			
		Pivnice	Cazin			
		Podgredina				
		Veinac	Velika Kladuša			
		St. Omladinska	Bosanska Krupa			0,5 ha
		HNC (Herzegovina-Neretva Canton)				
		Raštani	City of Mostar	undergrowth	none	
		Kosor				
		Vrelo Radobolje				
		Lišani				
		Žovnica				
		Počitelj	Čapljina	undergrowth		
		Čeljevo		grass		
		Međugorje	Čitluk	Grass and undergrowth		
		G. Blatnici				
		K.Gradac				
		Gradinići				
		Markovac				
		Dobro selo				
		Pokojište	Konjic	grass		
		Donje selo				
		St. Kralja Tomislava	Rama	Grass and undergrowth		
		Memići and Etno selo Remić				
		Jaklić and Družinović				Due to the inaccessibility of

				Forest and undergrowth		the terrain firefighters did not intervene
		Menjik				
		BPC (Bosnian-Podrinje Canton)				
		Mravljača, MZ Vranići	Goražde	Grass and undergrowth		Cca 3000m²
		SC (Sarajevo Canton)				14 minor interventions on putting out grass and low-growing plants
		ZDC (Zenica-Doboj Canton)				
		Along the road M-17, close to BP"Almy" Zenica, and in places Janjac, Mošćanica, street Ivan Gundulia, Gornja Gračanica, village Drinjani, and street ulici Ivana Cankara	City of Zenica	Undergrowth and dry grass		
		Varda, Bare, Haljinići, City cemetery and Starposle	Kakanj	Undergrowth and dry grass		
		Tower Banjer, and location Taukčići	Visoko	Undergrowth and dry grass		5000m²
		Metilji, Local community Solun	Olovo	Undergrowth and dry grass	5000	3 ha
		CBC (Cental Bosnia Canton)				
		Slimena	Travnik	Grass		
		Baščeluci	Jajce	Undergrowth		
		Bijela voda	Kiseljak	Undergrowth		
	15-16.02. 2017					
		USC (Una-Sana Canton)				
		Gornji Mulalići	Bužim	Grass and undergrowth		
		Janjila	Bosanski Petrovac	Grass and undergrowth		
		HNC (Herzegovina-Neretva Canton)				
		Lišani	City of Mostar	Grass and undergrowth		
		Kolonija-Rodoč		Grass and undergrowth		

		Kruševo		Grass and undergrowth		
		Gubavica		Forest		
		Vrapčići		Grass and undergrowth		
		Šuškovo	Čapljina	Grass and undergrowth		
		Gabela polje		Grass		
		Bjelave		Undergrowth		
		Domanovići (Krč)		Forest		
		Bivolje polje		Grass and undergrowth		
		Krehin Grac	Čitluk	Grass and undergrowth		
		Podorašac	Konjic	Pine forest		
		Cerići		Forest and grass		
		Hodovo	Stolac	Grass and undergrowth		
		Baranami		Grass and undergrowth		
		Stolovi	Neum	Grass and undergrowth		
		St. Diva Grabovačka	Rama	Grass		
		BPC (Bosnian-Podrinje Canton)				
		Bare	Goražde	Grass		600m^2
		WHC (West Herzegovina Canton)				
		Bošnjakovo brdo	Široki Brijeg	Grass and undergrowth		
		SC (Sarajevo Canton)				
				Grass and undergrowth		6 minor interventions
		TC (Tuzla Canton)				
		Šljivice	Grad Tuzla	undergrowth		
		Straža	Srebrenik	undergrowth		
		ZDK				
		Blatuša	Grad Zenica	Grass and undergrowth		
		Poljice	Zavidovići	Hay		
		Tušnjići	Visoko	Grass and undergrowth		
		Haljinići-Bistrik, Bijelo Polje, street S.ef. Merdanovića (near the entrance gate of Cement factory), in the Nažbilj settlement	Kakanj	Grass and undergrowth		

		CBC (Central Bosnia Canton)				
		Nova Bila	Travnik	undergrowth		
		Dubrave		undergrowth		
		Kanton 10				
		Glavice	Livno	Grass		
		Bijele Grede		undergrowth		
		Oplećani, Lib above village Omolj, Crvenice, Grabovice and Roško Polje	City of Tomislav	Grass and undergrowth		
		Kupreško polje	Kupres	Grass		
	14-15.02. 2017					
		HNC (Herzegovina-Neretva Canton)				
		Raška Gora	City of Mostar	Grass and undergrowth		
		Slipčići		Grass and undergrowth		
		Svinjarina		Grass and undergrowth		
		Čeljevo	Čapljina	Grass and undergrowth		
		Jasoč-Smarlovina		Grass and undergrowth		
		Bivolje brdo		Grass and undergrowth		
		Ivanjuša		Forest and undergrowth		
		Hasića glavica		Forest and undergrowth		
		Blizanci	Čitluk	Grass and undergrowth		
		Čtluk		Grass and undergrowth		
		Šurmanci		Spruce and undergrowth		
		Međugorje (Krstine)		Grass and undergrowth		
		Vionica		Grass and undergrowth		
		Žuranj		Grass and undergrowth		
		Ošnjići	Stolac	Grass and undergrowth		
		Jančica		Grass and undergrowth		
		Draševo mauntain	Prozor - Rama	Grass and undergrowth		
		WHC (West Herzegovina Canton)				
		Gornja Briitvica	Široki Brijeg	Grass and forest		

		ZDC (Zenica-Doboj Canton)				
		Kanal	City of Zenica	Grass and undergrowth		
		CBC (Central Bosnia Canton)				
		Đelilovac-Turbe	Travnik	Grass and undergrowth and oak forest		
	13.-14.02. 2017					
		HNC (Herzegovina-Nertva Canton)				
		Vojno	City of Mostar	Grass and undergrowth		
		Bačevići		Grass and undergrowth		
		Blagaj		Grass and undergrowth		
		Sutina		Grass and undergrowth		
		WHC (West Herzegovina Canton)				
		Grabovik	Ljubuški	Grass and undergrowth		
	12.-13.02. 2017					
		HNC (Herzegovina-Neretva Canton)				
		Potoci	City of Mostar	Grass and undergrowth		
		Zijemlja		Grass and undergrowth		
		Vrapčići		Grass and undergrowth		
		Dračevice		Grass and undergrowth		
		Kobilovača		Grass and undergrowth		
		Djevor	Jablanica	Grass and undergrowth		
		TC (Tuzla Canton)				
		Gornja Tuzla	City of Tuzla	undergrowth		
		WHC (West Herzegovina Canton)				
		Vitina	Ljubuški	Grass and undergrowth		
		BPC (Bosnia-Podrinje Canton)				
		Kalac	Goražde	Grass		500m^2

For the period from 2008 to 2013, according to data which is provided by the cantonal administration of civil protection in its regular reports received by the Operational Centre of the

Federal civil protection the following is reported. However, this is just a preliminary data as a more precise data is given by the Ministry of Agriculture, Water Management and Forestry of the Federation of B&H in the next table.

Fires form 2008.to 2013.

Year	Number of fires			Burned areas in total	Fires in total	Total number of people		
	Open space	On structures	On vehicles			Dead	Injured	Evacuated
2008	830	313	76	1.288.64	1.217	4	5	0
2009	719	384	48	405.24	1.154	10	25	27
2010	1.038	311	64	390.35	1.411	7	9	7
2011	2.806	470	103	1.796.29	3.379	5	20	0
2012	5.324	534	117	41.717.81	5.975	4	14	0
2013	1.939	544	92	3.486,01	2.575	6	13	350
IN TOTAL	12.656	2.556	500	49.084,34	15.711	36	86	384

According to the Ministry of Agriculture, Water Management and Forestry of the Federation of B&H the data concerning wild fires as well as estimated damage in the period from 2007 to 2012 is as follows:

Year	No of fires	Fired area (ha)	Burned wood mass (m^3)	Burned number of seedlings (pieces)	Estimated damage (KM)	Note
2007.	932	13.742,00	40.017,00	32.644,00	4.787.131,50	
2008.	355	5.354,00	32.318,00	199.533,00	1.897.047,0	
2009.	190	1.396,00	1.954,00	132.576,00	560.538,50	
2010.	116	116,00	1.268,00	15.807,00	217.345,50	This is for 8 Cantons as HNC and WHC did not submit the data
2011.	682	6.609,91	6.893,94	23.778,00	2.523.579,50	This is for 9 Canton as HNC dod not submit the data
2012.	1082	43.317,20	831 488,00	710.990,00	23.876.550,50	Data from the Ministry of Agriculture, Water Management and Forestry of the Federation of B&H
2007. – 2012.	**3357**	**70.535,11**	**913.938,94**	**1.115.328,00**	**33.862.195,50**	
2008. – 2012.	**2425**	**56.793,11**	**873.921,94**	**1.082.684,00**	**29.075.061,00**	

If detailed information is not available, at least overall statistics about occurred natural hazards in your country should be provided. Additionally, if not any data have been published so far by governmental organizations, please get in touch with editors of local or regional newspapers or internet platforms. Media reports of natural disasters are common in case of emergency.

1.1.2 Photo documentation

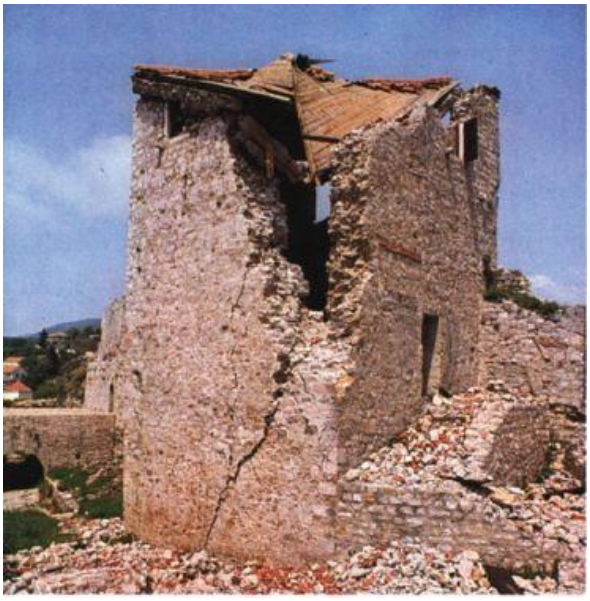
Photos of natural disasters might improve the understanding of different process types. Therefore, please provide a selection of pictures describing extreme events in your country.

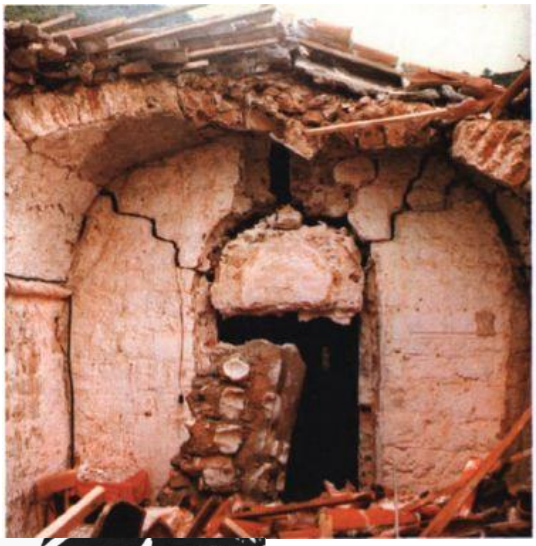
1.1.2.1 Earthquakes

Banja Luka earthquake-photos

Skopje earthquake-photos

Budva 15 sekundi nakon zemljotresa 15. April 1979. god.





1.1.2.2 Landslides

From the geological standpoint, many landslides in B&H appear to be related to the top soils and rarely to the failure of the underlying bedrocks. Areas consist of sandy clay, sandy silt soils and boulders are also affected by an increase of the pore water pressure (and subsequent reduction of the shear resistance). In many cases, these landslides in B&H are shallow and are observed on the relatively gentle slopes (typically less than 20 degrees) which often consist of thin layers of top soil and residual soils overlying weathered rocks. Many of these landslides can be classified into the "earth slide" or "earth flow" as per and "clayey soil slide".

In addition, "rotational slide" shown on Figures in the text or "weathered rock slide" and "colluviums deposit slide" are also occasionally observed in B&H .

Other factors such as suffusion, surface erosion and human factors can very often contribute to landslide occurrence.

Figure: Typical shallow „earth slide“ in B&H, creep movement is evident

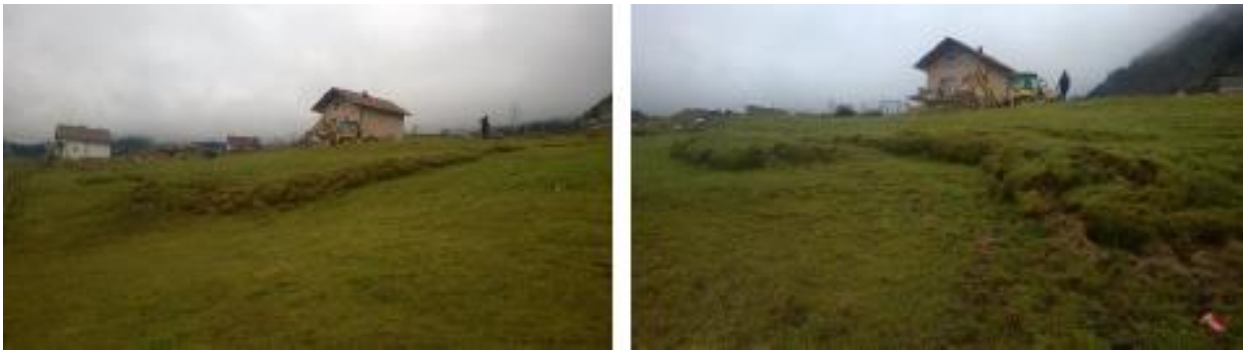


Figure: Typical shallow „earth slide“ observed after heavy rainfall

Figure: Typical „earth flow“ recorded during heavy rainfall events in May 2014

Figure: Rotational slide observed in B&H

Figure: Typical deformed shape of soil surface due to rotational and translational displacements

Figure: Typical shallow failure due to suffusion of soil particles (left) and damaged water supply system with uncontrolled irrigation of landslide area (right)

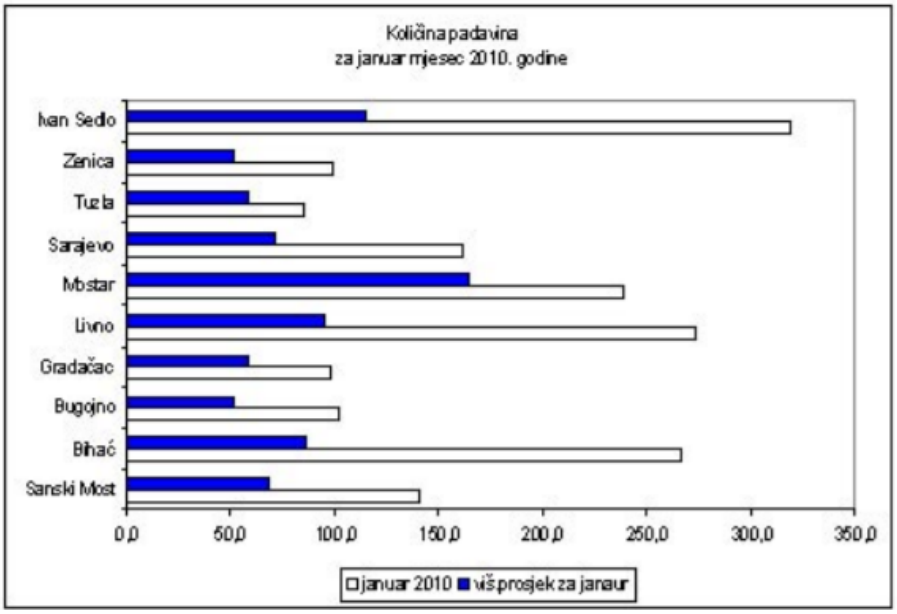
Figure: Examples of facility affected by landslide

1.1.2.3 Floods

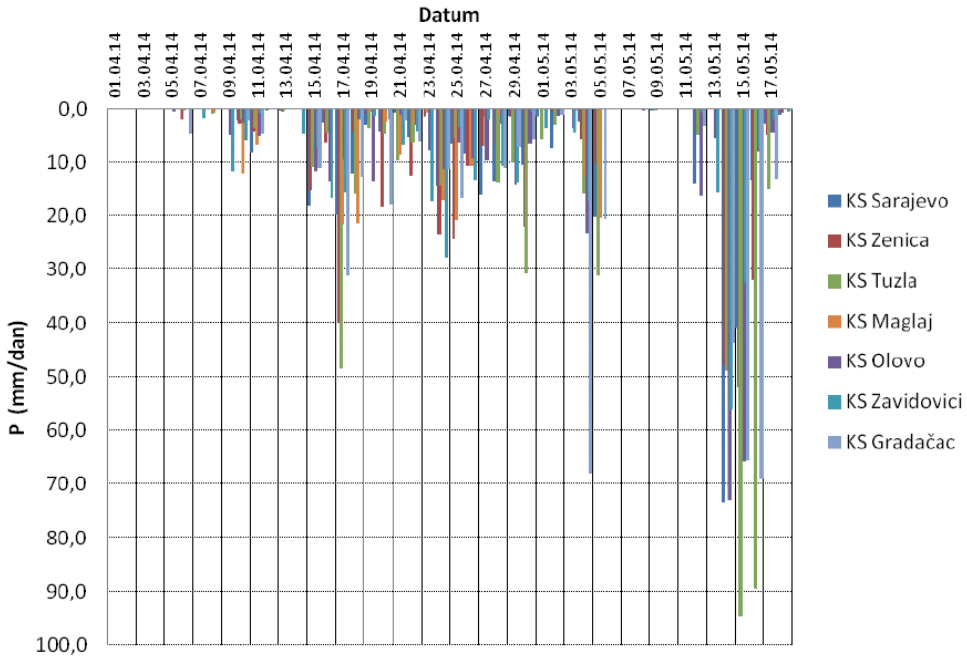
River Una, flood in 2001.

River Bosna, flood in 2010.

River Sana, flood in 2010.



January precipitation in 2010 compared average values for January (many years taken into account)



Showing the sum of daily values of rainfall on meteorological stations, 2014.

Topčić Polje May 2014. (up) and October 2014. (down)

The areas affected by floods in May 2014

1.1.2.4 Wild Fires

Forest fires are uncontrolled movements of uncontrolled fire on the forest area, and differ according to the type, method and origin of the damage.

Forest fires are one of the most common causes of intensive erosion processes occurring in the area of forests and forest soil, which leads to loss of fertile part of the soil as well as significant changes in physical-chemical properties of fertile part of the soil.

Geographical distribution of forest resources in Bosnia and Herzegovina is shown on a map.

Figure - Map of the geographical spread of forest resources in Bosnia and Herzegovina

Legend:

subtropical dry forest-yellow

temperate mountain forests- olive green

temperate continental forests- brown

Direct damages include loss of timber supplies, terrestrial vegetation and other forest products, and the cost of extinguishing the fire and rehabilitation.
Indirect damage includes a negative impact on beneficial functions of forests and is determined in a relative manner.
Figure down shows the distribution of forests in B&H and the spatial patterns of coniferous forests in the highlands, mixed forests at medium altitudes and broadleaved forests on low-level terrains and floodplains. (Forest Fire Country Studies, Produced by the Regional Fire Monitoring Center 2015).

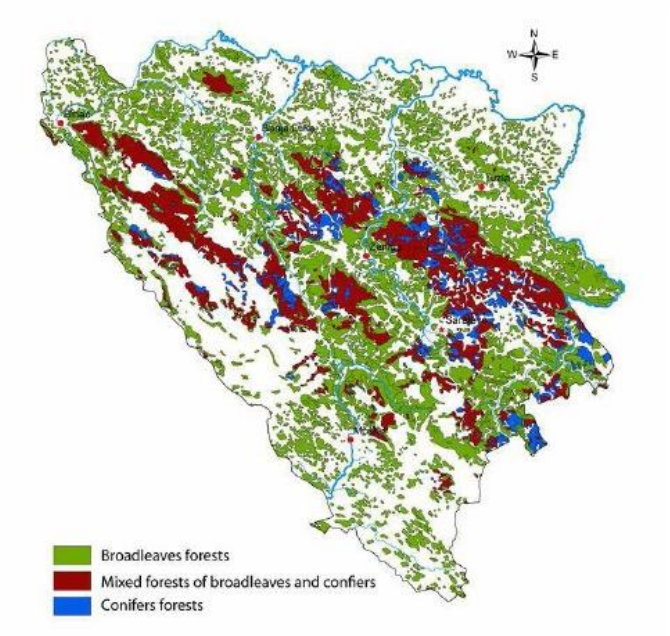


Figure - Distribution of forests in BiH

According to the 2006 categorization used by the European Environment Agency (EEA), the following categories of forests can be found in B&H: Category 4 – Acidophilous oak forests; Category 5 – Mesophytic deciduous forests; Category 6 – Beech forests; Category 7 – Mountainous beech forest; Category 8 – Thermophilous deciduous forests; Category 9 – Broadleaved evergreen forest; Category 10 – Coniferous forests of the Mediterranean, Anatolian and Macaronesian regions; Category 11 – Mire and swamp forests; and Category 12 – Floodplain forests.

Jablanica fire - 2013

Fire above Široki Brijeg - 2017

Fire of hay-2017

Fire in Trebevic, Sarajevo Canton, February 2017

1.1.2.5 Drought

Drought in Bosnia and Herzegovina during 2012

Drought in Bosnia and Herzegovina during 2013

Drought in Bosnia and Herzegovina during 2015

1.2 Analysis of risk management

1.2.1 Established practices for risk management

1.2.1.1 Geological disasters

1.2.1.1.1 Landslides

The topography of the central part of Bosnia and Herzegovina (B&H) features mountainous terrains with peaks ranging from 500 to 2000 m above sea level. Approximately 2,400,000 ha (or 48%) of the total land area is forested and the remaining about 2,700,000 ha (52%) are covered by agricultural lands (CPDR 2007). Due to the topographic characteristics as well as other natural

conditions such as torrential rainfall, landslides are continuous and well known hazards in B&H and represent complex and ever-increasing problems to communities and authorities at all levels. The risk assessment for B&H adopted by the Council of Ministers in 2012 has already registered a number of active landslides in the country.

The 1992 – 1995 war in the country also caused massive migration of people, linked with illegal construction of houses in the sloping areas or alongside riverbeds. In addition, lack of spatial planning documentation based on geological analysis leads to unsustainable territorial development and infrastructure investments, which in the long term also causes landslide hazards. Moreover, human activities relating to expansion on unsafe locations, unscientific mining, hazardous construction of roads, dams and ignoring natural features contribute to increased intensity of landslides. A torrential rainfall in the Balkan region in May 2014 caused extensive landslides and flood damage in B&H. A quarter of the B&H territory and approximately one million people which is equivalent to 27% of the country's population were affected by this disaster.

B&H terrain can be characterized by a miscellaneous and complex geological structure where different stratigraphic units of the Palaeozoic to Quaternary ages are found. The complexity is further increased due to a variety of lithological types of sedimentary, metamorphic and igneous rocks which are generally characterized by different degrees of weathering. Due to their variable physical and mechanical properties, these different rock massifs are subject to the process of decomposition and formation of clay and clay mixed with gravelly soils. The areas where top soil is deeper are potential areas for some geodynamic processes and phenomena including landslides. The stability map of FB&H is presented in the Figure down

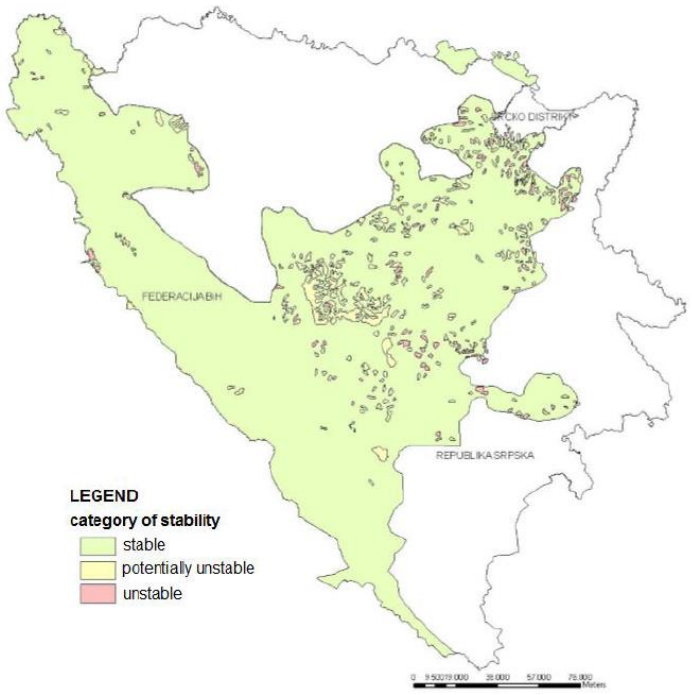


Figure: Stability map of FB&H (after Hrvatović)

Although majority FB&H lands are stable according to this map, considerable areas are also covered by potentially unstable materials. These potential unstable areas are often affected by

landslides due to human activities such as uncontrolled excavations, construction of facilities, uncontrolled drainage, uncontrolled agricultural development, etc.
To mange and mitigate the landslide risks, it is of importance to identify the causes of landslides. Causes of landslides are generally classified into the primary causes and the triggering causes. The primary causes are factors related to topography, geology, hydrogeology, etc. and the triggering causes include both natural and human activities such as heavy rainfall, snowmelt, earthquake, earthworks, etc.
The results of poll performed for 9 selected municipalities (UNDP, 2015) are given below

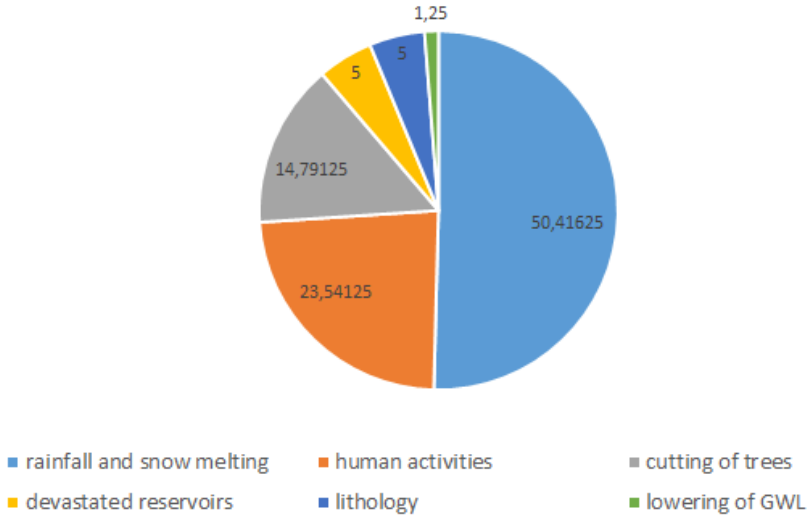


Figure: Landslide trigers (according to UNDP, 2015)

According to Custovic, approximately 83% of overall B&H land is located in the hilly area (300 to 500m above sea level), hilly or Mediterranean mountainous areas (500 to 700m above sea level) or mountainous area (more than 700m above sea level). In these areas, the soil is often shallow and groundwater table is high. These topographic and hydrogeological characteristics are considered to be one of the primary reasons of the high change of landslides in B&H.
The mean annual precipitation of hilly and mountainous areas in B&H ranges between 1500 and 2000mm (southern region) and about 1000mm (central region). Rainfall and/or combination of rainfall and snowmelt are one of the most common landslide triggers in B&H. Continuous heavy rainfall in mid May 2014 caused extensive landslides and flooding in B&H, Serbia and Croatia.
The prevention measures of landslide occurrence and risk mitigation may include but not limited to:

- Proper engineering is mandatory. There are a number of illegal constructions of houses in the landslide prone area. Construction activities without proper engineering assessment should be prohibited or restricted.
- Construction of earthworks for slopes should comply with the relevant standard or codes.
- Development of the landslide inventory system.
- The rating of the landslide risk could be developed as a function of the probability of the landslide occurrence and its consequences (finance, safety, environment, reputation, etc). This may be linked to the landslide inventory system to determine the urgency and the priority of the landslide remediation.
- The landslide inventory system could be also linked to other relevant legislations such as those associated with the development application system, planning control, building

regulation, deforestation, civil defense and emergency management, etc. so that the proposed activities within the landslide prone areas could be improved or restricted through proper engineering.

- Development of legislation such as "Landslide Prevention Law" which governs the landslide management and risk mitigations in B&H should be implemented.
- Many landslides in B&H are triggered by rainfalls. Monitoring of hourly rainfall should be undertaken. Warning systems based on rainfall data and/or ground displacement could be
- Utilized to minimize the landslide hazards. A statistical evaluation of rainfall and landslides could be utilized in establishing warning and evacuation control values.
- Excessive deforestation and inappropriate conversion of grass land to arable land should be restricted. Vegetation dries out the surface layers. Plant roots can also help stabilize slopes by anchoring a weak soil mass to fractures in bedrock, by crossing zones of weakness to more stable soil, and by providing long fibrous binders within a weak soil mass (Ziemer 1981).

Only few of listed prevention measures are included in local practices when considering risk management in B&H.

1.2.1.1.2 Earthquakes

The laws that are the basis for implementing the protection and rescue of people and property are:

- Law on protection and rescue of people and property in the event of natural or other disasters, "Official Gazette Federation of Bosnia and Herzegovina", no. 39/03, 22/06 and 43/10.
- Framework law on the protection and rescue of people and property in the event of natural or other disasters in Bosnia and Herzegovina (Official Gazette of Bosnia and Herzegovina 50/08)
- The methodology for the development of risk assessment of Bosnia and Herzegovina in the event of natural or other disasters (Official Gazette of Bosnia and Herzegovina 86/09)
- The law on jurisdiction of the authorities of the Sarajevo Canton in the field of protection and rescue of people and property in the event of natural or other disasters ("Official Gazette of the Sarajevo Canton 39/08")
- The Law on Amendments to the law on jurisdiction of the authorities of the Sarajevo Canton in the field of protection and rescue of people and property in the event of natural or other disasters ("Official Gazette of the Sarajevo Canton 19/11")
- Law amending the law on jurisdiction of the authorities of the Sarajevo Canton in the field of protection and rescue of people and property in the event of natural or other disasters ("Official Gazette of the Sarajevo Canton 45/15").

Assessment of natural disaster risk for B&H was done in 2012 and it represents the fundamental document which is used for development of the Protection plan and rescue of people and property in the event of natural or other disasters in Bosnia and Herzegovina and Programs for development of protection systems and rescue of institutions and authorities of B&H. This document is not final, and it, as any other document, represents a material that needs to be

updated dynamically. It is subject to changes, amendments, additions, upgrading. (http://www.msb.gov.ba/PDF/PROCJENA_UGRO%C5%BDENOSTI_BIH_07102013.pdf).
The plan of protection and rescue of people and property in the event of natural or other disasters of the institutes and bodies of B&H represents a framework for action regarding preparation, organization and implementation of protection and rescuing of people and property of institutes and bodies of B&H in the case of natural or other disasters. In the plan for protection and rescue the organization as well as the measures and means of conducting these protection and rescue measures are determined as well as tasks for institutes and bodies of B&H in the protection and rescue as well as forces and financial means required for fulfilling the tasks that are coming from the Framework Law ("Official Gazette" 50/08), Law on ministries and other administrative bodies of B&H ("Official Gazette"32/02, 5/03, 42/03, 26/04, 42/04, 45/06, 88/07, 35/09, 59/09 and 103/09), and other regulations that are dealing with the role and tasks of the institutes and bodies in the field of protection and rescue, as well as professional materials, international documents and practice. This plan gives guidelines for formation of protection plans and rescue at the entity level and Brcko District. The plan also aims to improve preparedness to natural or other disasters and to clarify the division of authority and responsibility in order to effectively protect people and property in the optimal use of resources. This plan actually is a practical information data and tool for coordination of risk reduction from natural or other disasters.
Assessment of risk was done for three cities Banja Luka, Grahovo and Ljubinje (Report done by Council of Ministers B&H in March 2011).

1.2.1.2 Hydrological disasters

1.2.1.2.1 Floods

- Water Law (FB&H Official Gazette No. 70/06)
- Law on rescue of people and material goods from natural and other disasters (FB&H Official Gazette No. 39/03, 29/06)
- Regulation on flood defense plans (FB&H Official Gazette No. 3/02)
- Regulation of the Federal headquarters of civil protection (FB&H Official Gazette No. 54/03)
- Regulation on the organization, content and implementation of measures for protection and rescue of people and material goods (FB&H Official Gazette No. 27/98)
- Regulation on types and contents of plans for protection from harmful effects of water
- The decision on the master plan of operational measures of flood control in 2007. (FB&H Official Gazette No. 18/07)
- • Federal operational plan of flood control (FB&H Official Gazette No. 07/11)

1.2.1.3 Meteorological disasters

1.2.1.3.1 Droughts

Drought monitoring in Bosnia and Herzegovina are carried out by two Hydrometeorological Servises in two entities: Federal Hydrometeorological Institute in Sarajevo (FHMI) and Republic of Srpska Hydrometeorological Institute in Banja Luka (RSHMI). Roles and responsibilities of the NHMSs in Bosnia and Herzegovina related to drought includes systematic observation and monitoring of hydrometeorological parameters; providing and publishing information, forecasts, products and services related to the weather, climate and water, provision of quality-assured historical and real-time hazard data; the derivation of drought-relevant parameters, indices and

indicators routinely collected data, and their comparison with past and expected values. Currently FHMI and RSHMI have their own separate meteorological and hydrological measurements, with the objective to monitor on entity level only (Figure down) Data (precipitation and temperature) are collected from the entities hydro-meteorological network that belong to Hydrometeorological services in Bosnia and Herzegovina and from another network of stations that belong to the Water Agencies. Regarding droughts, HMS's analyzes extreme weather conditions and produces drought maps, depending on user requirements, or for specific projects. Drought maps is based on calculations of SPI (Standardized Precipitation Index) on monthly basis. Also PDSI index should become operational in the near future. Drought indices have not officially been linked to drought impacts, whereas the different severity levels are given in Table.

Table. Definition of drought severity levels

Drought severity index	SPI	PDSI
Normal	0,49 < -0,49	0,49 < -0,49
Dry	-0,5<-0,99	-0,5< - 1,99
Moderate	-1<-1,49	-2<-2,99
Severe	-1,5<-1,99	-3< -3,99
Extreme	≤ -2	≤ -4

Figure. Network of meteorological stations in B&H

1.2.1.4 Wild Fire

In accordance with Article 26, item 3) of the Law on protection and rescue of people and material goods from natural and other disasters ("Official Gazette of the Federation B&H", Nos. 39/03, 22/06 and 43/10, hereinafter: Law on protection and Rescue) and article 13, item 2) of the Law on fire protection and fire service ("Official Gazette of B&H", No. 64/09, hereinafter: the Law on fire protection), and the Conclusion V. No. 1958 / 2014 from 06.11.2014 the Government of the Federation of Bosnia and Herzegovina, Federal Civil Protection Administration is in charge to

speed up the drafting of the Development Program for the next period, and submit it to the Government of the Federation of Bosnia and Herzegovina for acceptance.
Accordingly, the Federal Administration of Civil Protection at the end of 2015, took activities on the implementation of these conclusions, and in cooperation and with the participation of federal ministries and other organs of the Federation of Bosnia and Herzegovina, in accordance with Article 25, paragraph 1, item 2) Law on protection and rescue of people, produced a preliminary draft and draft development Program.

Law on fire protection and fire fighting
(http://www.civilnazastita.com.ba/propis/Zakon_pozar_vatrogastvo.pdf)
Extinguishing forest fires in Bosnia
(http://msb.gov.ba/PDF/STUDIJA_O_GASENJU_sPOZARA_U_BiH.pdf)
Law on forests http://fmpvs.gov.ba/upload_files/1444657237-ZOPrednacrt.pdf)

In Article 4, among other things, it states: Forest protection is a set of measures and activities that are required to take by the owners and users that manage forests for the protection of forests against fire, other natural disasters, pests, diseases and harmful anthropogenic impacts; in Article 94 , among other things, a creation of Rules is foreseen which is to regulate the content of plans for fire protection, data collection, keeping the register of forest fires, the conditions of using the data and the form in which the reports on forest fires referred to in Article 35, paragraph 9 of this Law;)

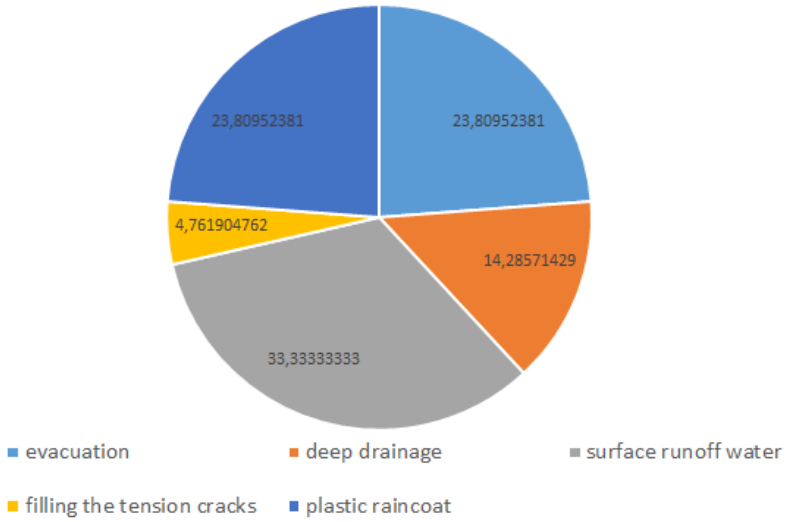
1.2.2 Assessment of risk management aspects

The objectives within this project include an assessment of the existing risk management in your country. Please outline advantages and disadvantages of the used strategies and point out any knowledge gaps.

1.2.2.1 Geological disasters

1.2.2.1.1 Landslides

There is no landslide risk matrix or risk rating system in B&H. The priority for remediation are given to landslides near infrastructure and facilities. In the case that landslide occurs, Civil protection usually performed some of the temporary remediation measures given by chart below:



It is interesting to note that the relation between number of landslides where only Emergency measures were done, to number of remediated landslides is 7:1 (UNDP, 2015)

1.2.2.1.2 Earthquakes

The civil protection was fully equipped with material and technical means as well as with the equipment needed for operation and action in the event of natural and other disasters until 1992. After the 1992 most of the material was stolen, destroyed or obsolete. Currently, civil protection, and organized and rescue forces **have negligible tangible assets and equipment in the form of hand tools and light handheld machines and appliances which are insufficient for the civil protection facilities to operate effectively in the protection and rescue actions in the resultant natural and other disasters**.

In the coming period it is necessary to plan adequate financial resources for purchasing and equipping the civil protection units **as well as training the personnel for protection and rescue** in accordance with the Law on Protection and Rescue.

The protection services are **not fully equipped and are lacking professional personnel**.

During the war activities (1992 - 1995), in the wider area of Bosnia and Herzegovina seismic stations were destroyed, and the installed instruments in the seismological center in Banja Luka, due to lack of maintenance, scarcity of spare parts and old equipment (30 years) are no longer feasible for quality use.

In order to reduce the consequences from earthquakes for people and property, it is necessary to take preventive measures that are to be implemented through regional and town planning of cantons and municipalities. In addition, it is necessary to apply the appropriate laws and regulations on the method of construction of residential, commercial, industrial and infrastructure facilities (roads, railways, water and sewage networks, etc.).

Taking into account the specific conditions of seismic areas, locations where structures are constructed and applying the fundamental principles of earthquake engineering in design can have a large impact on the reduction on the consequences due to the earthquake. Based on the existing situation it can easily be concluded that the existing composition of the housing stock and the concentration of buildings in certain areas does not provide the possibility for effective protection against earthquakes, except for buildings which were built according to modern-resistant structural systems in major cities: Sarajevo, Banja Luka, Tuzla, Mostar, Zenica, Doboj and etc.

Given the high seismicity of the territory of Bosnia and Herzegovina, and insufficient number of existing seismic stations and outdated seismic instruments, **it is necessary to modernize the network of seismic stations**, in order to conduct systemic registration, collection, analysis and study of seismic and seismic-tectonic events (natural and induced earthquakes, explosions and rock bursts), the study of seismicity, seismic activity and the frequency of earthquakes, as well as the definition of the seismic action effects of near source and far source earthquakes in the studied area and forecasting their impact on soil, water, water courses and facilities.

For the purpose of preventive measures to protect people and property from these kinds of natural disasters, it is necessary to draw up maps (earthquakes epicenters, seismic risk, maximum intensity), seismic, seismic-tectonic and other maps, necessary for spatial planning and seismic design and construction.

To evaluate the effects on people and property in the event of an earthquake on the territory of Bosnia and Herzegovina, it is necessary to have data regarding the structure of the housing stock and the entire infrastructure. So, in that respect it is necessary to make a database of all types of structures built in Bosnia and Herzegovina and conduct their risk assessment in order to qualify and quantify possible risks due to earthquake actions.

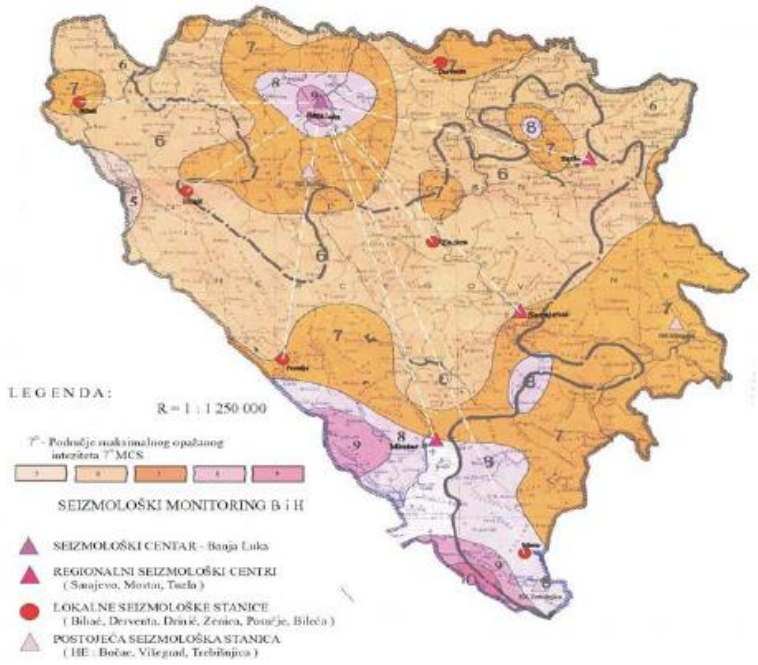
In order to increase the public awareness and public education for disaster risk reduction it is necessary to form a guide. As well create awareness among policy makers about the consequence of earthquake which is crucial for appropriate planning and prompt implementation. It is necessary to conduct talk programs, seminars, workshops and conferences in different levels in cooperation with Government of B&H and other stakeholders. It is necessary to share experiences among the professionals, developing national/international linkages with similar agencies, improve coordination mechanism among the stakeholders and keeping update with the recent global achievements in the field of earthquake risk reduction.

Incorporating Disaster Risk Reduction aspects in the higher educational curriculum, developing and examining the National Emergency Operation Centre (NEOC) and assisting the local Government for developing response and recovery plans, risk sensitive land use plans, bylaws, guidelines, which has ultimately helped the government stepping ahead for earthquake risk reduction and preparedness in the country.

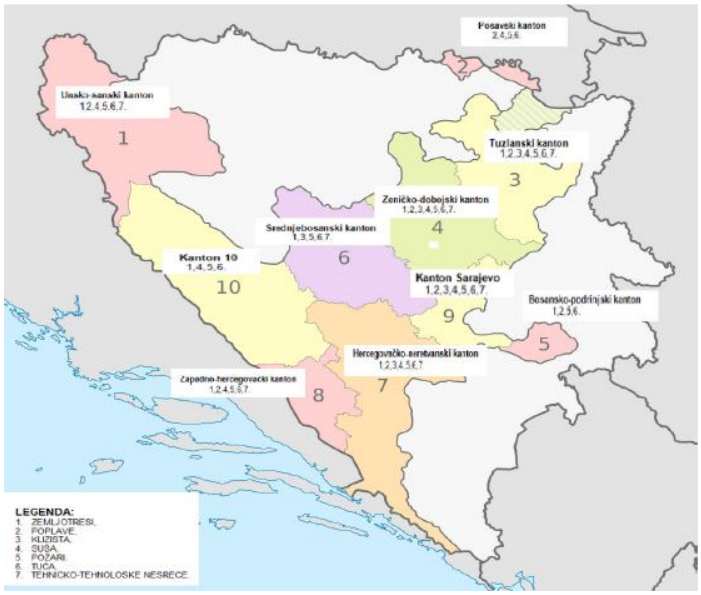
A development program for protection and rescue from natural and other disasters in the **Federation of Bosnia and Herzegovina for the period of seven years was developed in September 2016.**

On the basis of the assessment it was concluded that the existing building stock and concentration of the buildings in certain regions, illegal construction and landslides, due not offer a good possibility for effective protection against earthquakes, except for the structures that are built using modern design codes and regulations.

Measures and activities that are to reduce the earthquake list are stated. It is clearly stated that all Cantons (from 1 to 10) are subject to earthquake risk and dangers in all urban areas. The intensity of the earthquake being from 7, 8 and 9 MCS, special emphasis is given to the Cantons 7 and 8 (see map below).



Cantons and risks from natural disasters are indicated in the figure below:



LEGEND:
1. Earthquakes
2. Floods
3. Landslides
4. Draught
5. Fire
6. Hail
7. Technical and technological disasters

1.2.2.2 Hydrological disasters

Out of all extremes of climate parameters on the territory of Bosnia and Herzegovina the most devastating impact have floods and droughts. They have a devastating effect on agriculture of affected areas, water balance, and buildings, causing soil erosion, forest fires and others. The rainfall and precipitation regime one cannot influence, so far. However, we can implement measures to adapt to them, as well as mitigation measures that arise on this occasion. As far as the river flows, control measures should be taken to be within the limits of "iron" stated extremes. It should collect water when it has a surplus that could be used in periods when there is none. For example, around Sarajevo there are several smaller rivers in the mountainous region, where less potential evapotranspiration is possible, due to lower temperatures. Crna rijeka, Bijela rijeka, Misoča, Stavnja, Lepenica, Fojnica and tributaries are ideal for the construction of multi-purpose

systems from which water could be used for purposes of water supply, production of drinking water for the market (domestic and foreign), for irrigation, production of electrical energy, and others.

1.2.2.2.1 Floods

By entity laws of the Water (2006) have established two inter fully independent system of water management in B&H, complete division and independent management of these water resources state of Bosnia and Herzegovina - and that each share Entities and Brcko District

At the very beginning consideration of the situation in this complicated situation, it is important to give a general remark that water laws and related strategic plans, when the flood concerned, predominantly related to flood prevention. The laws on the protection of accidents and related strategic documents and plans are directed to the prevention, rescue phase and elimination of consequences of accidents, and therefore also flood.

When we talk about strategic and planning documents, it is important to note that for the implementation of measures for prevention of floods responsible entity ministries and agencies for water, while planning for the implementation of measures under the program plans to protect rescue people and property in simplified terms, competent: Sector protection and rescue Directorate at the Ministry of security, the entity, cantonal and municipal civil protection.

Flooding with catastrophic outcomes, especially from May 2014 indicate that the flood protection system is still incomplete and dysfunctional, and that in future all necessary strategic and planning documents in B&H make timely coordinated, concerted, and most importantly, all to achieve an integrated national and regional flood protection system, which guarantees to citizens greater security of life and property.

Unfortunately, new strategies, the analysis of the functionality of water management in B&H, on the analysis of the existing concept of civil protection in B&H, the analysis of all the problems that came to light in May 2014 on the issue of coordination in the rescue of people and goods during natural disasters in B&H (the development of new risk maps with marked zones of risk of natural disasters, the analysis allowed for the construction of residential buildings in places that are in the red zone past floods, the penalties for careless public institutions and individuals, etc.), the parliaments and governments of all levels of government in Bosnia and Herzegovina are still talking insufficiently, and the information and reports on these topics go unnoticed.

1.2.2.3 Meteorological disasters

1.2.2.3.1 Droughts

Drought is an insidious natural disaster, which has a significant impact on agriculture, water management, other economic activities, as well as human activity and the environment. In contrast to other natural disasters, drought occurs slowly, last long, and covers a large area, although its spatial distribution is not possible to accurately locate in advance. Before analyzing drought it is important to define what is meant by drought. For meteorologists those are periods with total rainfall well below average; in agriculture those are periods during which soil moisture is well below average and insufficient for the growth and development of agricultural crops, and for hydrologists it refers to small flows to rivers and extremely low water levels in the reservoirs that take a long time.

Drought can be divided into three groups:

- Meteorological - a large area created a significant shortage of rainfall compared to the

normal value for a specific area and time of year;
- Hydrological - characterized by a drop in water levels in lakes, rivers, and groundwater level decrease;
- Agricultural - appears in the growing season when the soil moisture and rainfall are insufficient to enable the plants normal growth and development. Due to intense evapotranspiration dried to the surface, and then the deeper layers of soil, causing water shortage in plants (different winter, spring, summer and autumn drought).

Drought can be displayed in two ways: via the quantity of water shortages in the soil in mm and through the relationship between actual and potential evapotranspiration (SET/PET) with the so-called coefficient of drought. The average annual water deficit in the soil in B&H is about 125 mm, with the largest in the southern parts (300 mm), considerably lower in northern (100 mm) and lowest in the central parts (50 mm). Agriculture must be protected not only from average droughts but also those that occur once a decade. Therefore, one must take into account the frequency of drought.

Highest coefficients (4.0) are in those areas (central) where the lowest average value is seen. On the other hand, the lowest coefficients (1.67) are in those regions (south) in which the average values are the highest. In considering the drought, atmospheric and soil drought are taken into account, using the water balance of the soil. This analysis included eight sites, and made the water balance of the soil for long periods of time (30 years), to show the difference between them.

The incidence of drought
The greatest risk of drought in Bosnia and Herzegovina is in the northeast and southwest. Namely, in the last 50 years 7 extremely dry periods were noted.

It was found that the strongest droughts occur in the Mostar area. In that part of B&H the catastrophic drought with annual soil water deficiency of over 400 mm was recorded in 1952. Very mild drought has Bihać area, or they are not present at all. Other locations are between these two.

Descending order of drought that occurs once every ten years would be as follows: Mostar > Bijeljina> Bosanski Brod> Tuzla> Sarajevo> Livno> Banja Luka> Bihać

Table: Annual water deficit in the soil in mm

	The scale of **intensity**					
	Annual soil water deficiency in mm					
	0	**1 -100**	**101 - 200**	**201 - 300**	**301 - 400**	**>**
Location	No drought	Very mild drought	Mild droughts	Severe drought	Very severe drought	Catastrophic drought
Bihać	17	10	3	0	0	0
Banja Luka	12	12	4	2	0	0
Bosanski Brod	4	8	13	5	0	0
Bijeljina	3	6	13	7	1	0
Tuzla	12	13	2	3	0	0
Livno	6	17	5	2	0	0
Sarajevo	8	11	10	1	0	0
Mostar	0	8	9	10	2	1

For agriculture are threatening droughts that occur during the growing season, due to a reduction or complete absence of yield, and are particularly dangerous to drought in the south of the country conducive to the spread of forest fires.

Depending on the climatic characteristics of climate, drought can occur in different seasons, and with varying intensity. In the Mediterranean climate drought may last for 5-6 months a year, and in the northern parts of the country and karst fields 3 months (August-October).
In the flat part of the country drought is less pronounced than in Herzegovina, while at least expressed in the mountainous part of Bosnia.

In the area of the northern Bosnia it was recorded, during the spring - summer 2003, the drought that was more intense than the one recorded in 2000. The lack of rainfall in the summer of 2003 caused hydrological drought, which is manifested by reducing the surface and deep water reserves.

Analysis of drought based on SPI index (standardized precipitation index) indicates an increase in dry years in the last decade. The main characteristic of SPI index is to be counted for different time intervals (1, 3, 6, 9, 12, 24 and 48 months). This diversity allows the SPI monitors short supplies of water (important for agriculture) and long-term water supplies that are associated with the flow of water in rivers, water levels in lakes and ground water wells (important for Hydrology). 2003 should be added to a series of years with extreme drought that occurred during the spring and summer.

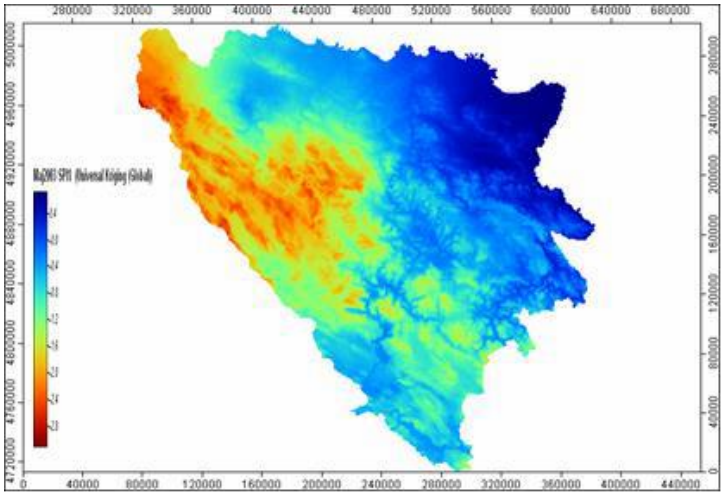


Figure: SPI 1 index for May 2003rd

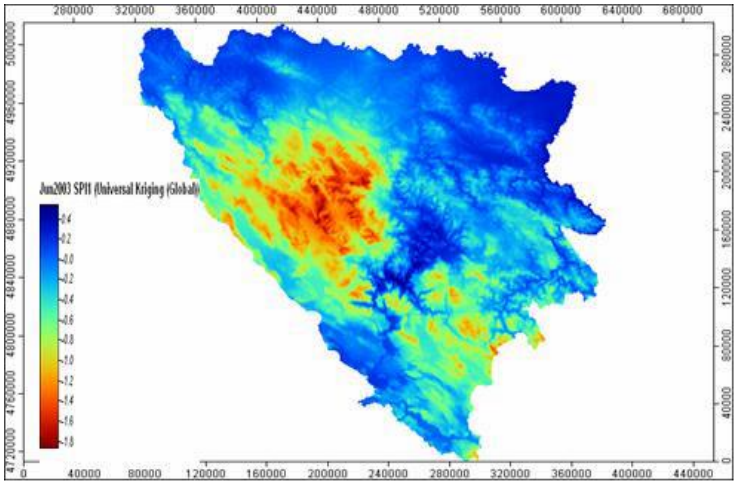


Figure : SPI 1 index for June 2003rd

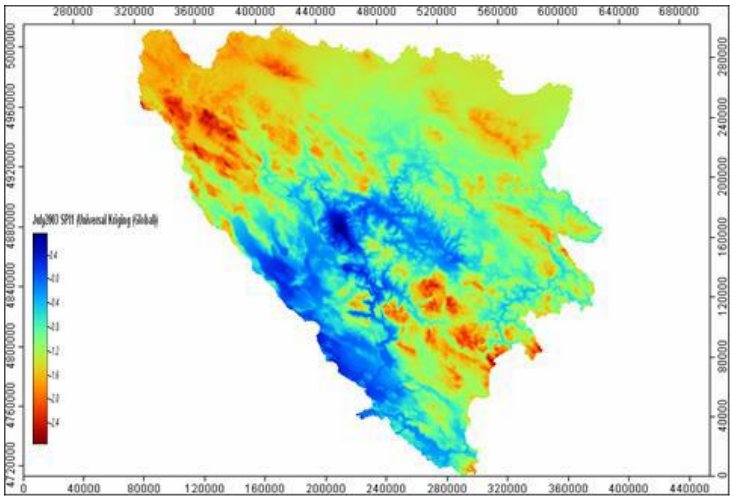


Figure : SPI 1 index for July 2003rd

Table: Average monthly deficit of precipitation P/PET for four town in BIH for periods 2001–2012 and 1961–1990, and diference wich shows increase of drought trend

1961-1990

	IV	V	VI	VII	VIII	IX
Bihać	2,18	1,29	0,95	0,82	0,96	1,42
Gradačac	1,35	0,99	0,82	0,65	0,63	0,80
Sarajevo	1,50	1,01	0,83	0,70	0,54	1,36
Mostar	2,21	0,88	0,59	0,28	0,41	1,43

2001-2012

	IV	V	VI	VII	VIII	IX
Bihać	1,79	1,13	0,78	0,51	0,73	2,00
Gradačac	1,17	0,74	0,86	0,48	0,42	0,89
Sarajevo	1,31	0,93	0,70	0,61	0,46	1,31
Mostar	1,87	0,73	0,47	0,26	0,34	1,33

DIFFERENCE

	IV	V	VI	VII	VIII	IX
Bihać	0,39	0,16	0,16	0,31	0,23	-0,58
Gradačac	0,18	0,25	-0,04	0,16	0,21	-0,09
Sarajevo	0,19	0,08	0,13	0,09	0,09	0,06
Mostar	0,35	0,15	0,12	0,02	0,07	0,10

Sub-humid zones 0,50<P/PET<0,65
Semi-arid zones 0,20<P/PET<0,50

(Note: Red color in Table are marking fields with positive difference, ie. it shows the decline of the index P / PET, or increase the dry trend in the period 2001-2012. compared to the period 1961-1990)

During the last decades in Bosnia and Herzegovina there were several drought years (2000, 2003, 2007, 2011, 2012): In August 2000, Bosnia and Herzegovina suffered from the worst drought in 120 years; about 60% of agricultural production was affected which resulted extremly food deficiency.

In summer 2003. more communities in B&H was hit by fourmonth drought which caused arround 200 million euro damages in agriculture and affected 200.000 people ”

In summer 2007. Extreme hight temperatures and drought destroyed more than 40% agricultural production and caused forest fires which affected about 250 ha

Also in 2012 we had prolonged drought period which caused damages from 1 bilion USD in agricultural production and 70% reduced grains and vegetable yealds. Reduced energy production from power plant for 25 %.

1.2.2.4 Wild Fire

Assessment of fire risk in their area, in the context of the Canton's risk assessment of natural and other disasters, was done by only three cantons (Una-Sana, Tuzla and Sarajevo Canton), while the fire safety plan for their area was done only by one canton (Tuzla canton). It is clear that this is still an open issue and something that has not been completed for the entire region of the Federation of B&H.

Going to a lower level, level of municipalities, assessment of fire risk in their area as part of risk assessment/municipality of natural and other disasters, from a total of 79 municipalities/towns in the Federation of Bosnia and Herzegovina, was done by only 25 municipalities (Bosanska Krupa, Domaljevac- Samac, Gracanica, Tuzla, Lancaster, Doboj Istok, Gradačac, Kalesija, Kladanj, Lukavac, Sapna, Srebrenik, Vares, Zavidovici, Zenica, Maglaj, Tesanj, Kakanj, Gorazde, Travnik, Travnik, Jablanica, Konjic, Hadzic, Stari Grad), while 12 municipalities (Bosanska Krupa, Gracanica, Tuzla, Gradacac, Kalesija, Vares, Zenica, Tešanj, Goražde, Jablanica, Stari Grad and Hadzici) issued a fire safety plan for their area.

In the last decade it has been almost impossible to carry out a good-quality analysis, mainly because statistical data on fires and burned areas are not collected in the same way in FB&H, RS and BD. Data submitted on fires in FB&H cover the fire seasons from 2008 to 2012. However, there is no precise information on the distribution of fires on the territory of FB&H, thus the data cannot be used to analyze the occurrence of fires.

There are no valid and official data for the main causes of forest fires in BiH, although unofficially the main cause is the human factor (in about 98 percent of all forest fires). (Forest Fire Suppression in Bosnia and Herzegovina, Sarajevo, 2014)

According to some unofficial sources, the main reasons for forest fires in BiH are agricultural burning (field clearing in spring and stubble burning in summer) and negligence when lighting fires in or near forests. There are some cases of arson, but these are not proved as there is no official investigation or court verdict. Lightning is a minor cause of forest fires (fewer than 2 percent of cases).

One of the main problems in B&H is the existence of areas contaminated by landmines. The current area contaminated by landmines is estimated at around 1,176.5 km2 or 2.3 percent of BiH territory, of which 129,774.6 ha or 10.5 percent are forests or forest land (The Legacy and Challenges of the Aerial Fighting of Wild Fires in Bosnia and Herzegovina Involving Land Mines, Zadar, 2015). This represents a particular problem for the implementation of the forest fire protection measures prescribed during forest management activities. In addition, it is almost impossible to organize forest fire suppression activities, from either the ground or the air.

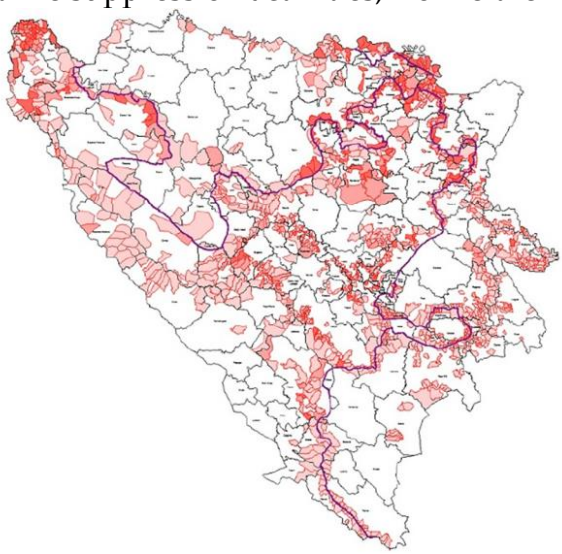


Figure - Distribution of mines The Forest Sector in Bosnia and Herzegovina, Regional Office for Europe and Central Asia of the Food and Agriculture Organization (FAO) of the United Nations, 2015

1.3 Analysis of responsible institutes

1.3.1.1 Geological disasters

1.3.1.1.1 Earthquakes and Landslides

Organization structure-State Level

The system for protection and rescue in B&H has its structures organized on different levels: state level, entity level, cantonal level, city level and municipality level. After the Framework Law on the protection and rescue of people and property in the event of natural or other disasters in Bosnia and Herzegovina has been enforced the responsibilities of different authorities and institutions of B&H was determined in the field of international cooperation, as well as international cooperation and coordination as well as cooperation and coordination with entity civil protection units and authorities in charge for civil protection of Brcko District. The jurisdiction of the institutes and bodies of B&H regarding systems for protection and rescue are very often separated between two or more institutions and on the state level the consist of:

1. Council of Ministers of B&H (CoM)

Pursuant to the Framework Law, the Council of Ministers of B&H on the state level manages the system of protection and rescue when natural and other disasters exceed the capacities of the authorities at the lower levels. The Council of Ministers declares the state of a natural or other disaster on a part or the whole territory of Bosnia and Herzegovina upon the proposal of the Coordination Body of Bosnia and Herzegovina of protection and rescue or under the request of the authorized entity or Brcko District, which had already declared a state of natural or other disasters.

CoM is responsible for establishing and Development Program of protection and rescue system at the level of the institutions and authorities of Bosnia and Herzegovina, and its submission to the Parliamentary Assembly for adoption. CoM brings the methodology for development of risk assessment of Bosnia and Herzegovina from natural or other disasters, Risk Assessment B&H and plan of protection and rescue from natural and other disasters institutions and bodies B&H. CoM decides on seeking international assistance for protection and rescue, and coordinates the implementation of standard operating procedures for its acceptance following the declaration of natural or other disasters. Additionally it also decides on the provision of international assistance in the event of natural or other disasters.

2. Coordination Body (CB) of B&H for protection and rescue

Coordination Body has the primary coordination role at the national level and coordinates the activities of protection and rescue in the whole territory of Bosnia and Herzegovina, while the lower levels are responsible for the management, which is in line with the Framework Law.

In accordance with the Framework Law, CB of B&H, at the request of a lower organizational level authority, proposes to the CoM to declare a state of natural or other disaster on the territory of Bosnia and Herzegovina, as well as the termination of such state. This provision indicates that the primary function of this body is coordination, and not a body that issues orders/commands which belongs to the authorities at the lower level.

This body coordinates the activities in the protection and rescue with the institutions and bodies of the entities and Brcko District (BD) and the institutions and bodies at the state level, after CoM declares a state of natural or other disaster on a part or the whole country. This body also coordinates the reception and delivery of international aid and donations in the protection and rescue, following the declaration of natural or other disasters. A significant segment of

jurisdiction of the coordination is within this body. This body monitors the implementation of the imposed measures and submits reports to the CoM on their activities. CB of B&H, if necessary, invites other institutions, bodies, agencies, organizations and experts on specific issues of interest for protection and rescue in B&H or abroad to participate in the work without the right to vote. Members of CB of B&H shall submit to the Ministry of Security information necessary for the operation of CB of B&H, if necessary, and at least once every three months.

3. Ministry of Security of B&H (MS)

This ministry as well coordinates the field of protection and rescue in Bosnia and Herzegovina. MS, through the Department for Protection and Rescue, performs professional and all other administrative tasks in the field of protection and rescue.

MS coordinates the activities, ie. coordinates activities and tasks of protection and rescue and the exchange of data, information and reports on conducted measures regarding protection and rescue. MS is also responsible for ensuring the implementation of the Framework Law and other regulations in the field of protection and rescue, pursuant to that Law. MS carries out the Security Policy of B&H within its jurisdiction.

MS in coordination with other members of the system for protection and rescue in Bosnia and Herzegovina is responsible for drafting and proposing a set of strategic and operational documents in the field of protection and rescue. This set of documents, among other things, refers to the development of the Program of protection and rescue, the Risk Assessment of Bosnia and Herzegovina, Protection and rescue plans, different by-laws on international cooperation especially giving and receiving of international assistance during disasters.

CoM on the proposal of the MS adopted the Guidelines for international coordination regarding receiving, sending and transit of international help for protection and rescue. MS, among other things, is responsible for the implementation of international cooperation in this field as well as procedures for communication between the institutions and bodies of Bosnia and Herzegovina and the institutions and bodies in B&H with the entities in the event of natural or other disasters, as well as the procedures for providing information to the public.

Very important segment of the jurisdiction is the request from the Ministry of Defense for engagement of the Armed Forces of B&H in case of natural or other disasters, following the exhaustion of available civilian resources to respond in such events.

MS provides working conditions for the CB B&H and performs professional and administrative tasks for the needs of the body.

3.1 Operation and Communication Center - 112

With the aim for permanent collection of data on all types of phenomenon and dangers that can lead to natural or other disaster, the CoM within MS has established the Operation and Communication Center - 112. The obligation to form such a center arises from Directive 2002/22/EC and other mechanisms the Council and the Parliament of the European Union aimed at strengthening the capacities of systems for civil protection of the Member States of the European Union.

4 Ministry of Defense of B&H (MD)

In the event of natural or other disasters of large scale, when civil structures for protection and rescue with their forces, resources and capacities are not able to provide an adequate response the Armed Forces of B&H (AF) are involved. B&H Presidency at the request of civilian authorities responsible for rescuing people and property in the event of natural and other disasters brings the Decision on the implementation of activities for engaging the Armed Forces of B&H. MS B&H on the basis of the stated procedures in charge of receiving requests from the entity governments

and BD authorities in case of need for the assistance of the Armed Forces in connection with natural or other disasters. After receiving the request, the MS performs a procedure that will ensure the continued engagement of the AF of B&H. Engaging AF of B&H to assist civil authorities in responding to natural or other disasters is carried out in accordance with the Law on Defense of Bosnia and Herzegovina (B&H Official Gazette, 88/05).

5 Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (MFTER)

Ministry of Foreign Trade and Economic Relations within its jurisdiction at the state level has certain responsibilities on the issue of water management in the Department of Water resource of this ministry. Within its jurisdiction, MFTER is responsible for conducting foreign policy on water management in the field of competence relating to the preparation and signing of international agreements, while the entities are responsible for the implementation of these agreements. CoM adopted at the end of January 2015 the Action plan for flood control and river management in B&H for the period 2014-2017.

6 Directorate for Coordination of Police Bodies of Bosnia and Herzegovina (DCPB)

Directorate for Coordination of Police Bodies of B&H was established as a government agency within the MS. Some of its responsibilities are communication, cooperation and coordination between the police authorities of Bosnia and Herzegovina, as well as the organization and implementation of physical and technical protection of persons and facilities of the B&H authorities and the diplomatic and consular authorities which are specifically protected in accordance with relevant laws. Also, DCPB is one of the signatories of the Agreement on mutual assistance and cooperation of five agencies responsible for law enforcement. The signatories of this agreement, in addition to the Directorate for Coordination of Police Bodies (DCPB B&H), and the State Investigation and Protection Agency (SIPA), Border Police of B&H, Federal Police (FUP) and the Ministry of Internal Affairs of Sarajevo Canton (MUPKS) . The agreement is designed for the needs in crisis situations that require emergency response in order to preserve public order and protection of life or property, and that go beyond the current capabilities of individual agencies.

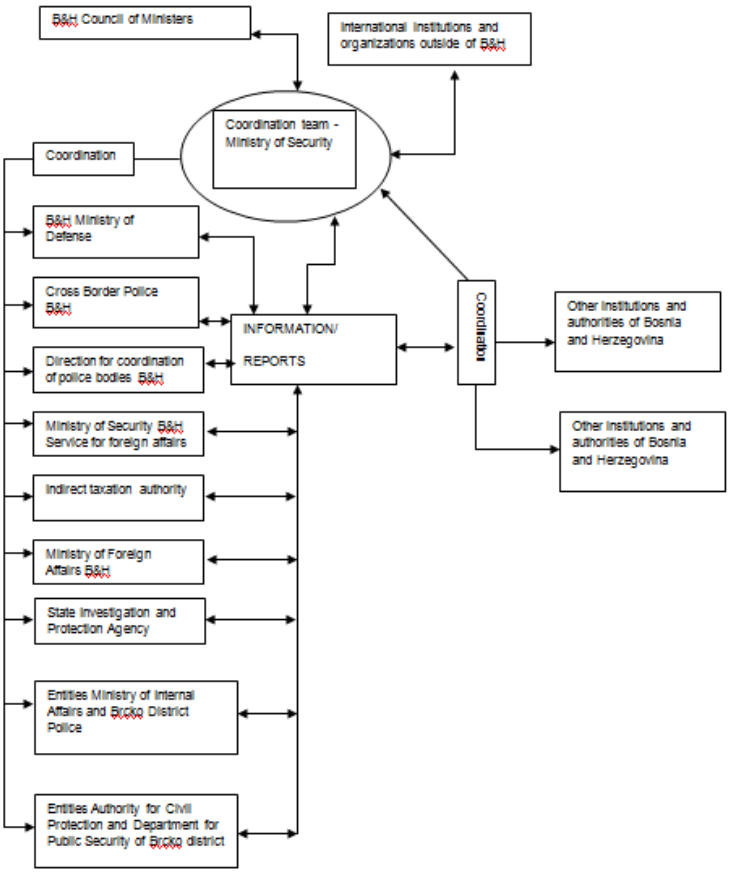
7. State Investigation and Protection Agency- SIPA

SIPA is one of the signatories of the Agreement on mutual assistance and cooperation of five agencies responsible for law enforcement.

8. Ministry of finance and treasury B&H

Provides financial assistance in crisis situations.

The following chart shows the path of information at the state level



Organizational structure for protection and rescue at lower levels

Obligations and the needs of organization, preparation and implementation of protection and rescue of people and property in the Federation of Bosnia and Herzegovina, are formulated by the Law on Protection and Rescue, as well as implementing regulations arising from this law.

This law prescribes and defines the rights and duties of the Federation of Bosnia and Herzegovina, cantons, cities and municipalities in the area of protection and rescue. All of these levels of government establish appropriate bodies of civil protection by the law and other regulations, such as:

- Federal Civil Protection - for the Federation of Bosnia and Herzegovina,
- Cantonal Administration of Civil Protection - for areas of Cantons,
- Municipal/City/Civil protection - in all municipalities (city).

The composition of the stated bodies of civil protection for all levels of the organized civil protection operational centers are formed in accordance with the Regulations on the organization and functioning of the operational centers of Civil Protection ("Official Gazette of B&H", 8/07).

1. Implementation of the Law on Protection and Rescue

In addition to the formation of these structures of the civil protection which are formed with the aim to carry out administrative, professional and other activities in the field of protection and rescue, for all levels of government in the Federation of Bosnia and Herzegovina formulate appropriate act on the establishment of professional and operational body for the management of protection and rescue actions, ie. Staff civil protection.

1.1. At the federal level

After the Federal Civil Protection became an independent organization which directly responds for their work to the Government of the Federation of Bosnia and Herzegovina, its scope of work and all other issues of importance are formulated, which are important for the organization and functioning of this body, by the Law on Federal Ministries and other bodies of the Federal Administration ("Official Gazette of the Federation B&H", Nos. 48/99, 19/03, 38/05, 2/06, 8/06, 61/06 and 48/11).
According to the Regulation on the organization of protection and rescue services of the Federation of Bosnia and Herzegovina ("Official Gazette of the Federation B&H", Nos. 58/06, 40/10, 14/12 and 66/12) different federal services for protection and rescue have been established among which is the Federal Institute for seismology and hydrometeorology FHMZ – Sarajevo.

1.2. At the cantonal level

After the enforcement of the Law on Protection and Rescue, in all cantons in the Federation of Bosnia and Herzegovina, Cantonal Administration of Civil Protection have been formed but until now they have not been fully staffed and equipped with adequate materials as we as not fully operational.
Headquarters of civil protection as professional and operational bodies which are to manage protection and rescue actions have been established in all cantons but they are not fully equipped and not fully operational.
Commission to assess the damage caused by natural and other disasters have been established in all cantons of the Federation of Bosnia and Herzegovina.

1.3. At the municipal/city level

Since the Law on Protection and Rescue has been enforced, to this day the process of forming municipal/city civil protection services that perform administrative, professional and other tasks of protection and rescue from the jurisdiction of the municipality is still in process.

1.4. Commercial companies and other legal persons referred to in Article 32 of the Law on Protection and Rescue.

1.5. Organizational structures for protection and rescue

In accordance with the obligations under the Law on Protection and Rescue and implementing regulations arising from this law, after collection and analyzing the indicators of the implementation of these commitments, it has been conclude that the state of the organization structure of the protection and rescue system in the Federation of Bosnia and Herzegovina is uneven in the cantons and municipalities and therefore does not contribute to the efficiency of the system for protection and rescue in the stage of prevention, rescue and elimination of consequences. There are 10 cantons and organization is different in each and every one. As per report conducted by the Center for Security Studies (June 2010), not even one level of organization (municipality, canton, entity) has a complete equipped Service for protection and rescue.

1.3.1.2 Hydrological disasters

1.3.1.2.1 Floods

In accordance with the Constitution of B&H and the constitutions of the Federation of B&H and Republic of Serbian and Arbitration Award on Brcko District, responsibilities for water management (ie. For the development, protection, use, protection from the harmful effects-flood) are the responsibility of the entities and the Brcko District.
At the same time, B&H foreign policy is the responsibility of B&H institutions. The entities have the right to establish special relations with neighboring countries, consistent with the sovereignty

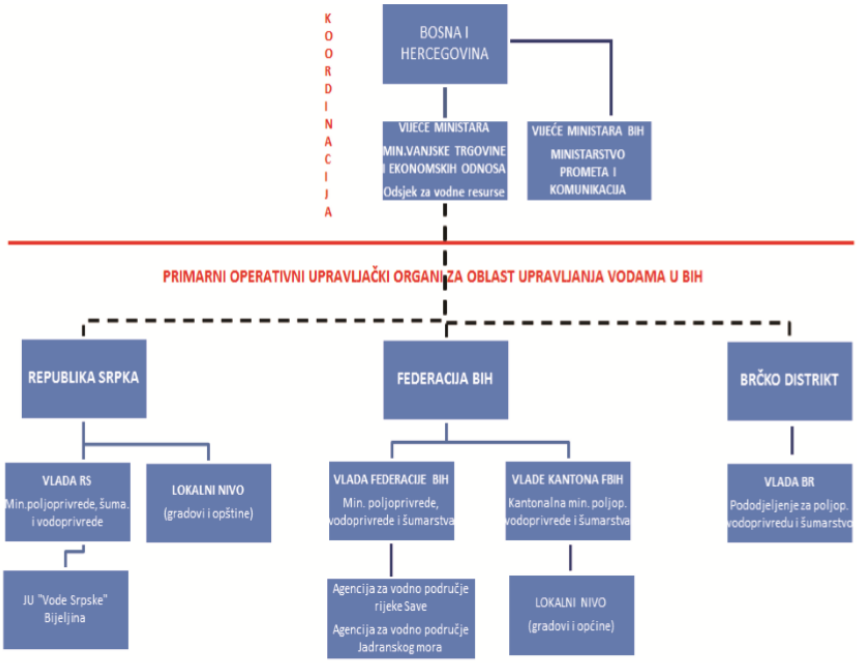
and territorial integrity of Bosnia and Herzegovina, and with the consent of the Parliamentary Assembly may enter into agreements with states and international organizations.

When it comes to B&H water resources management, this means that the conclusion of appropriate international agreements (both multilateral and bilateral) is responsible only B&H, but they are responsible for their enforcement entities and District. This constitutional arrangement has allowed to establish the jurisdiction of the Ministry of Foreign Trade and Economic Relations to perform certain tasks and duties. Department of Natural Resources, Energy and Environment Ministry, in this sense, is responsible for carrying out the normative legal, study-analytical and information-documentation tasks.

The current organization of flood control

The Government of the Federation, on the basis of provisions of the flood protection plans and proposals of the Federal Minister of Agriculture, Water and Forestry, has adjudicated on the Main plan of operational measures against floods, the beginning of each year for the current year.

Organization of the management structure of the system of water management in B&H.



Federal Ministry of Agriculture, Water and Forestry (Ministry) was established pursuant to the Law on Federal Ministries and performs administrative, professional and other tasks related to the competence of the Federation in the area of Agriculture, Water and Forestry.

According to the Law on Water,. have established agencies for river basins as professional institutions "for the implementation of water management tasks", namely: the Agency for the Sava River Basin (Sava RBD), based in Sarajevo (www.voda.ba) and the Agency for Water Area of the Adriatic Sea (AVP Adriatic sea), based in Mostar (www.jadran.ba).

In the Federation, in addition to federal, in water management participate and cantonal ministries, responsible for the subject area: Una-Sana canton, Cantonal Ministry of Agriculture, Water and Forestry, (www.vladausk.ba); - Posavina Canton, the Ministry of Agriculture, Water and Forestry, Water Management Division (www.zupanijaposavska.ba);

- Tuzla Canton, the Ministry of Agriculture, Water and Forestry (www.vladatk.kim.ba); - Zenica-Doboj Canton, Ministry of Agriculture, Forestry and Water Management, Department of Water and Forestry (www.zdk.ba);- Bosnia-Posavina Canton, Cantonal Ministry of Economy (www.bpkgo.ba); - Central Bosnia Canton, the Ministry of Forestry, Water Management and

Agriculture, the Department of Water Resources, in charge of operations of the water sector in Range Canton (www.sbk-ksb.gov.ba) Cantonal Ministry of Economy (www.bpkgo.ba); - Central Bosnia Canton, the Ministry of Forestry, Water Management and Agriculture, the Department of Water Resources, in charge of operations of the water sector in Range Canton (www.sbk-ksb.gov.ba);
- Herzegovina-Neretva Canton, Ministry of Agriculture, Forestry and Water Management (www.vlada-hnz-k.ba); - West Herzegovina Canton, Ministry of Physical Planning, Resources and Environment, (www.vladazzh.com); - Sarajevo Canton, Ministry of Economy, Department of Agriculture, Water and Forestry. (Www.privreda@ks.gov.ba); - Livno Canton, Ministry of Agriculture, Water and Forestry (www.vladahbz.com)
Responsibilities of water management are mainly the cantonal ministries of Agriculture, Water and Forestry, similar to the federal level, while in some cases the jurisdiction of the ministries of economy
Unlike the water sector where the state level there is no formal authority which is in control of waters, in the area of protection and rescue of people and property in the state of natural and other disasters, the state has jurisdiction, and is responsible for the planning and implementation of measures.

1.3.1.3 Meteorological disasters

1.3.1.3.1 Droughts

Meteorological disasters, i.e., the management of these hazards in B&H at the state level are regulated by the Framework Law on protection and rescue of people and property from natural or other disasters in Bosnia and Herzegovina ("Official Gazette", No. 50/08). On the basis of this law, the drawing up methodologies for the development of risk assessment of Bosnia and Herzegovina from natural or other disasters have been instructed. This document should include detailed risk assessment of all natural hazards, including the drought, and will serve as a platform for the adoption of appropriate legislation for all levels of government in Bosnia and Herzegovina.

Under the Article 10 of the provision of the UNCCD, Bosnia and Herzegovina is preparing National Action Programmes (NAPs) to, among others, identify the factors contributing to and practical measures necessary to combating desertification and land degradation, and mitigate the effects of drought. In this framework, NAPs should enhance national climatological, meteorological and hydrological capabilities and the means to provide a drought early warning system. This includes strengthening drought preparedness and management at local, sub-regional, regional, entity and national levels and incorporating long-term strategies to mitigate the effects of drought, in line with national policies for sustainable development. Strategically, country should come with recommendations for drought related policies and legislation to facilitate the implementation of the NAPs, in particular at national drought mitigation strategies and contingency plans.

1.3.1.4 Wild Fire

The organizational set-up and institutional arrangements in the forest sector are shown in the Figure below.

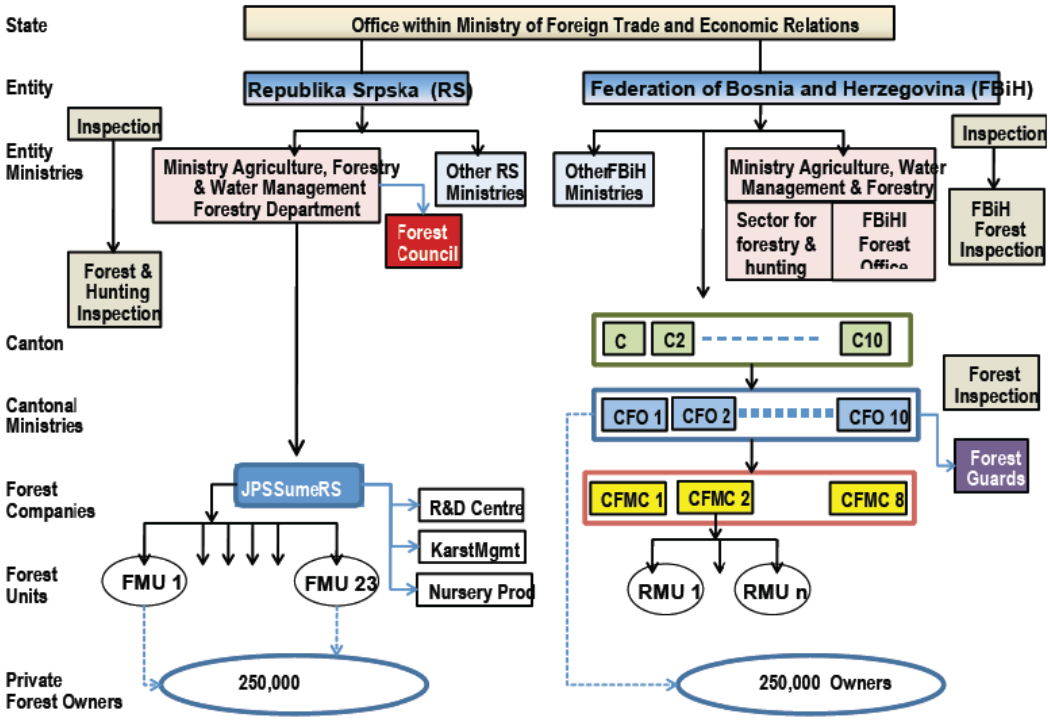


Figure - organizational set-up and institutional arrangements (The Forest Sector in Bosnia and Herzegovina, Regional Office for Europe and Central Asia of the Food and Agriculture Organization (FAO) of the United Nations, 2015)

Direct competences in the forestry sector are held at entity level (FB&H and RS) and at the level of Brcko District. The institutions at these levels are responsible for the development of forest policy as well as for the development and implementation of forestlegislation. Among its competencies, the Ministry of Foreign Trade and Economic Relations (MOFTER) is responsible for tasks and duties falling within the jurisdiction of the state of BiH, including the definition of policies and basic principles, the coordination of activities and the consolidation of entity plans with those of international institutions in the areas of agriculture, energy, environmental protection, the use of natural resources and tourism. The Sector for Agriculture, Food, Forestry and Rural Development operates within MOFTER, and in terms of forestry issues deals mainly with coordination activities.

In FB&H, forest management competencies are devolved to the cantonal governments. Each canton is responsible for the forest resources within its administrative boundaries.
At FB&H level, there is a Forestry Department within the Ministry of Agriculture, Water Management and Forestry (MAWMF). The main bodies within the MAWMF are:

- the FBiH Forest Office (FFO), which is responsible for forest silviculture and protection, forest utilisation, subsidies and support payments for forestry, as well as the development and monitoring of processes in forestry, including an overall monitoring role in relation to activities within the forest sector; and
- the FB&H Forest Inspection (FFI), which performs overall inspection services safeguarding the implementation of all actions relating to the Law on Forests within FB&H. In the absence of an adopted law, the FFI also operates under the Law on Inspection.

At cantonal level, responsibility lies with the MAWMF of FBiH, with the exception of Sarajevo Canton, West-Herzegovina Canton and Bosnian-Podrinje Canton, which fall under the responsibility of different ministries. In this respect, further important bodies are:

- the Cantonal Forest Office (CFO), which controls the activities of the cantonal forest management companies (CFMC) and provides advice and support to private forest owners. The CFO prepares forest management plans (FMP) for all private owners and plays a major role in guarding and protecting forest resources, including from illegal activities; and
- - the Cantonal Forest Inspection (CFI), which forms part of the Cantonal Inspection Service. Their role is essentially the same as that of the FB&H Forest Inspection.

Federal Civil Protection and cantonal governments and municipal/city civil protection, become an essential professional body in the field of fire protection and fire fighting with the task to ensure the implementation of the Law on Fire Protection according to the Law on Fire Protection. On the basis of the available data it is clear that until now not all cantons have passed the cantonal law. Cantonal law on fire prevention and firefighting passed in five of the 10 cantons in the Federation of Bosnia and Herzegovina (Tuzla, Zenica-Doboj, Una-Sana, Central Bosnia and Sarajevo Canton).

In accordance with the above legislative acts and the political structure in BiH, the main institutions responsible for forest fire protection are described below.

1. Ministry of Security of B&H

The Ministry of Security of B&H is responsible for the execution of international obligations, cooperation, coordination and the revision/approval of the entities' protection and rescue programs and plans. There are 10 sectors within the ministry, one of which is the Sector for Civil Protection.

Under the existing legislation, both the state and the entities have jurisdiction over their own civil protection structures. Entities are both financially and jurisdictionally autonomous from the state. Each level has its own specific mandate, with the state focusing on civil protection strategy while the entities focus on operational matters.

At the state level, the Sector for Civil Protection of the Ministry of Security is the highest-level body with competences and responsibility for international cooperation, internal coordination, the strategic planning of protection and rescue measures, and training programs.

Three departments have been established within the sector:

- The Department for the Strategic Planning of Protection and Rescue Measures
- The Department for Structures and Training
- The Department for International Cooperation

The Ministry of Security coordinates and manages the planning and exchange of data and information, and reports on risk reduction activities carried out in the entities and Brcko District. The entities and Brcko District, within the framework of their competences in the area of protection and rescue, define, plan, train, organize, finance and execute protection and rescue measures with the aim of reducing risks and removing or mitigating the harmful consequences of disasters caused by natural or other hazards.

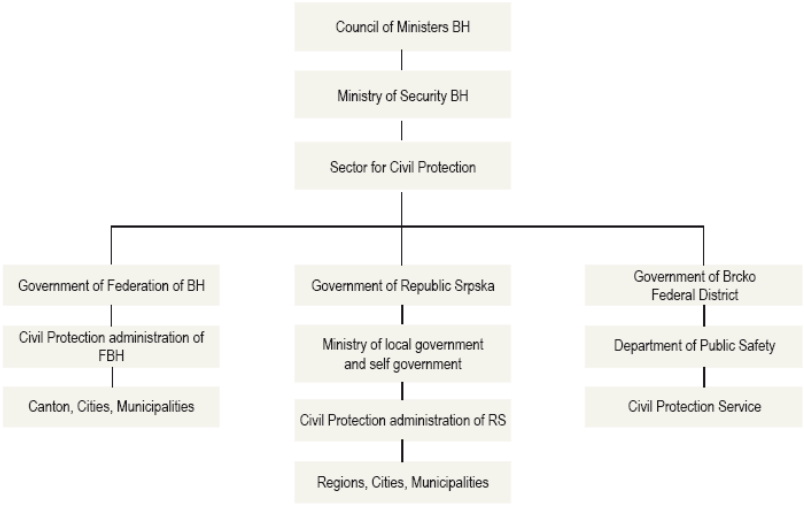


Figure - Organization of the Sector for Civil Protection of B&H (The Structure, Role and Mandate of Civil Protection in Disaster Risk Reduction for South Eastern Europe", South Eastern Europe Disaster Risk Mitigation and Adaptation Programme, 2009)

The civil protection structure in FB&H reflects the administrative organization of the entity, which is particularly complex and decentralized due to its three-tier administrative system of federation, cantons, and municipalities or cities. Each level has the constitutional authority to make regulations and to determine matters in all areas of society, including protection and rescue (Figure below).

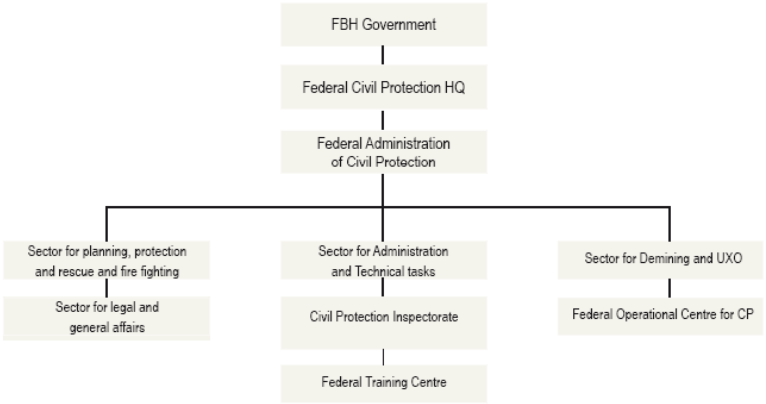


Figure - Organization of civil protection in FB&H (The Structure, Role and Mandate of Civil Protection in Disaster Risk Reduction for South Eastern Europe", South Eastern Europe Disaster Risk Mitigation and Adaptation Programme, 2009)

The Civil Protection Administration of RS has competences for planning; the issuing of obligations regarding the lending of material resources for civil protection needs; and damage assessment directives. The director of civil protection is responsible for the administration and organization of the entire structure, as well as for training programs for civil protection units (Figure below).

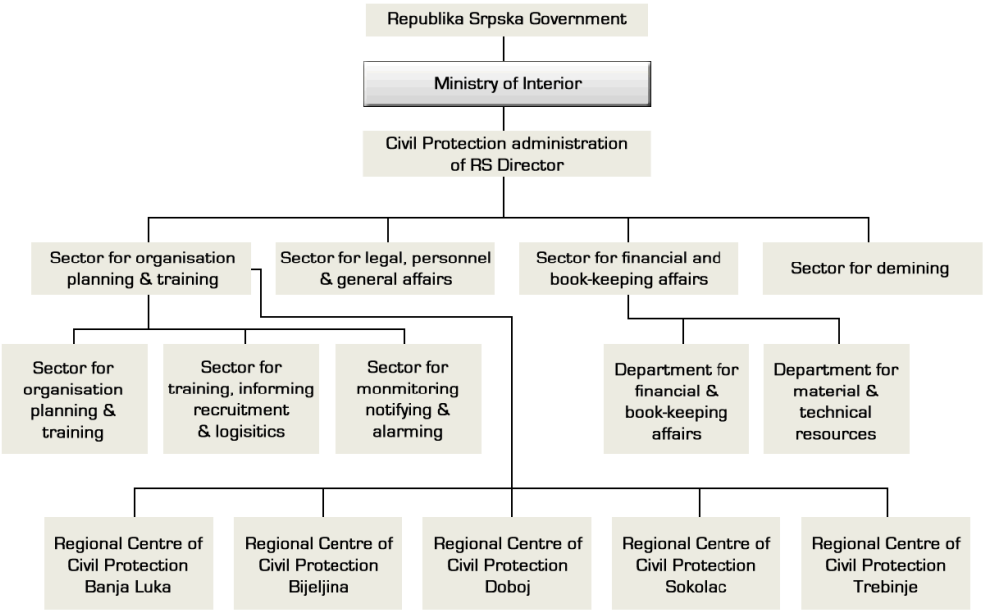


Figure - Organization of civil protection in Republika Srpska (The Structure, Role and Mandate of Civil Protection in Disaster Risk Reduction for South Eastern Europe", South Eastern Europe Disaster Risk Mitigation and Adaptation Programme, 2009)

No specific laws on civil protection have been adopted by Brcko District, and current legislation in this area refers to that of FB&H and RS.

General comment

The unique political structure of B&H has an impact on the functioning of its public institutions and on all areas of public life. As a consequence, a large number of institutions (at state, federal, cantonal and municipal level) are involved in natural disaster protection. In order to organize their activities and competences, there are also a large number of legal acts (laws, sub-laws, rulebooks etc.). All this helps to explain why the system of natural disaster protection in B&H is not asefficient as it should be. It can be concluded that the number of laws regulating this issue should be dramatically decreased, while the harmonization of the most important legal acts among entities and institutions should be ensured. This is one of the most important preconditions for the better functioning of the natural disaster protection system in B&H.

The existence of a proper early warning system for natural disasters may significantly improve preparedness for natural disaster protection in B&H. At present there is no early warning system in B&H. Taking into consideration the specific local context in B&H, this system can only beseen as a temporary solution and the need for a national early warning system remains.

The problem of ensuring the existence of well-trained personnel and firefighters and appropriate equipment also exists in B&H. There is a need for training centres at entity level, but with the same (i.e. harmonized) training programs.

The problem of the contamination of forests and forest land with landmines has already been emphasized.

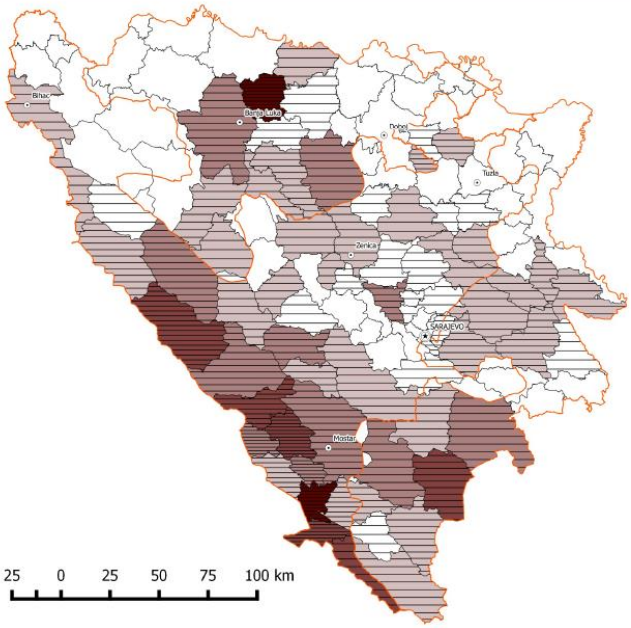
2 Few helpful information:

Organization of Bosnia and Herzegovina

UNDP in 2016 has developed hazard maps for the following natural disasters http://www.preventionweb.net/english/professional/maps/:

Bosnia and Herzegovina Population Exposure Map 2

Population Exposure to Earthquake Risk



1. Data

This map shows the relative earthquake risk and the population exposed to earthquke risk as a ratio of the total population in each municipality. The data is based on the earthquake hazard map developed in February 2016. The data was calculated using an earthquake distribution grid investigating concentration and probability of earthquake events above magnitude 4 on the Richter scale within a 0.1 degree area with a return period of 65 years, and the Gridded Population of the World data from Columbia University. Using the QGIS raster calculator, these layers were multiplied to extract GDP pixels within EQ hazard pixels. This layer was then summed using zonal statistics and aggregated at municipal level. At the end, data was clustered using a Jenks natural breaks optimization method.

2. Legend

Entity Border

Municipal Border

Earthquake Hazard [143]

- Very High [2]
- High [6]
- Medium [11]
- Low [31]
- Very Low [93]

Population Exposure [143]

- 64% to 92% [6]
- 39% to 64% [8]
- 23% to 38% [16]
- 7% to 23% [25]
- 0% to 7% [17]
- 0% [71]

3. Sources

United States Geological Survey and Columbia Univsersity data available from the websites at <www.usgs.gov/> and <www.sedac.ciesin.columbia.edu/>

4. Feedback

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5. Disclaimer

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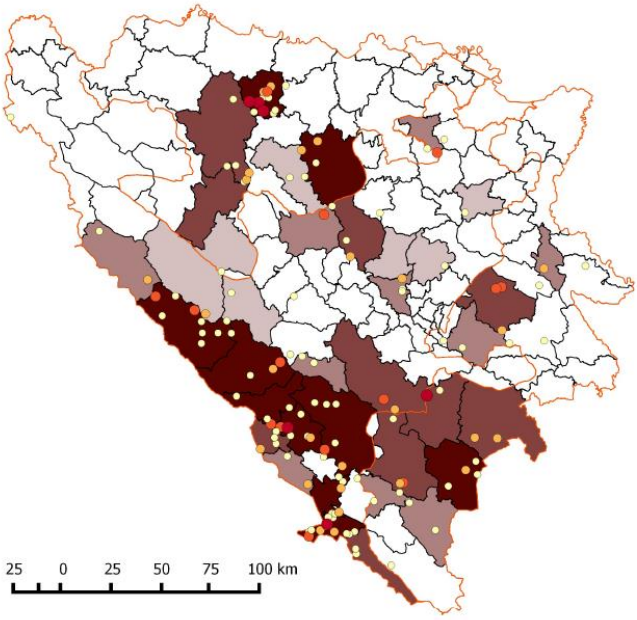
Date created 03 March 2016

Bosnia and Herzegovina Earthquake Hazard Map



1. Data

This earthquake (EQ) hazard map is based on analysis of earthquake events from 1950 to 2015. The color coding of municipalities indicates the relative level of earthquake risk. The map sums the number and magnitude of seismic events above 4 on the Richter scale within municipal borders.

2. Legend

Entity Border

Municipal Border

Earthquake Hazard Level [# of municipalites] [143]

- Very High [11]
- High [10]
- Medium [11]
- Low [9]
- Very Low [10]

Earthquake Events by Magnitude [133]

- 5.5 - 7 [6]
- 5 - 5.5 [14]
- 4.5 - 5 [26]
- 4 - 4.5 [87]

3. Sources

Data from the United States Geological Survey (USGS) Earthquake Archives extracted on 28 August 2015 filtered by location, magnitude and time period.

4. Feedback

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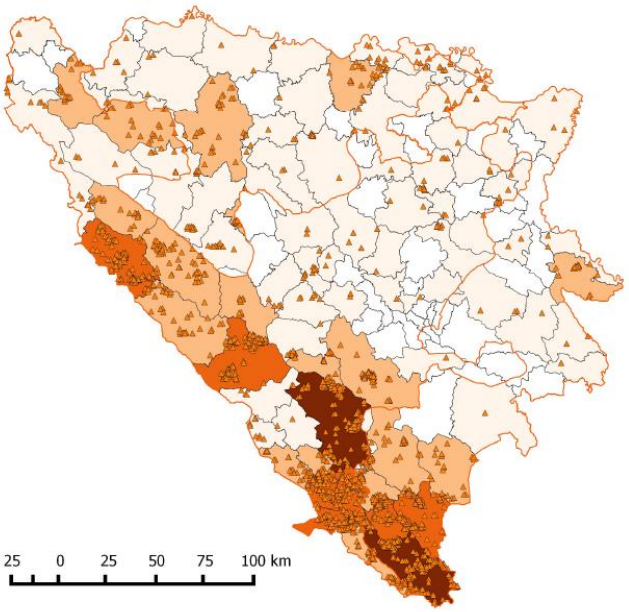
Date created 25 January 2016

Bosnia and Herzegovina Fire Hazard Map



1. Data

This fire hazard map is based on analysis of fire events 2001-2014. The vector data shows fire events at the GPS coordinate level. The color coding of municipalities indicates the relative level of fire risk estimated by a count of High Temperature Events (HTE) within municipal borders.

2. Legend

Entity Border
Municipal Border
High Temperature Events (HTE)
Fire Risk Level
Very High
High
Medium
Low
Very Low

3. Sources

Data from the Fire Information for Resource Management System (FIRMS) provided from Earthdata by NASA. The datasets from 2001 to 2015 is a count in polygon analysis of real events with a confidence above 80% using the MODIS near real-time (NRT) active fire / hotspot database.

4. Feedback

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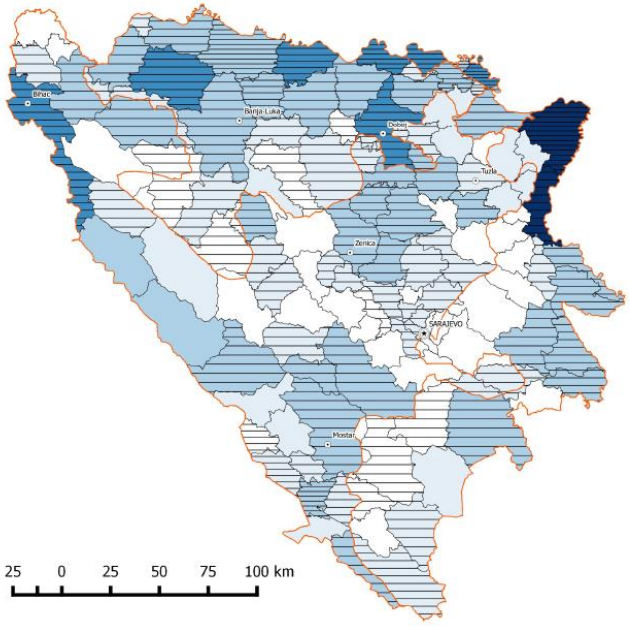
Date created 26 January 2016

Bosnia and Herzegovina Population Exposure Map 1

Population Exposure to Flood Risk



1. Data

This map shows the relative flood risk and the population exposed to flood risk as a ratio of the total population in each municipality. The flood data is based on the flood hazard map developed in January 2016. The exposure data was calculated using the Global Assessment Report on Disaster Risk Reduction (GAR) 2015 database on flood hazard with a return period of 100 years, and the Gridded Population of the World from Colombia University. Using the QGIS raster calculator these layers were multiplied to extract population pixels within flood hazard pixels. This layer was then summed using zonal statistics and aggregated at municipal level. At the end, the data was clusted using a Jenks natural breaks optimization method.

2. Legend

Entity Border
Municipal Border
Flood Hazard Level [143]
Very High [2]
High [7]
Medium [36]
Low [51]
Very Low [47]
Population Exposure Ratio [143]
60% to 97% [3]
36% to 60% [6]
20% to 36% [8]
10% to 20% [24]
1% to 10% [50]
0% [52]

3. Sources

GAR 2015 and population data available from the websites at <http://risk.preventionweb.net/capraviewer/main.jsp> and <http://sedac.ciesin.columbia.edu/data/collection/gpw-v4>

4. Feedback

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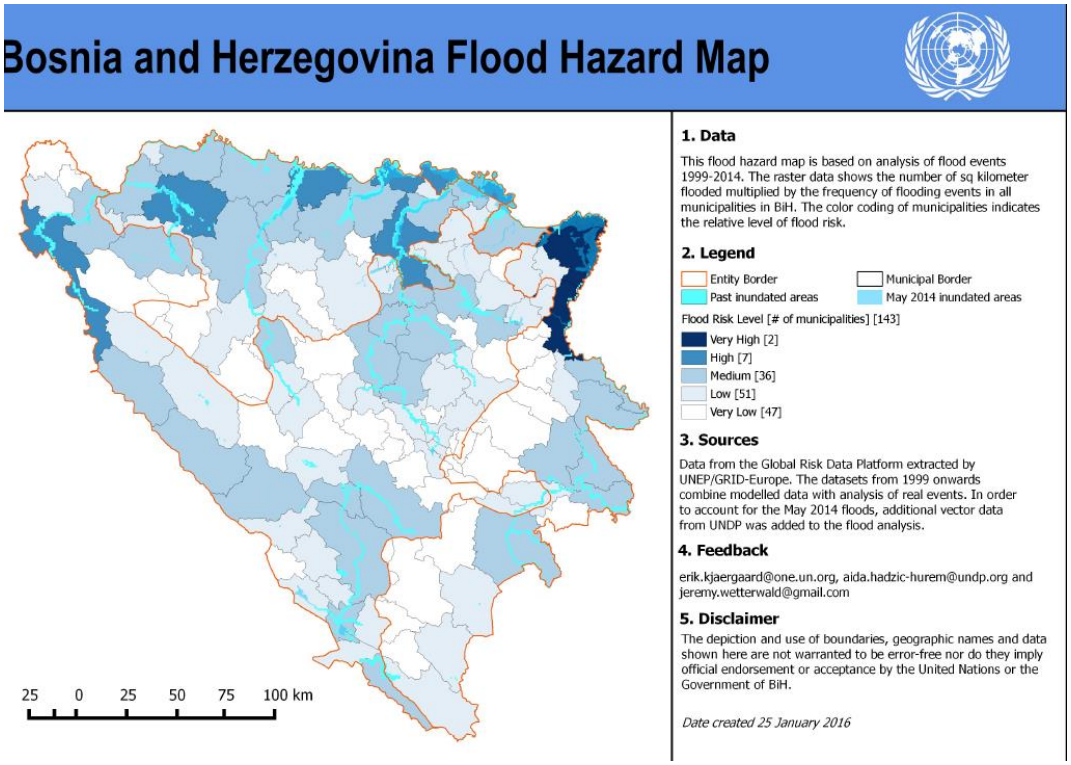
Date created 03 March 2016


Bosnia and Herzegovina Flood Hazard Map
25 0 25 50 75 100 km
1. Data
This flood hazard map is based on analysis of flood events 1999-2014. The raster data shows the number of sq kilometer flooded multiplied by the frequency of flooding events in all municipalities in BiH. The color coding of municipalities indicates the relative level of flood risk.
2. Legend
Entity Border
Municipal Border
Past inundated areas
May 2014 inundated areas
Flood Risk Level [# of municipalities] [143]
Very High [2]
High [7]
Medium [36]
Low [51]
Very Low [47]
3. Sources
Data from the Global Risk Data Platform extracted by UNEP/GRID-Europe. The datasets from 1999 onwards combine modelled data with analysis of real events. In order to account for the May 2014 floods, additional vector data from UNDP was added to the flood analysis.
4. Feedback
erik.kjaergaard@one.un.org, aida.hadzic-hurem@undp.org and jeremy.wetterwald@gmail.com
5. Disclaimer
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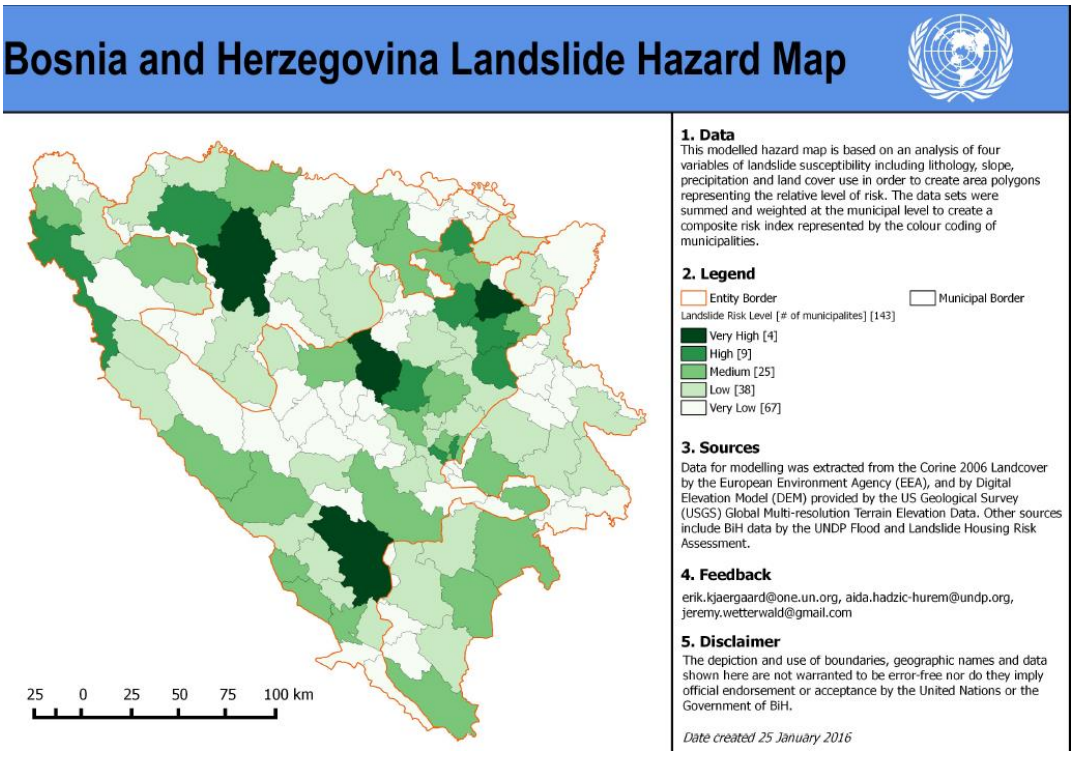
Date created 25 January 2016


Bosnia and Herzegovina Landslide Hazard Map
25 0 25 50 75 100 km
1. Data
This modelled hazard map is based on an analysis of four variables of landslide susceptibility including lithology, slope, precipitation and land cover use in order to create area polygons representing the relative level of risk. The data sets were summed and weighted at the municipal level to create a composite risk index represented by the colour coding of municipalities.
2. Legend
Entity Border
Municipal Border
Landslide Risk Level [# of municipalites] [143]
Very High [4]
High [9]
Medium [25]
Low [38]
Very Low [67]
3. Sources
Data for modelling was extracted from the Corine 2006 Landcover by the European Environment Agency (EEA), and by Digital Elevation Model (DEM) provided by the US Geological Survey (USGS) Global Multi-resolution Terrain Elevation Data. Other sources include BiH data by the UNDP Flood and Landslide Housing Risk Assessment.
4. Feedback
erik.kjaergaard@one.un.org, aida.hadzic-hurem@undp.org, jeremy.wetterwald@gmail.com
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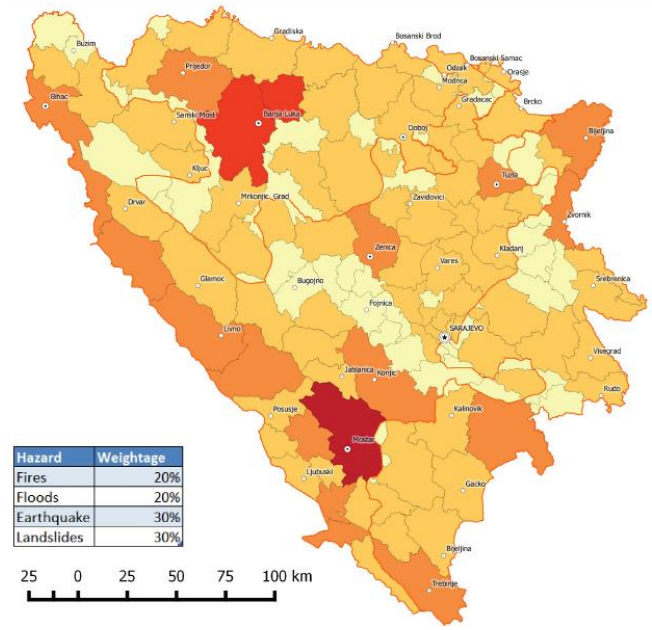
Date created 25 January 2016

Bosnia and Herzegovina Multi-Hazard Map 3

Sudden Onset Disaster Focus



Hazard	Weightage
Fires	20%
Floods	20%
Earthquake	30%
Landslides	30%

1. Data

This multi-hazard map depicts fire, earthquake, flood and landslide susceptibility by municipality. The map depicts a composite index of four hazards with the following weightage: floods (20%), fires (20%), earthquakes (30%) and landslides (30%). This weightage pays special attention to sudden-onset hazards that threaten the survival of people in at-risk municipalities.

2. Legend

Entity Border — Municipal Border

Natural hazard susceptibility [# of municipalities] [143]

- Very High [1]
- High [2]
- Medium [15]
- Low [74]
- Very Low [51]

3. Sources

For data sources please refer to the four individual hazard maps for Bosnia and Herzegovina developed September 2015 to February 2016. The data sets were normalized and merged based on the index described above and mapped in QGIS.

4. Feedback

erik.kjaergaard@one.un.org, aida.hadzic-hurem@undp.org, jeremy.wetterwald@gmail.com

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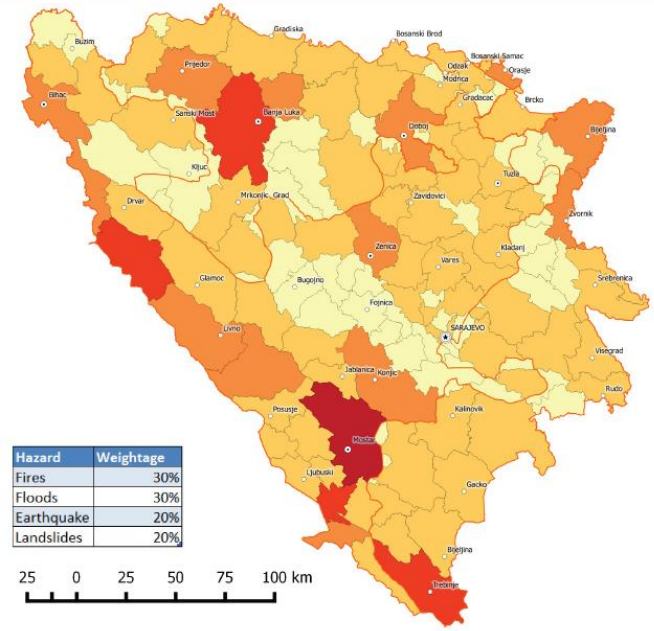
Date created 17 February 2016

Bosnia and Herzegovina Multi-Hazard Map 4

Livelihood / Climate Change Focus



Hazard	Weightage
Fires	30%
Floods	30%
Earthquake	20%
Landslides	20%

1. Data

This multi-hazard map depicts fire, earthquake, flood and landslide susceptibility by municipality. The map depicts a composite index of four hazards with the following weightage: floods (30%), fires (30%), earthquakes (20%) and landslides (20%). This weightage pays special attention to flood and fire hazards that threaten the livelihoods of people in susceptible municipalities and are linked to climate change.

2. Legend

Entity Border — Municipal Border

Natural hazard susceptibility [# of municipalities] [143]

- Very High [1]
- High [4]
- Medium [12]
- Low [67]
- Very Low [59]

3. Sources

For data sources please refer to the four individual hazard maps for Bosnia and Herzegovina developed September 2015 to February 2016. The data sets were normalized and merged based on the index described above and mapped in QGIS.

4. Feedback

erik.kjaergaard@one.un.org, aida.hadzic-hurem@undp.org, jeremy.wetterwald@gmail.com

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Date created 17 February 2016