Response to WP1

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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

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1 Natural Disasters in Western Balkans

1.1 Identification of Natural Disasters in the Republic of Serbia

Serbia is a landlocked country situated in southeastern Europe, in the centre of the Balkan Peninsula, between 41°53′ and 46°11′ latitude North and 18°49′ and 23°00′ longitude East on an area of 88,509 km². Because Serbia covers part of the Pannonian Plain in the north, the country also belongs to Central Europe, while due to its southern region, in terms of geography and climate, Serbia is also considered as Mediterranean country.

The climate of Serbia is moderately continental, with localised variations and a gradual change between the seasons. Nearby geographical regions like the Alps, the Mediterranean Sea, the Bay of Genoa, the Pannonian Basin and the Morava Valley, the Carpathian and Rhodope Mountains, as well as Serbia's hilly and mountainous region, with its valleys and plateaus, significantly influence the weather and climate in Serbia. The dominant position of river valleys from the south towards the hilly areas in the north of the country allows the deep penetration of polar air masses in southern regions. The vast majority of Serbian territory lies in a temperate climate zone, but the southwestern regions border the subtropical and continental climate zones.

The mean annual air temperature for areas 300 m above sea-level is **10.9°C** and for regions at an altitude of 300 m to 500 m it is around 10°C. In mountainous regions above 1000 m the air temperature is around 6°C, while in regions above 1500 m it is around 3°C. Autumn is warmer than spring. The coldest month is January with the mean monthly temperature ranging from -6°C in mountainous regions to around 0°C in the country's flat regions. The warmest month is July with the mean monthly temperature ranging from 11°C to 22°C.

The annual rainfall in low-lying areas ranges from 540 to 820 mm. Regions which are 1000 m above sea-level have between 700 and 1000 mm of rainfall annually, while some mountain peaks in southwestern Serbia have up to 1500 mm of rainfall a year. The majority of Serbia has continental rainfall patterns, with larger volumes in the warmer half of the year, apart from southwestern areas, which have the most rainfall in autumn. June is the rainiest month, with an average of 12 to 13% of the total annual rainfall that month. February and October are the least rainy months. The normal annual volume of rainfall for the entire country is 896 mm.

The northern part of Serbia, Vojvodina, located in the Pannonian Plain, is predominately flat. There are also plains in Macva, Posavina, Pomoravlje and Stig, as well as in Negotin Krajina in eastern Serbia. 55% of Serbia's land is arable, the large part of which is located in Vojvodina, the country's main agricultural region. The central part of Serbia and the hilly Sumadija region are located south of the Sava and Danube rivers. Further, south, the hills gradually give way to mountains.

The mountain landscape of Serbia is rich in canyons, gorges and caves, as well as preserved forests, which are home to a multitude of endemic species. Serbia's mountains belong to the Rhodopes range, which runs along the right and left sides of the South and Great Morava rivers and to the Carpathians and Balkan Mountains, which are located in the eastern part of Serbia, south of the Danube river.

Serbia has total population of 7,243,007 and is home to many different ethnic groups. According to the 2011 census, Serbs are the largest ethnic group in the country and constitute 83.3% of

population. Hungarians are the largest ethnic minority in Serbia, concentrated predominately in northern Vojvodina and representing 3.5% of the country's population (13% in Vojvodina).
Natural disaster is an event of hydro meteorological, geologic or biological origin caused by actions of natural forces such as: earthquake, flood, torrent, storm, heavy rain, atmospheric discharge, hail, drought, escarpment or landslide, snowdrifts and avalanche, extreme air temperatures, accumulation of ice on watercourse, epidemic contagious diseases, livestock epidemic contagious diseases, occurrence of pests and other large-scale natural events which can endanger health and life of people or cause damage of large-scale.[1]
Any specific natural disaster can be described by analyzing various factors that determine how great an impact it will have on people:
1) Frequency - how often is the event likely to happen,
2) Duration - the length of time the event lasts,
3) Extent - does it affect a wide area or region or a small one,
4) Speed of onset - happen quickly with no warning and over quickly or build slowly before the peak period,
5) Spatial dispersion - the area that is likely to be affected by a particular event,
6) Temporal spacing - how hazards occur in time; are they random or do they occur within a cycle.

Earthquakes

Earthquakes are unexpected, sudden and short-lasting strikes, vibrations and ground tremors due to release of energy caused by tectonic movements and volcanic activities.
Epicentre is the place or, more precisely, the zone on the terrain surface, where the earthquake is felt first.
Intensity of an earthquake is assessment of the effects caused by the earthquake on the terrain surface, i.e. effect of the earthquake on facilities, terrain and human and animal behavior. It is expressed in seismic scales.
Earthquake magnitude is measure of the assessment of intensity of the earthquake at its hearth. It shows how many times the measured quake is stronger than so-called "chosen" quake.[2]
As for the Republic of Serbia, a strong earthquake which can cause damages on buildings occurs every ten years on average. The Republic Seismological Bureau locates the place where the earthquake has occurred, measures its magnitude based on which the assumed intensity, i.e. strength of the earthquake in its epicenter is defined.
Majority of the earthquakes have been located in the area of Central Serbia (Kraljevo, Kopaonik) and South Serbia (Autonomous Province of Kosovo and Metohia). Fewer earthquakes have been located in Eastern and South-eastern Serbia, while the smallest number of earthquakes has been located on the territory of the Autonomous Province of Vojvodina.[3]

Floods

Flood is appearance of unusually large quantity of water at certain place due to acting of the natural forces (high amount of rainfalls) or due to some other causes such as easing or demolition of dams, either natural or man-made ones created because of pollution (blocking) of

[1] The Law on Emergencies ("RS Official Gazette", No 111/2009, 92/2011 i 93/2012)
[2] Instructions on Methodology of Assessment of Vulnerability and the Protection and Rescue Plans in Emergencies ("RS Official Gazette", No 96/2012)
[3] National Strategy for Protection and Rescue in Emergencies ("RS Official Gazette", No 86/2011)

the rivers due to slides and erosion, war destruction etc. In most cases they appear because of discharging of surface flows caused by characteristic of the basin (geologic composition, morphology, vegetation cover and way in which the terrain is used) as well as by unregulated riverbed. Floods are frequent events due to influence of torrents upon lower courses as well as due to elevation of groundwater level.

Torrents are temporary waters of relatively high inclination (>2%), with changing quantity of water and disproportionally big quantity of towed and floating drifts in relation to the flow. Majority of the towed contents, i.e. boulders, fragments and stone make 45-70%, and density of the torrential masses is 13,8-15,3 kN/m^3. The basic erosion form of this process is torrential riverbed and the basic accumulation form is torrential alluvion.[4]

The scales and power of floods are usually quantified in terms of their recurrence interval (their probability of recurrence). This can be explained using an example of occurrence of river floods in a river cross-section.

100-year or 1-percent-annual-chance flood is the standard for floodplain management purposes. 100-year represents a degree of risk and damage worth protecting against, but it is not considered to impose stringent requirements or burdens of excessive cost on property owners. For streams with recorded annual peak flows, the 10-, 2-, 1- and 0.2-percent-annual-chance (10-, 50-, 100-, and 500-year) floods are determined.

Floods can be classified as:

- Riverine flooding induding overflow from a river channel, dam-break floods, flash floods, alluvial fan floods, ice-jam floods,
- Urban floods,
- Fluctuating lake levels,
- Coastal flooding.

The causes of flood can be direct and indirect. Direct are: rain, landslides, earthquakes and snow and ice melt, while indirect are: size and shape of the water basin, the density of the river network and level of groundwater. Also, anthropologic factor can be cause of flood[5]. It is especially important because it is being constantly increased. Anthropologic factor is manifested through illegal construction of residential buildings on riversides, placing floating river dubs, cafes near riverbanks and clearing the forests in flash flood basins.

Flood occurs suddenly, it has long duration and this type of natural hazards usually covers a large areas. From these reasons the damages caused by floods are very severe, because along river banks and in river valleys is the highest concentration of population and commercial buildings, the maximum infrastructure density, as well as the most fertile land[6].

During the survey relating emergencies, most of the municipalities in the Republic of Serbia have said that they suffer enormous damages caused by floods (over 70%). According to the Law on Waters and in accordance with categorization of the water-flows, defence against floods is divided into two categories: defence on the first order waters and defence against torrential floods.

Public waterpower engineering companies organize defence of the first order waters which are primarily big watercourses with already built protection systems and organization of defence.

[4] Instructions on Methodology of Assessment of Vulnerability and the Protection and Rescue Plans in Emergencies ("RS Official Gazette", No 96/2012)

[5] Bonacci, O., 2008. Water related risk management, Vodoprivreda 0350-0519, 234-236, pp. 167-174.

[6] Burton, J., Kates, R.W., White, G.F., 1978. The Environment as Hazard, Oxford University Press, New York.

Specific characteristic of torrential floods is that they appear suddenly and last for a short period of time. They fall into category of predictable, suddenly appearing and short lasting phenomena, leaving ruins behind them. They occur during and after strong, very intensive storm events which can happen irrespectively of the season.
Besides overflowing of the rivers and brooks in case of abundant atmospheric precipitation, the populated place are also endangered by inadequately maintained drainage channels around and in the populated places.
There are 187 operationally functioning hydrological stations for the needs of monitoring of the situation and changes in the characteristics of the watercourse hydrological regime in the Republic of Serbia.[7]

Landslides and Escarpments on Slopes and Inclinations

Sliding is a contemporary geological process of tear off and move of rock mass in mountains and on descents over a stable groundwork and along clearly distinguished sliding area or zone.
Landslide is result of the sliding process. It is, in its essence, part of the terrain in which the process of sliding is active.
Escarpment is a group of bigger blocks or smaller fragments of rock mass, which fall near bottom of a slope or bank.[8]
Significant increase of level of the underground and surface waters caused by abundant precipitation, i.e. water saturation of the potentially unstable mass, causes landslides. In such conditions, certain parts which are not capable of accepting larger quantity of water occurring due to rain, snow or watercourses, are potentially vulnerable to appearance of landslides. These parts are primarily the ones containing clay and situated on lower terrain and in the valleys by the bigger rivers.
Estimates show that the highest number of landslides in Europe is located on the territory of Serbia. 25% of the Republic of Serbia is potentially at risk for landslides and rock falls[9].
The landslides occurring on the territory of the Republic of Serbia are in 70% of the cases well – known and mostly explored. There are 3,137 active and potential landslides on the territory of the Republic of Serbia. Certain number of the landslides endanger living facilities in the populated places (about 3.727 facilities and about 7.755 citizens), while most of the landslides endanger local roads and highways. The landslides in the Republic of Serbia are widespread in the south-eastern part of the Pannonian Plain or, to be more precise, on the northern slopes of Fruska Gora and in the region of the Danube between the cities Belgrade and Smederevo.[10]

Adverse and Dangerous Atmospheric Events

Depending on intensity, duration of direct and indirect losses, there are two types of metrological events: adverse and dangerous.
Adverse meteorological events are hydrometeorogical events which because of their intensity, duration or time of occurrence do not reach critical values or characteristic values, but they can cause damages to specific, weather dependent economic sectors.

[7] National Strategy for Protection and Rescue in Emergencies ("RS Official Gazette", No 86/2011)
[8] Instructions on Methodology of Assessment of Vulnerability and the Protection and Rescue Plans in Emergencies ("RS Official Gazette", No 96/2012)
[9] Lazic, M., Bozovic, D., 1995. Geological atlas of Serbia: Engineering Geological Map 1:2000000, Republic Foundation for Geological Investigations, Belgrade.
[10] National Strategy for Protection and Rescue in Emergencies ("RS Official Gazette", No 86/2011)

Hydrometeorogical dangers are hydrometeorogical events which because of their intensity, duration or time of occurrence pose a threat to human security and can cause serious damage to economic sectors. These phenomena become risky and dangerous when they reach critical or characteristic values.[11]

Snow Blizzards and Snow Drifts

Snow blizzard is a weather event characterized by low temperatures, winds force of which is 7 Bf (14 m/s) or more, as well as heavy snowfalls which reduce visibility to 0.5 km or less in the period of at least 3 hours.
Snow drift is deposited snow which is, while the snow blizzard is in progress, formed by wind into ridges or piles of snow which are deposited close to some barrier or uneven terrain.[12]

Heavy snowfalls and snow drifts caused by east wind (košava) in winter can slow down or block local traffic in cities and towns, but they can also slow down or block intercity, highway, railway, water and air traffic, which can result in serious consequences in production, supply and life in general. Enormous damages can be made due to collapsing of some facilities as result of snow drifts and load and that consequently can cause collapse of transmission lines, interruption of telephone lines, demolition of dwelling houses and other facilities.
Ice on rivers can be especially dangerous and cause a lot of problems, especially in case there is ice on big rivers where, when the ice begins to melt, ice blocks are created which can raise the water level and even turn the river flow thus endangering human lives, traffic and inflicting enormous material damage. Especially dangerous places are in the area of Bezdan and Djerdap where there are so-called "bottlenecks". The problems caused by ice also occur almost every winter on the Velika Morava, Sava, Timok etc.

Hail

Hail is a kind of precipitations in solid state. Precipitations are the aerated water products which either in solid or liquid form fall from clouds onto ground or they are forming near the very ground.[13]
Methodology of preventing hail is implemented in the period from 15 April to 15 October on total area of 7,749.800 hectares out of which the area 5,052.957 hectares is farmland.
Operational, methodological and developmental activities in the area of protection against hail are performed in the Sector for Defence against Hail. The system consists of: 13 radar centres, about 1,650 active hail launching stations, telecommunication system covering the territory of the Republic of Serbia and operation and methodological centre in Belgrade.[14]
Hail is a regular event in the warm part of a year in the Republic of Serbia. It can cover various areas which usually look like narrow and short ribbons. A special system for fighting hail which also deals with its monitoring is established because of enormous significance of this very dangerous meteorological event. Average number of the days in Serbia when potentially

[11] Ibid
[12] Instructions on Methodology of Assessment of Vulnerability and the Protection and Rescue Plans in Emergencies ("RS Official Gazette", No 96/2012)
[13] Ibid
[14] National Strategy for Protection and Rescue in Emergencies ("RS Official Gazette", No 86/2011)

dangerous hail cloudiness can be developed is 110; during the average period of 60 days the rockets are launched, and about 12,000 rockets with the ranges of 6 and 8 km are spent.[15]

Drought

Drought is defined as a natural event which appears when the precipitations significantly negatively deviate from normal values and cause serious problems in hydrological balance which have adverse effect on the ground production systems. There are the following types of drought: meteorogical, agriculture, hydrological and socioeconomic and they are mutually connected, although each of them has special factors of forming and various influences.[16]
Drought as a natural disaster caused by deficiency of precipitations in a longer period of time causes numerous negative consequences in the area of agriculture, water supply, energy, health, environment protection and other areas. Due to climate changes, more often and more intensive droughts have been registered in the area of the Balkan Peninsula, in wider area of Mediterranean and South-eastern Europe, and similar trend can be expected in the coming decades. The data gathered by meteorogical observation show that the severest droughts have been registered in the last two decades and they were especially severe in north-eastern, eastern and southern parts of the country.[17]

Epidemics of Contagious Diseases

Illness is in expression which describes disorder of the normal processes in an organism, i.e. irregular development of the life functions as well as the reactions to the internal and external irritants of mechanical, physical-chemical, biological or psychological character.
Contagious disease is an ailment of people and animals appearing after infection ignited by a cause, i.e. infective agent which has its natural reservoir, source and ways of spreading.
An epidemic of contagious disease is raise in number of the affected by the contagious disease higher than the usual one in certain population and in certain period of time.[18]
In case of epidemics of contagious diseases, the Ministry of Health initiates forming of common bodies and operational teams for: activities of the health system, planning and coordination, communication as well as monitoring and estimation of the situation.[19]
Big epidemics have happened in our country in various historic periods, such as epidemic of typhus which inflicted enormous damage to Serbian army and people during the First World War; there was epidemic of variola in 1972 which is belived to be the biggest epidemic in post-war Europe, as well as epidemic of tularemia on the territory of former Yugoslavia in the late 90s of the last century.[20]

[15] https://meteoplaneta.rs/wp-content/uploads/2012/04/ZASTITA-OD-GRADA-U-SRBIJI_Tihomir-Dejanovic.pdf
[16] Instructions on Methodology of Assessment of Vulnerability and the Protection and Rescue Plans in Emergencies ("RS Official Gazette", No 96/2012)
[17] National Strategy for Protection and Rescue in Emergencies ("RS Official Gazette", No 86/2011)
[18] Instructions on Methodology of Assessment of Vulnerability and the Protection and Rescue Plans in Emergencies ("RS Official Gazette", No 96/2012)
[19] National Strategy for Protection and Rescue in Emergencies ("RS Official Gazette", No 86/2011)
[20] Infectious Agents as a Security Challenge: Experience of Typhus, Variola and Tularemia Outbreaks in Serbia Prof.Dr Elizabeta Ristanovic, MS, PhD, БЕЗБЕДНОСТ Часопис МУП РС, Београд, 2/2015[SECURITY, Magazine of RS MIA, Belgrade, 2/2015]

Large-scale Fires

Fire is a process of uncontrolled combustion which threatens lives of people, material goods and the environment.[21]

According to their consequences, large-scale fires are sometimes close to and sometimes even exceed definition of a natural disaster. Forest fires, caused either by of human negligence or appearing spontaneously, can endanger entire territories.

It is a forest user's obligation to monitor general condition of all forms of property in the forest as well as their vulnerability to natural disasters.

Prevention protection against fires is carried out in accordance with the Law on Forests which defines obligation of designing and implementation of the regulated plan documents – plan of protection of forests of all forms of ownership against fire for the period of five years. Annual elaboration of the fire protection closely defines fire protection duty hours and the procedure in case of fire (way of organizing of people, transport of the equipment, informing of the competent services etc.)

The Law on Forests defines ban of ignition of open fire in a forest and on the terrain in vicinity of a forest at the distance under 200m from the forest edge, except at the place specifically defined, organized and clearly marked for that purpose along with implementation of the prescribed measures.

It was in spring 2008 when, in order to contribute to the widest possible organized protection of the forest against fire in the Republic of Serbia, the Republic Hydrometeorogical Bureau began to calculate the potential danger of forest fires on the territory of the Republic of Serbia using Canadian method for defining the index of the danger of forest fire occurrence - Fire Weather Index (FWI).[22]

1.1.1 Types of Extreme Events

Occurence of significant number of various kinds of natural disasters, of different frequency and intensity is specific for the territory of Serbia. With an average of 100 disasters in ten years from the beginning of the 19th century, number of the natural disasters by the end of the 20th century reached the number of even 2.800 disasters in ten years.

Table1. Number of natural disasters by periods. Source: National strategy of protection and rescue in emergencies, Official Gazette of the Republic of Serbia, No. 86/2011

1900–1940	1960–1970	1980–1990	1990–2000
100	650	2. 000	2. 800

In most cases occurence, scope and duration of natural disasters cannot be predicted in advance, but there are some phenomena for which, based on experience, statistics and methods of modelling as well as the place where they usually occur, it is possibile to expect that they could occur. An assessment of vulnerability of the territory of the Republic of Serbia to floods and landslides has been done and, based on the available statistics, the map of natural disasters risk (forest fires, floods, landslides and earthquakes) has been made.

[21] Instructions on Methodology of Assessment of Vulnerability and the Protection and Rescue Plans in Emergencies ("RS Official Gazette", No 96/2012)

[22] National Strategy for Protection and Rescue in Emergencies ("RS Official Gazette", No 86/2011)

The following table shows the estimated area of the Republic of Serbia vulnerable to natural hazards and it covers total area of 57.33 %.[23]

Table 2. Areas vulnerable to natural hazards in the territory of Serbia

Natural hazard	Area [km2]	Percentage of total Serbian area [%]
Seismic hazard VI II–IX MCS	16388.59	18.55
Seismic hazard IX–X MCS	1109.71	1.26
Excessive erosion areas	3320.80	3.76
Landslide hazard areas	13327.60	15.08
Areas vulnerable to drought	18306.93	20.72
Potential floodable areas	15198.07	17.20
Highest risk of forest fires	3154.95	3.57
Vulnerable areas in Serbia	50659.87	57.33

[23] Dragicevic, S., Filipovic, D., Kostadinov, S., Ristic, R., Novkovic, I., Zivkovic, N., Andjelkovic, G., Abolmasov, B., Secerov, V. and Djurdjic, S. (2011). Natural Hazard Assessment for Land-use Planning in Serbia. International Journal of Environmental Research,5(2), 371-380.

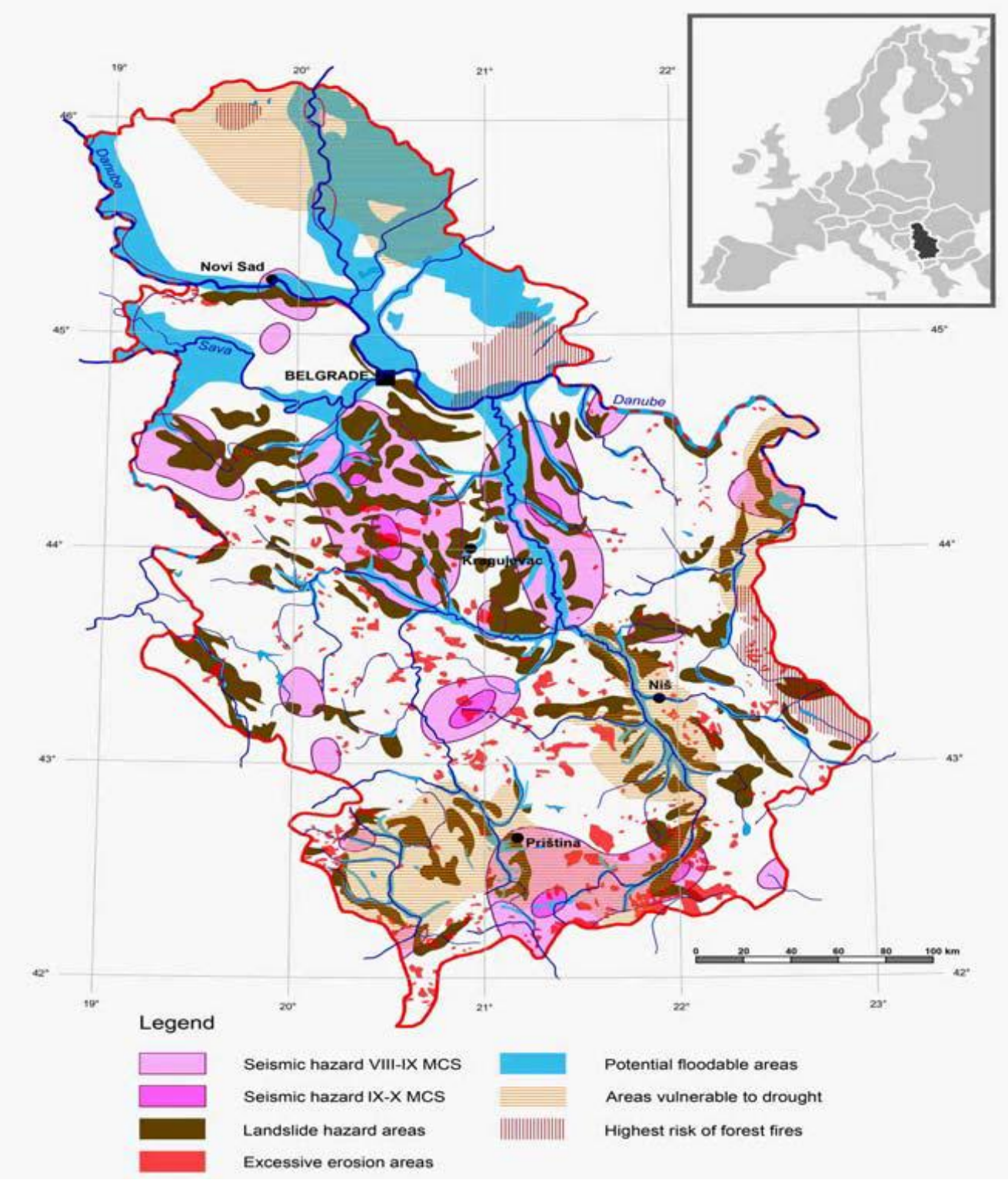

Figure 1. Integral vulnerability map of the natural hazards on the territory of Serbia
Source: Natural Hazard Assessment for Land-use Planning in Serbia [24]

Most experts agree that the dimate changes will cause more frequent extreme climate consequences such as floods, landslides and fires.[25] Positive trend of number of catastrophic

[24] Ibid

and unfavourable natural events especially reflects with the events depending on the meteorological conditions.

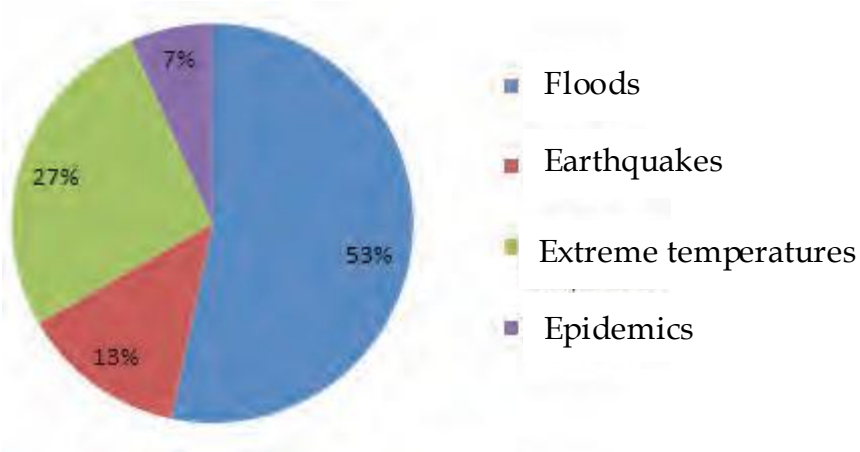

Figure 2. Frequency of various natural disasters in Serbia from 2000-2011. Source: EM-DAT.

Territory of Serbia is subject to natural disasters and the risk varies depending on the type of the disaster and possible damage. Natural disasters endanger health and lives of the population, inflict enormous matarial damage and thus significantly influence upon everyday life of population of the Republic of Serbia whose material position is unenvialbe even without the damage caused by natural disasters.

The table below contains the data relating the natural disasters registered in the last 20 years or so on the territory of The Republic of Serbia, as well as the data relating epidemic of contagious diseases in the last 100 years.

[25] PROCENA ranjivosti na klimatske promene :Srbija / [autori Goran Sekulić ... et al.]. - Beograd : Centar za unapređenje životne sredine : Svetski fond za prirodu, 2012 (Novi Sad : Stojkov). - 66 str. [ESTIMATION of vulnerability to climate changes: Serbia, authors Goran Sekulić ... et al.- Belgrade: Centre for the Environment Improvement: The World Fund for Nature, 2012(Novi Sad : Stojkov). – p.66]

Table 3: Identification of extreme events

Process type	Date	Catchment area/ Region	Municipality	Fatalities	Overall losses (€)	Additional information
Earthquake	May 1980	Kopaonik				measuring 5,8 on Richter scale
	September 1998		Mionica			measuring 5,7 on Richter scale
	November 2010		Kraljevo	2 killed, 180 injured		measuring 5,4 on Richter scale
Flood	1999	The river Velika Morava	Sumadija	8		30 bridges damaged
	2005	The river Tamis	Secanj, Zitiste, Plandiste			85.000 ha ad 150 houses flooded, 1000 people evacuated
	2005	The river Juzna Morava	Nis, Jablanica, Rasina, Toplica			
	2014	Serbia	24 municipalities	51	1,800,000,000	31879 people evacuated
Landslides and escarpments	2006	Bogdanje	Trstenik			130 houses destroyed
	2014	Umka-Duboko	Belgrade		54,000,000	Area of 1.8 km^2, about 14,000,000 m^3
	2014	Krupanj	Krupanj		4,680,000	389 facilities either damaged or destroyed
	2014	Kladovo	Kladovo			30 landslided
Blizzards and snowdrifts	February 2014	Vojvodina, Eastern Serbia	Feketic, Majdanpek, Knjazevac			snowdrifts 5m high
	January 2017		13 municipalities in Serbia	Several people	60,000 per day	Regular ice defence along part of the Danube, Sava and the entire flow of the Tisa
Hail	May 2015	Central Serbia	Arilje, Kragujevac		10,000,000	50 % of raspberry growing areas
	June 2016	Banat	Pancevo			Damaged facilities, vehicles, crops
Drought	2000	Vojvodina and Central Serbia			657,000,000	Extreme drought, 37-61 tropic days
	2003	Vojvodina nad Central Serbia			940,000,000	Extreme drought
	2007	Serbia			564,000,000	Caused 258 forest fires
	2011	Eastern, South-eastern and Central Serbia			470,000,000	Extreme drought
	2012	Vojvodina and Central Serbia			1,900,000,000	5 to 8 heat waves
Epidemic of contagious diseases	1914-1918	Serbia		150,000 - 200,000		Typhus
	March 1972	Serbia- total number of 174 persons	124 Kosovo, 1 Vojvodina,	175 ill, 35 died		Variola
	1998, 2010, 2014	Sokobanja, Pcinja, Gadzin Han		– 16 30		Tlaremia
Large-scale fires	2007	Stara planina, Rtanj,	Pirot, Kraljevo, Vranje	Several injured	40,000,000	22.000 ha of forest, 258 forest fires
	August 2012	Tara, Zlatibor	Bajina basta	2 killed, 22 injured	more than 30,000,000	11.000 ha of forest, 20 large-scale fires

The study *„Study on Economic Benefits of RHMS of Serbia", The World Bank study group, 2005, Belgrade, Serbia* identified the weather dependent economic sectors in The Republic of Serbia, participation of these sectors in gross national income (without VAT), registered and assessed damage. Participation of the weather dependent sectors in gross national income of The

Republic of Serbia without the Autonomous Province Kosovo and Metohia, at constant prices without VAT from the year 2002 for the period from 2000 to 2004 varied from 42% to 43.8%. Already in 2005 participation of the weather dependent sectors in gross national income of The Republic of Serbia was 47.18%. The World Bank's Study comprised only 49% of the weather dependent sectors and it did not take in consideration the damage caused by forest fires. However, 258 forest fires were registered during 2007. The area of 33.000 hectares of overgrowth was burnt an out of that area, 16.000 hectares were forest area. The forest fires caused the damage of about 40 million Euros. 24 million Euros was the amount necessary only for recovery. Indirect damage was not estimated.

Table 4 shows the estimated damage in the weather dependent sectors in The Republic of Serbia. There is no doubt that Serbian economy suffers enormous losses in material goods, but it is also obvious that the atmospheric disasters on the territory of The Republic of Serbia cause losses in human lives.

Table 4: *Estimated damage in the weather dependent sectors in The Republic of Serbia*

Sector/unfavorable weather events	**Estimation of losses in sectors**	
	Average annual losses in millions of dinars	**Average annual losses in human lives**
Agriculture/floods	from 3.100 to 8.500	Several to tenths
Waterpower engineering/floods	About 1.960	----------
Agriculture/hail, heavy rainfalls, strong wind	About 7.316	Several to tenths killed by thunder stroke
Agriculture/ drought, frost	About 4.000	No losses
Production of energy (heat)/ extremely low air temperature	About 716	Several to tenths
Maintenance of roads/snow, ice, icing	About 3.500	----------
Losses in human lives on highways, regional and local roads caused by bad weather conditions vary from 105 to 131 per year		
Commercial air traffic	From 54 to 72	----------
TOTAL	**From 16.648 to 48.572**	**From several to 160**

1.1.1.1 Earthquakes

Seismic activity is present on the territory of Serbia where 50% of the territory is potentially threatened by the earthquakes magnitude of which is 7 and 20 % by the earthquakes magnitude of which is 8.[26]

[26] UN (2008). *South Eastern Europe Disaster Risk Reduction and Adaptation Initiative – Risk Assessment for South Eastern Europe*, Desk Study Review, Geneva: United Nations.

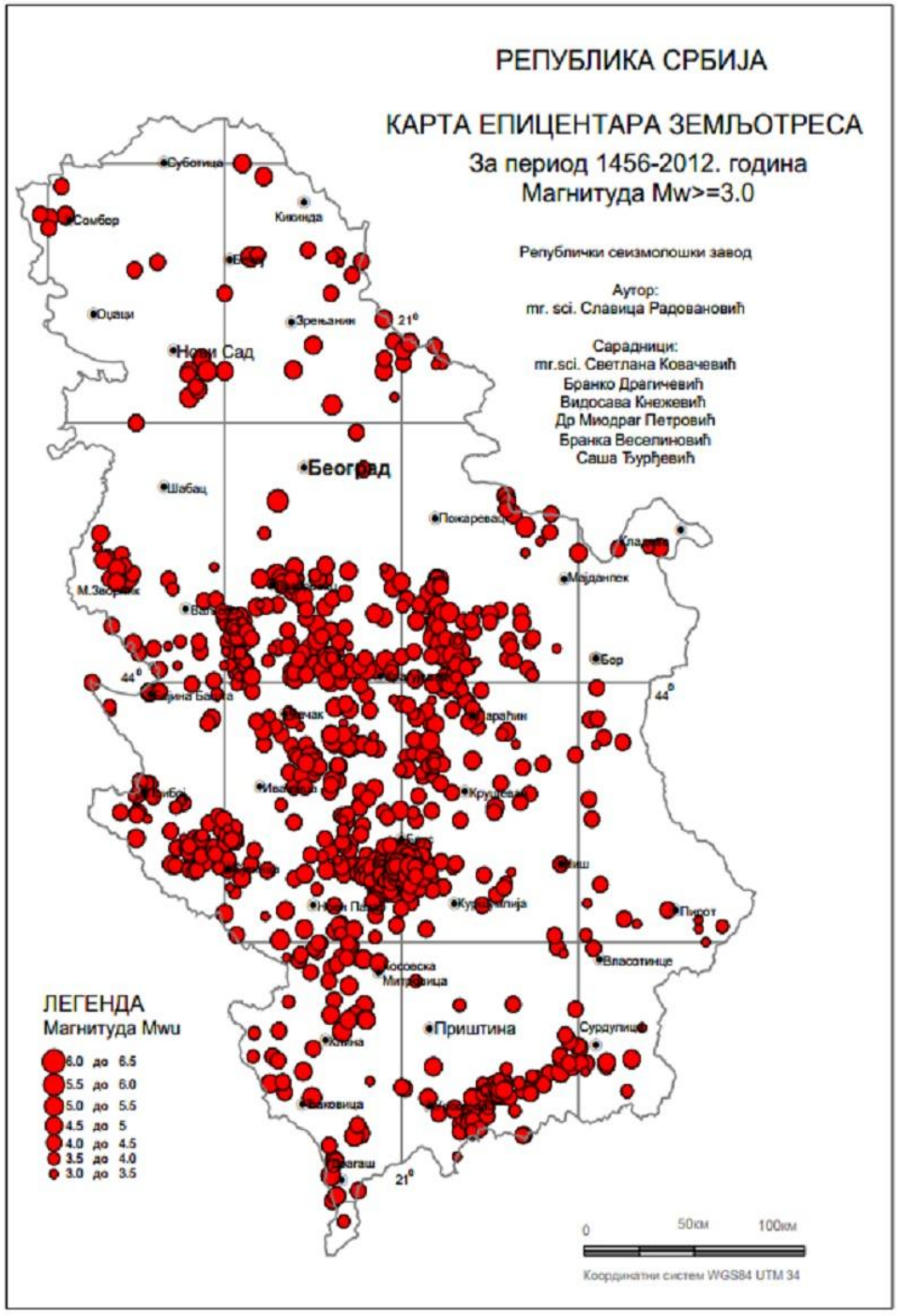

Figure 3.Map of epicenter of the earthquakes in Serbia in the period 1456-2012 Source: www.seismo.gov.rs

Majority of the earthquakes take place in Central Serbia and the areas around Kopaonik, Mionica, Rudnik, Trstenik[27] and South Serbia.

Serbia is situated in seismically active area, on the edge of so-called Mediterrenean transitional seismic zone or, to be more precise, Mediterranean belt. Thanks to its position on the very edge of the plate, the earthquakes in Serbia cannot measure more than 6,2 to 6,3 on the Richter scale.

[27] Radovanović, S. (2008). Seizmološka izučavanja u Srbiji. *Materijali i konstrukcije* 51(2), 66-74. [Radovanović, S. (2008) Seismic Research in Serbia, *Materials and Constructions* 51(2), pp. 66-74]

The strength of the earthquake which occurred on Kopaonik on 18 May 1980 was 55,8 on the Richter scale. Based on the first catalogues issued by the Seismic Bureau, constant weak to moderate seismic activity was registered in the area of Kopaonik in the period from 1900 to 1980. 32 earthquakes were located from the beginning of 2009 to 11 February 2009, and the last stronger earthquake was registered on 10 April 1998 and its magnitude was 4,5 on the Richter scale.

Epicentre of the earthquake in the area of Mionica was in several villages in that municipality and the municipality of Ljig, the mountain chain from Suvobor to Maljen. According to the data provided by the Commission for making of the damage list, about 12000 objects and 6500 houses were damaged only on the territory of Mionica.

On Wednesday, 3 November 2010 at 01:56 an earthquake with magnitude of 5,4 degrees in Richter occurred in the region of Kraljevo. Intensity of the earthquake was estimated to 7,5 degrees in MCS. The epicentre was about 10km north-west of Kraljevo, in the valley of the Gruža river in the villages Vitanovac, Vitkovac and Stubal by the road Kraljevo-Kragujevac.

The earthquakes of the abovementioned intensity are considered as moderate earthquakes which can cause damages on poorly-built buildings, older buildings and structure facilities, i.e. the facilities without seismic protection. The earthquake was felt in other towns in Serbia as well, and the Republic Seismic Bureau published the data saying that these quakes were of lower intensity, about 3 degrees in Richter.

The earthquake caused the most serious damage to a suburb of Kraljevo – the settlement Grdica where a married couple died because of collapse of the house they lived in. There were also 180 injured people but none of them were life-threatened.

Damage caused by the earthquake was visible on many houses. There were about 16,000 damaged facilities out of which more than thousand and a half were out of use, while about 10,000 of them were to be repaired.[28] Some parts of the town of Kraljevo were without electricity supply as well as without water. As for public institutions, the Health Centre was damaged as well as the Public Health Institute. Military facilities also suffered damage.

Figure 4 shows the map of epicenter-closer area affected by the earthquake on 3 November 2010 and the zones with 7 and 6 degree of damage.

[28] prezentacije.mup.gov.rs/svs/2010-11-03.html

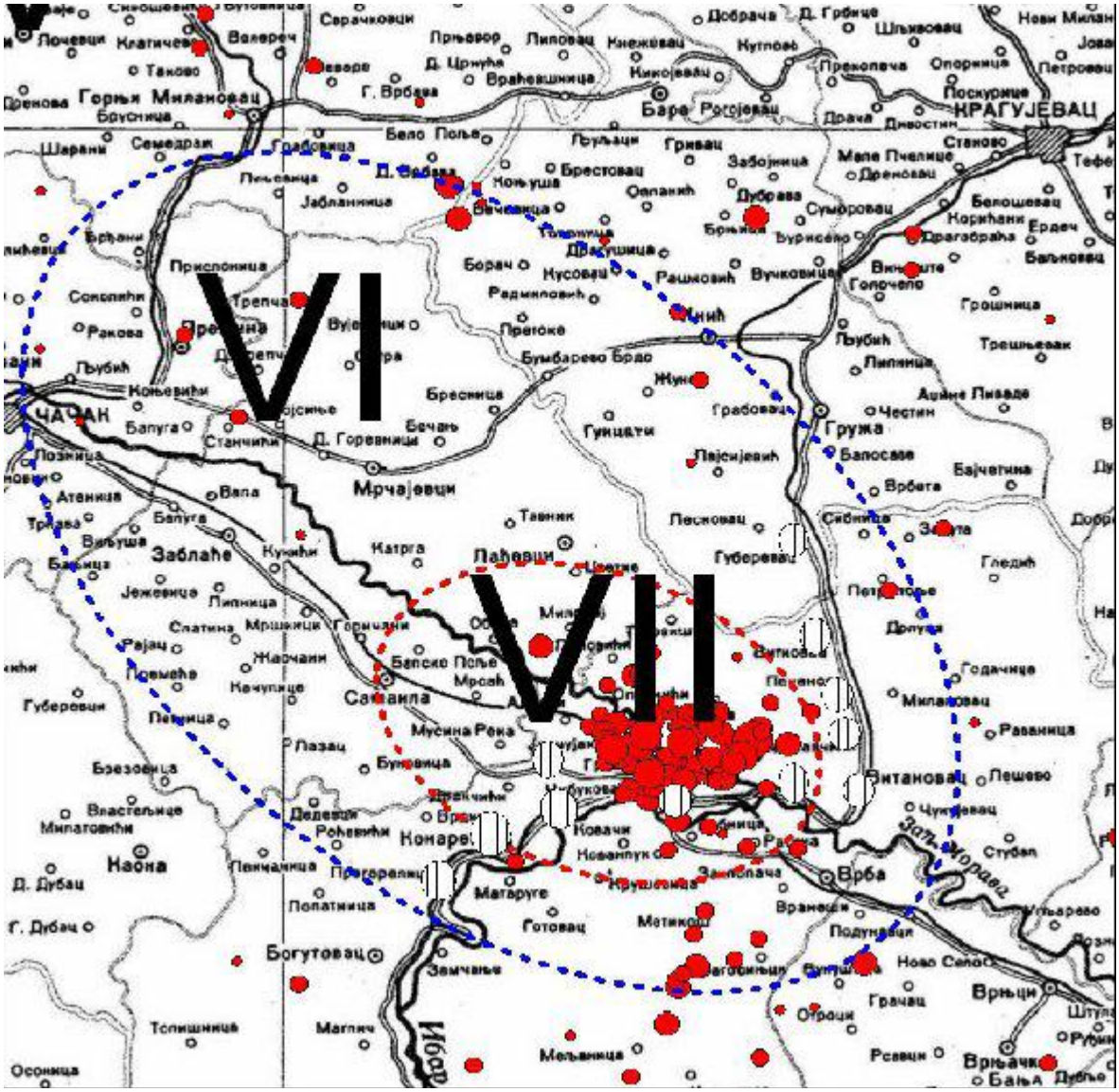

Figure 4: Map of the epicenter-closer area affected by the earthquake on 3 November 2010. Source: www.seismo.gov.rs

Maximum damages in the 7 degree zone were: total demolition of the chimneys and their falling inside the buildings, demolition of the dividing walls, gaping cracks in the supporting walls, and totally demolished buildings in cases of the ones without protection against earthquake.

Maximum damages in the 6 degree zone were: partial demolition of chimneys, cracking of the dividing walls, cracks in the supporting walls.

1.1.1.2 Floods

Floods affect large number of people and cause enormous material damage. Floods on big rivers and torrential floods are most frequent natural disasters in the Republic of Serbia and that is because of the position and relief of Serbia.

The rivers in Serbia belong to the watersheds of the Black (81,261 km^2 or 92% of the Serbia territory), Adriatic (4,500 km^2 or 5% of the Serbia territory) and Aegean (2,650 km^2 or 3% of the Serbia territory) seas. On more than 90% of the Serbian territories, there are rivers that join the Danube, thus going to the Black Sea. The rivers in the Aegean one are the Lepenac, Pcinja and few others in the southern Serbia, along the border with Macedonia and Bulgaria. The longest river in Serbia is the Danube. More than one fourth of this river's bed stretched through Serbia, and all 588 km are navigable. Also among the navigable rivers are the Sava and Tisa, as well as part of the Morava, which is the largest Serbian river. The Morava flows through the most fertile area of the central Serbia, and the most populated, called Pomoravlje.

In Serbia, 12.4% of its territory (10,968 km^2) is potentially endangered by flooding. The largest flood areas are in the basins of rivers Tisa (2800 km^2), Sava (2,243 km^2), Velika Morava (2,240 km^2) and Danube (2,070 km^2)[29]. The main causes of floods in the Tisa river basin are small stream slope, geological composition and broad alluvial plains. In the river basins of Danube and Sava, floods are caused by precipitation and by coincidental flood waves of their tributaries. The main problems in the Velika Morava River basin are flash floods.

Riverine and torrential floods are the most significant natural disasters on the territory of Serbia. Torrential flood represents sudden appearance of maximal discharge in river bed with high concentration of hard phase. Climate, specific characteristics of relief, distinctions of soil and vegetation cover, social-economic conditions have done that the occurrence of torrential flood waves is one of the resulting forms of existing erosion processes. The region exposed to the greatest flood risk is the Vojvodina.

The torrential floods that occurred in the watersheds of the main tributaries of the following rivers in the past 20 years were: the Kolubara (June of 1996; May of 2011; May of 2014), the Great Morava (July of 1999), the Kolubara and the Drina (June of 2001), the South Morava (November of 2007), the West Morava, the Drina and the Lim (November of 2009), the Great Timok (February of 2010), the Pcinja (May of 2010), the Drina (December of 2010) and the Sava (May of 2014). Problem also arises due to reduction in or complete lack of maintenance of flood protection facilities, but also due to inadequate maintenance and use of river channels.

According to Dragicevic et al. (2013)[30], the potentially flooded area in Serbia with a 100-year return period is 15,198.07 km^2 (17.2% of total area). Serbia is mostly threatened by the floods of small to medium-size torrential rivers mostly in late spring (from May to the end of June), a period characterised by intensive rainfalls of a few-hour duration. Kovacevic-Majkic et al.

[29] Garilović, Lj., 1981. Poplave u SR Srbiji u XX veku – uzroci i posledice, Posebno izdanje, knjiga 52, Srpsko geografsko društvo, Beograd.
[30] Dragicevic, S., Ristic, R., Zivkovic, N., Kostadinov, S., Tosic, R., Novkovic, I., Borisavljevic, A., Radic, B., 2013. Floods in Serbia in 2010 – Case Study: The Kolubara and Pcinja River Basins. Geomorphological impacts of extreme weather, Springer Geography, 155-169.

(2014)[31] found that floods threaten 18 % of Serbia's territory along large rivers (1.6 million ha), as well as 512 large settlements, a great number of industrial facilities, 4,000 km of roads and 680 km of railroads.

One of the great registered floods occurred in Obrenovac in 1930. Level of water was 40 cm above street level. Also, flood occured 7 years later (1937), when embankment was breached at Breska settlement in Obrenovac.

The flood in the Juzna Morava basin was in 1948. It was caused by rains which tired of land with water and flash floods brought a lot of sediment in river basin. As a result of flood, the Juzna Morava River destroyed all bridges.

One of the longest and the largest flood was in the Danube river basin from March to July 1965. The main cause was snow melt in Czechoslovakia. 43 municipalities were affected with flood only on the territory of Vojvodina. Also, flood destroyed 1800 houses and 23,000 people and 60,000 livestock were evacuated. 300,000 people had to be vaccinated of infectious diseases. Many companies, roads (214 km), railways (80 km) were damaged. 50,000 people worked daily on the rescue and it was built 177 km of embankment. In addition, flood occurred in the Velika Morava basin (May 1965) and in the Zapadna Morava basin (May 1965). Flood covered area of 17,000 ha in the Velika Morava basin. The main reason for flood in the Zapadna Morava basin was precipitation (more than 100 mm) in Čačak, Kraljevo and Kruševac, and flood affected all municipalities this basin.

Overflow of river Tisa caused flood in 1970. The main reason for this disaster was rain and snow melt in Hungary and in Romania. Government was taken the comprehensive measures against flood, for the first time in Serbia.

At the end of the 20th and beginnig of the 21st century catastrophic floods used to take place frequently. Significant floods occured in 1980, 1981, 1988, 1999, 2002, 2005 and 2006.[32]

Many embankments (for 50 years return period) were built after II world war in Obrenovac, but disastrous flood occurred in 1981.

In the river basins of major tributaries of the Velika Morava great flash floods occurred in July 1999. As result of floods 8 people lost their lives, dozens of thousands of houses and hundreds of commerce buildings were damaged and 30 bridges in basins of the Velika Morava, the Jasenica, the Kubršnica and the Lepenica were destroyed[33].

Flood occurred on the Tisa and the Tamiš in 2000. Main reason for flood was sudden melting of snow and intensive rainfall from the slopes of Carpathian Mountains.

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[31] Kovacevic-Majkic, J., Panic, M., Miljanovic, D., Miletic, R., 2014. Vulnerability to natural disasters in Serbia: spatial and temporal comparison. Natural Hazards 72, 945–968.

[32] Милановић, А., Урошев, М., Милијашевић, Д. (2010): Поплаве у Србији у периоду 1999-2009. година хидролошка анализа и мере заштите од поплава. Гласник српског географског друштва. Свеска XC. Бр.1:93-121.[Milanović, A., Urošev, M., Milijašević, D. (2010): The Floods in Serbia in the period 1999-2009, hydrological analysis and protection measures against floods, Herald of the Serbian Geographic Association, Volume HS, No 1:93-121]

[33] Milanović, A., Milijašević, D., 2008. Recent floods as a factor of environment degradation in Serbia. Fouth International Conference „Global Changes and Problems Theory and Practice", 20-22 April 2008, Sofia, Bulgaria, Proceedings, Faculty of Geology and Geography, Sofia University „St. Kliment Ohridski", pp. 87-92.

In the flood on the Tamiš in 2005, the most of damage were in municipality Sečanj, Žitište (approximately 50,000 ha of area with 20,000 people) and Plandište (35,000 ha with 14,000 people) (Milanović and Milijašević, 2008).

Flooding in April 2005 caused serious damage to private property, agriculture and public infrastructure. For example the total damages in the three most flood prone municipalities in Banat caused by the flooding was estimated at EUR 12.6 million. According to Vode Vojvodine the total costs of rescue operations and protection works, excluding of reconstruction works, amounted to EUR 3 million.

In November 2007, flood occurred in the Vlasina river basin, due to saturation of soil with water and high elevation of ground water, caused by snow melting (Milanović et al, 2010).

In 2010, the flood in the Pcinja River Basin and in the Kolubara River Basin affected 670 ha of land and 257 buildings were flooded with the total damage at 370,000 €. According to data provided by the Directorate of Water of the Republic of Serbia, the material damage caused by floods over the past several years is estimated to be 25 million euros a year. Over the past 60 years, floods killed more than seventy people and caused material damage estimated to be eight billion euros[34].

Catastrophic floods registered in Serbia in May 2014 caused enormous damages. During the third week of May 2014 Serbia was affected by heavy rains and the rains were caused by the field of low air pressure ("Yvette") formed above the Adriatic Sea. Record amount of rainfall was registered then: more than 200mm of rain fell in Western Serbia during only one week which equals the amount of rainfall for a three-month-period under standard conditions.

Enormous amount of rain caused fast and significant increasing of big rivers levelin Western, South-western, Central and Eastern Serbia on the Sava, Tamnava, Kolubara, Jadar, Zapadna Morava, Velika Morava, Mlava and Pek rivers. Enormous amount of rain and increasing of the water level had three immediate effects:

- High intensity sudden floods which caused total demolition of the houses, bridges and parts of the roads (in Krupanj and in vicinity of Šabac);
- Increased level of water caused big floods in urban parts (especially in Obrenovac) and in rural parts (around Šabac) and
- Increased flow of underground waters caused occurence of numerous landslides (around Krupanj and Bajina Bašta).

As a result of these events, total number of 1,6 million people in whole country were either directly or indirectly affected by the disaster. Floods and landslides caused death of 51 people out of which 23 people drowned. Besides, another 31,879 persons were temporarily evacuated from their flooded and destroyed homes; 24,000 of them were from Obrenovac. Most of the evacuated persons found their shelter with their relatives, but 5,000 were placed in temporary accommodation organized by the Red Cross of Serbia and RS Government. This doubled number of internally displaced people which had made majority of the displaced people even before the floods.

[34] Ristic, R., Kostadinov, S., Abolmasov, B., Dragicevic, S., Trivan, G., Radic, B., Trifunovic, M., Radosavljevic, Z., 2012. Torrential floods and town and country planning in Serbia. Natural Hazards and Earth System Sciences 12(1), 23–35.

Total value of the destroyed goods in 24 affected municipalities covered by Damage assessment was 885 million Euros, and value of the losses was 640 million Euros, so total amount was 1,525 million Euros as shown in the Table 5. This amount of money makes 3 % of total Gross domestic product in the whole country providing evidence of the seriousness of the catastrophy caused by the floods and landslides.

The damage from the flood in Kolubara mines is estimated to at 100 million EUR minimum. Water turned Kolubara mines into lakes. Each of the four mines is flooded, two of them completely. In the biggest OPM Tamnava – West Field, even 10 excavators are flooded and six of them are completely under water. Mining Basin Kolubara produces 70% of Serbia lignite which is used in thermal power plants TENT producing more than 50% of Serbian electricity. At some places, water is as deep as 60 meters. In Obrenovac and the region, 22 power transformer stations were flooded and one cannot enter there.

When we take in consideration some municipalities which were not included by the Needs assessment in the proces of renovation and which were affected by the disaster less than previously mentioned ones, the eastimated value of the damages and losses should be increased from 1.7 to 1.8 million Euros.[35]

Table 5. Asessment of total damage and losses caused by the floods

	Effects of floods expressed in millions of Euros		
	Damage	**Losses**	**Total**
Social	**234,6**	**7,1**	**241,7**
Housing	227,3	3,7	230,9
Education	3,4	0,1	3,5
Health	3,0	2,7	5,7
Culture	1,0	0,6	1,6
Productive	**516,1**	**547,6**	**1.063,6**
Agriculture	107,9	120,1	228,0
Production	56,1	64,9	121,0
Trade	169,6	55,2	224,8
Tourism	0,6	1,6	2,2
Mining and energy	181,9	305,8	487,7
Infrastructure	**117,3**	**74,8**	**192,1**
Traffic	96,0	70,4	166,5
Communication lines	8,9	1,1	10,0
Water supply and hygiene	12,4	3,2	15,7
General problems	**17,2**	**10,6**	**27,9**
Environment	10,6	10,1	20,6
Management	6,7	0,6	7,2
Total	**885,2**	**640,1**	**1.525,3**

[35] Floods in Serbia in 2014: Report on assesment of the needs for recovery and renovation after the damages caused by floods, Belgrade, 2014

1.1.1.3 Landslides and Escarpments on the Slopes and Inclinations

The area of Serbia is seriously exposed to risks from landslide.
Estimates show that the highest number of landslides in Europe is located on the territory of Serbia. About 25% of Serbia is potentially at risk for landslides and rock falls[36]. Furthermore, one of the largest landslides on the continent, Duboko, is in Serbia. About 70% of landslides in Serbia are known and researched (Figure 5.).

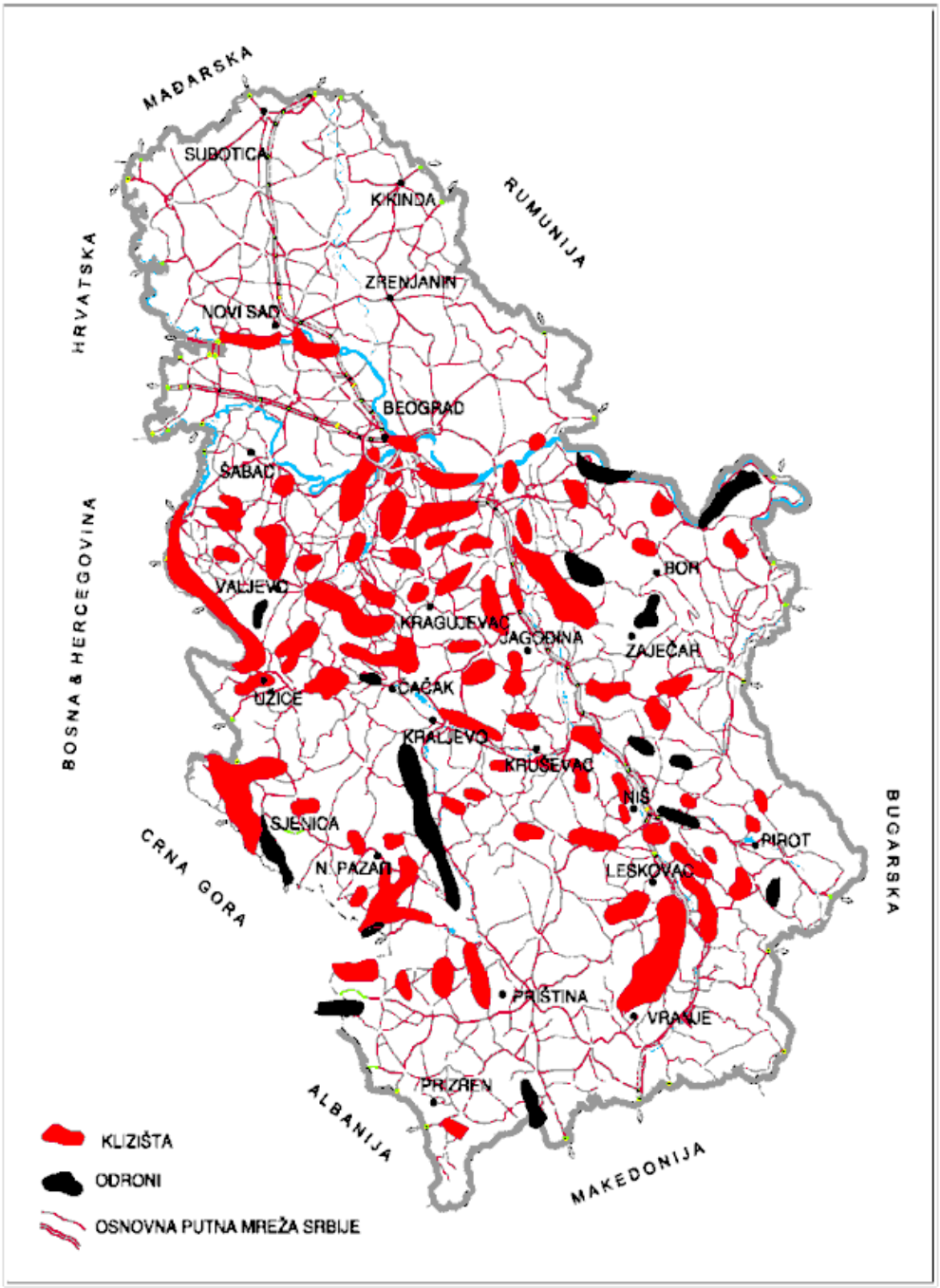


Figure 5. Map of rockfalls and landslides in Serbia[37]

[36] Lazic, M., Bozovic, D., 1995. Geological atlas of Serbia: Engineering Geological Map 1:2000000, Republic Foundation for Geological Investigations, Belgrade.
[37] Abolmasov B. 2014, Predavanja iz inženjerske geodinamike. Zaštićena multimedijalna prezentacija. www.rgf.rs

In Serbia, huge landslides that caused significant social-economic influence were registrated. Some of them are: Zavoj (1963), Jovac (1977) and Bogdanje (2006).

Landslide Zavoj was created after heavy rainfall and snow melting in spring 1963. Sunny side of Stara Planina was affected and rushed into the valley of the Visočica River. This created a natural dam and created a lake behind the dam, flooding the village of Zavoj. Landslide was 1.3 km long and 160-220 m wide with mass of 240,000 m^2. Natural dam was later consolidated and surpassed by the construction of natural dam Zavoj.

Landslide was activated in village Jovac, municipalities Vladičin Han, in February 1977. Landslide was 3 km long, 1 km wide with sliding surface of 500 m deep. Total horizontal movement was 500 m, for one month (total period of movement). Landslide closed the canyon of Jovačka River was in a distance of 200 m. The accumulation of water created a lake with the following dimensions 1,500 m long, 200 m width and 10 m depth. The total damage was estimated on 15 million euros. Especially, agricultural production was damaged with 63.32% of the overall damages (about 500 ha of forest, fields, pastures and orchards was destroyed). Village Jovac had the most of the damage with 118 householders destroyed, Ostrovica had 18 householders destroyed, Belovance 11 and Kunovo 7[38].

Landslide Bogdanje was caused by heavy floods and uncontrolled deforestation in village Bogdanje near Trstenik. 200 people were evacuated and 130 houses were destroyed. In the same year, emergency state was proclaimed in Trstenik and Lucane. In Koceljeva occured 95 landslides and they damaged 67 houses. Also, in Ljig municipality was 150 landslides.

There are around 3,000 active and potentially active landslides in Serbia. Most of them cause the damage on local roads and highways and a few of them cause the damage on residential buildings. As far as Serbia is concerned, there are landslides in south-eastern part of Pannonian plain and in central parts. One of well-known landslides is on the right bank of the Sava and the Danube (Umka, Duboko, Vinča, Ritopek, Čortanovci, near Grocka, Karaburma, Smederevo and near Novi Sad). Main reason for landslides trigger is permanent erosion of the right riverbanks and intensive precipitation.
One of the oldest landslides is Umka-Duboko (first written documents about them are 200 years old), with maximum depth of 26 m. Total length of Umka is 1,700 m and its width is around 900 m. It is the shape of a wide fan with area of approximately 1.8 km^2 and volume of around 14,000,000 m^3. Umka directly depends on the precipitation and the levels of the Sava and it is slow moving landslide[39]. The total costs of remediation landslide Umka are estimated on 54 million euros[40].

Landslides derived after floods in 2014 caused enormous losses to citizens and economy.

[Abolmasov B. 2014 – Lecture in the field of engineering geodynamics, multimedia presentation www.rgf.rs]
[38] Jevremović, D., Kostić, S., 2011. 1977 Jovac Landslide – a New Overlook on Environmental Effects and Material Loss, Proceedings of 17th Meeting of the Association of European Geological Societes, 14-18 September 2011, Belgrade, pp. 193-197.
[39] Abolmasov, B., Milenković, S., Marjanović, M., Đurić, U., Jelisavac, B., 2015. A geotechnical model of the Umka landslide with reference to landslides in weathered Neogene marls in Serbia, Landslides 12, pp. 689-702.
[40] Mitrović, P., Jelisavac, B., 2006. Sanacija klizišta Duboka, Materijali i konstrukcije 49 (1-2), pp. 46-59.

Heavy rains in our country in May 2014 and afterwards left a large amount of water that eroded and destroyed ground, moving huge amount of eroded material. Torrential streams destroyed fields, roads, railways, houses and other objects. Broad landslides occurred after the floods.
One of the municipalities most affected by landslide in 2014 was Krupanj. Total number of damaged and destroyed objects was 389. In Krupanj, total damage was estimated on 5 million Euros[41].
In municipality of Kladovo, 30 landslides were registrated after intensive rainfall and floods in September 2014[42].

1.1.1.4 Adverse and Dangerous Atmospheric Disasters

Snow Blizzards and Snowdrifts

In February 2014 east wind of hurricane strength made enormous snowdrifts in Vojvodina. The drifts were up to five meters high and a few hundred meters long. Firefighting, military and gendarmerie units were helping the local winter services in such a way that they used heavy machinery, primarily on the highway Subotica-Novi Sad near Feketić, as well as on the road between Bačka Topola and Mali Iđoš where the rescue teams took the frostbitten pasengers from their under snow vehides and transported them to the nearest villages. More than 700 snow-trapped people were evacuated and the military and police helicopters rescued 172 persons. All of 100 passengers were evacuated from two international trains which were blocked between Zmajevo and Vrbas because of strong snow drifts and wind.
In the beginning of 2014, due to natural disaster caused by snowfall and low temperatures in northern part of Serbia (Vojvodina), the Serbian Army Forces were involved in the tasks of reconnaissance from ground and air, the tasks of air and land evacuation of the snow-trapped citizens and passengers on the corridor 10 along the highway E-75 from Novi Sad to Bačka Topola. During the period of four days the Serbian Army members managed to evacuate 332 citizens (240 air-evacuated and 92 land-evacuated), the trapped ones were provided with about 1,000 l of tea, about 600 meals and 350 pieces of clothes and blankets for warming.[43]

In January 2017 the emergency situation was declared in 13 municipalities in Serbia because of extremely low temperatures. 139 people were evacuated in Serbia from the beginning of the ice wave. Most of them were evacuated from Vranje and its surroundings, there were 300 rescuers and firefigters on the terrain and the army and police members were involved depending on the needs. There were even human casulties from freezing.
The roads: Trgovište – Donji Stajevac - Radovnica - Bosilegrad, Trgovište – state border with Macedonia (the border crossing Kalovo).
Regular ice protection was declared on a part of the Danube, Sava and along complete flow of the Tisa. Navigation was suspended on the Tisa – from the dam on the Tisa to the border with Hungary, on the Sava near Sremska Mitrovica and near Šabac, as well as on the Danube from Bezdan to Kladovo.

[41] Đokanović, S., 2016a. Landslides and damages at objects as consequence of intensive rainfalls in municipality of Krupanj, Technics-Mining, geology and metallurgy 67 (1), pp. 48-53.
[42] Đokanović, S., 2016b. Intensive rainfalls as reason for forming the landslides in municipality of in September 2014 Kladovo, Technics-Mining, geology and metallurgy 67 (6), pp. 823-830.
[43] Simović, M., 2014. Experiencies relating engagements of the Serbian Army in emergency situations in 2014 - experiencies, Finall paper at Advanced Security and Defense Studies, Military Academy Human Resource Department MoD

Suspension of navigation caused daily damage in the amount of 60,000 Euros, because the damage per ship was 1,000 Euros and 60 ships were anchored.

Hail

Hail which was falling on the territory of Central Serbia on 15 May 2015 around four o'clock devastated orchards and raspberry grounds. Hail the size of an egg was falling in the villages around Kragujevac, and the hailstorm cloud continued to move towards Paraćin affecting then the area of Ivanjica which is well known for production of fruits, especially raspberries. The hail destroyed 50% of the raspberry ground in the area of Ivanjica municipality, and an unofficial damage assessment is 10 million Euros.[44]

Nasty weather and hail the size of a fist which stroke Pančevo on 20 June 2016 around 7 PM inflicted enormous damage. The most numerous damages could be found on the roofs of the houses, residential buildings but on the cars as well. Several people who were either outside or were trying to rescue their property suffered minor injuries. The crop also suffered damage, both in the south of Banat and north of Banat where the hail totally destroyed the harvest on the area of around three thousand hectares in the area of the village Mokrin near Kikinda and serious damage was inflicted on another approximately two thousand hectares.

Drought

Drought is both a complex natural hazard and a disaster[45], which is characterized by lack of precipitation. Four distinct types of drought can be identified: meteorological, agricultural, hydrological and socio–economic droughts[46]. It is not easy to determine the beginning and the end of droughts (they can persist for months or even years) and often cover large areas. That is why they represent one of the most expensive disasters.

Drought is often represented in terms of drought indices, which facilitate identification of drought intensity, duration, water deficiency and spatial extent. One of the most often used drought indices is SPI (Standardized precipitation index)[47]. Duration of severe and extremely dry periods may serious impact agriculture, ecology, economy and water supply. Adequate estimation of drought characteristics implemented in drought monitoring and early warning might be helpful for planning of efficient use of water resources, hydroelectric and agricultural production.

Impacts of drought include:

- Economic impacts include losses in the timber, agricultural, and fisheries communities, resulting in the form of higher commodity pricing,

[44] http://www.blic.rs/vesti/drustvo/izgubili-milione-za-15-minuta-grad-ubio-i-nas-i-maline-tuzicemo-drzavu/pd9fqgq

[45] Paulo, A.A., Rosa, R.D., Pereira, L.S., 2012. Climate trends and behaviour of drought indices based on precipitation and evapotranspiration in Portugal. Nat. Hazards Earth Syst. Sci. 12 (5), 1481–1491.

[46] Wilhite, D.A., Glantz, M.H., 1985. Understanding the drought phenomenon: The role of definitions. Water Int. 10 (3), 111–120.

[47] McKee, T., Doesken, N., Kleist, J., 1993. The relationship of drought frequency and duration to time scales, Eighth Conference on Applied Climatology, Anaheim, California.

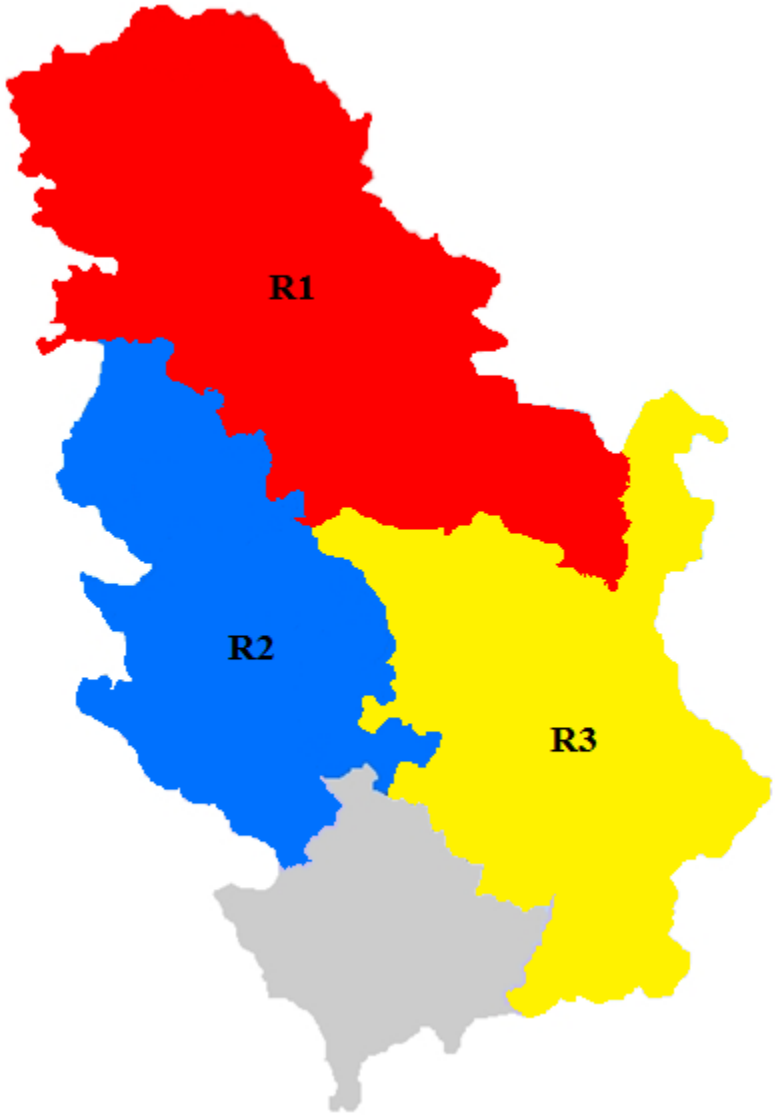
- Social impacts include increased chance of conflict over commodities, fertile land, and water resources or abandonment of cultural traditions, loss of homelands, changes in lifestyle, and increased chance of health risks due to poverty and hygiene issues,
- Environmental impacts of drought include loss in species biodiversity, migration changes, reduced air quality, and increased soil erosion.

Territory of the Republic of Serbia is located in a region of the world considered vulnerable to climate change[48]. Droughts are most prevalent in the Vojvodina and Posavina (north of the country, where level of rainfall is low and where agricultural land is of the best quality) and in the eastern areas of Serbia. Droughts in Serbia usually occur every 3 to 5 years. They can reduce agricultural production ffrom 20 to 80%. Droughts have been frequent since 1990 with increasing intensity and duration. They have had great impact on the production of food and energy, human health, biodiversity and water supply[49]. Droughts cause damages in Serbia, especially to agricultural production (500 million Euros per year).

Gocic and Trajkovic identified three distinct drought sub–regions: R1, R2 and R3[50].

Region R1 includes the north and the northeast part of Serbia, region R2 includes the western part of Central Serbia and southwestern part of Serbia and region R3 includes central, east, south and southeast part of Serbia.
The R1 is characterized by the lowest amount of precipitations in the country and most intensive agriculture. The R2 is mostly forested with the average annual precipitations to 1000 mm, while the R3 is characterized by a moderate–precipitation regime with the average annual precipitations to 650 mm. The R2 had the monthly precipitations values above average, while R1 and R3 had the precipitations values under average in Serbia.

[48] Intergovernmental Panel on Climate Change, (IPCC), 2007. Climate Change 2007: The physical Science Basis, in: Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, edited by: Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K. B., Tignor, M., and Miller, H. L., Cambridge University Press, Cambridge, New York.
[49] Ibid
[50] Gocic, M., Trajkovic, S., 2014. Spatiotemporal characteristics of drought in Serbia. Journal of Hydrology 510, 110–123.



Note: No available date

Figure 6. Drought–based regionalization in Serbia

Time series of SPI–12 for Serbia and three sub–regions are presented in Figure 7. Based on the SPI–12 values and defined categories of dry and wet conditions, the periods of drought were 1948–1953, 1958–1968, 1982–1985, 1988–1994, 2000–2003, and 2011–2012, whereas the periods with wet conditions were 1954–1957, 1969–1981, 1986–1987, 1995–1999, and 2004–2010[51].

[51] Ibid

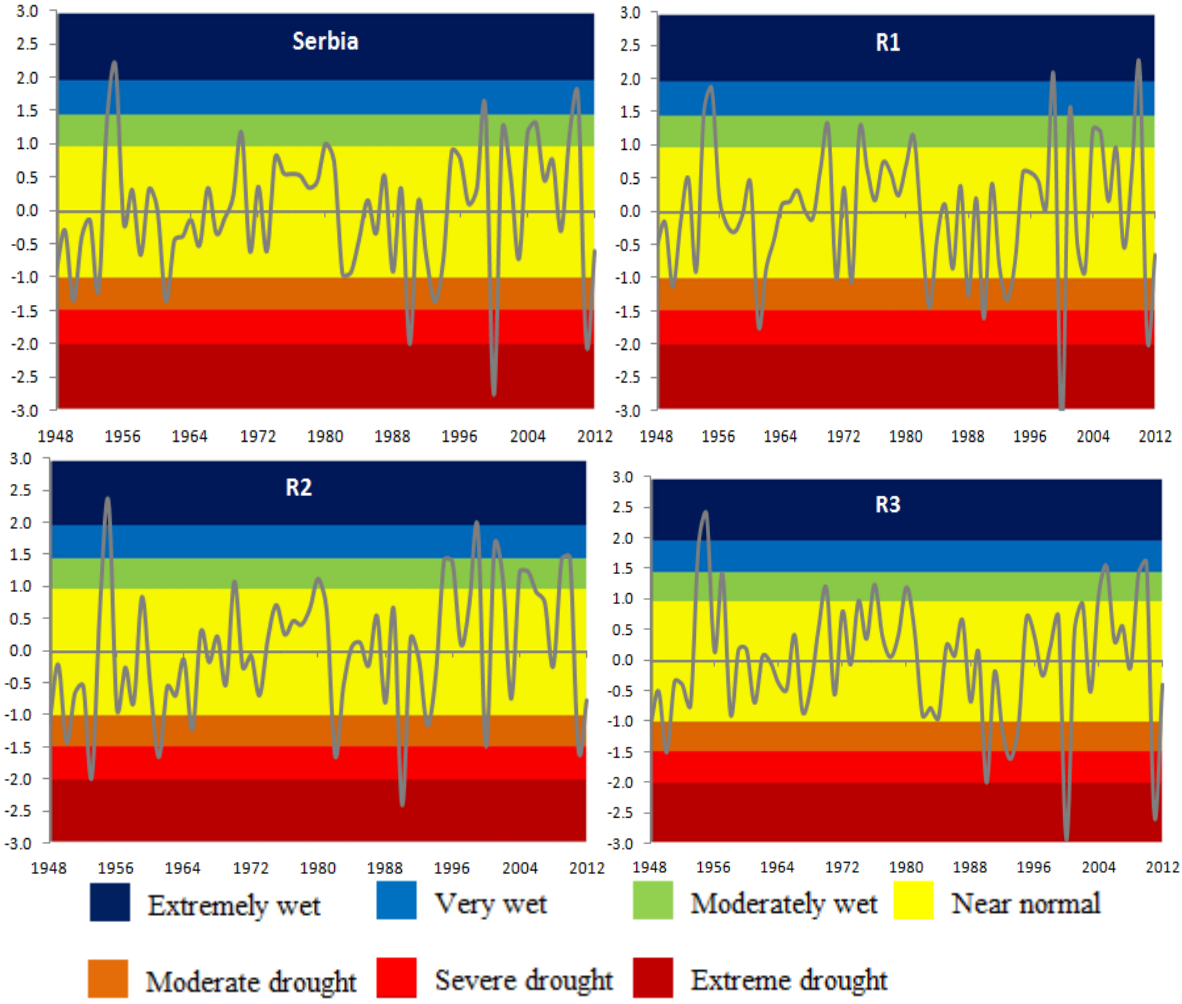


Figure 7. Time series of SPI–12 for Serbia and three sub–regions

Droughts that occurred in 2000 and 2003 had the same characteristics: lack of precipitations and high temperatures during growing season. According to SPI, these droughts fall under the category of extreme droughts[52].

Drought in 2000 occurred in Vojvodina and in Central Serbia. Number of days with air temperatures above 30 ºC was from 37 to 61 days. Total damage was 650 million Euros[53].

One of the longest droughts occurred in 2003, and it started in March and ended in August. The main reason for this drought was high values of average monthly air temperatures during the growing season which caused a large number of tropic days. This drought influenced upon crops, especially upon corn, soybeans, sugar beets and sunflowers[54]. Damage from drought was estimated to the amount 940 million Euros.

[52] Nacionalni akcioni plan ublažavanja posledica suše i degradacije zemljišta, 2015. Ministarstvo poljoprivrede i zaštite životne sredine, Republika Srbija, Beograd. [National Action plan for mitigation of the consequences of drought and the terrain degradation, 2015, Ministry of Agriculture and Environmental Protection, The Republic of Serbia, Belgrade]

[53] Korak, 2012. Vek suše ili vek navodnjavanja, Časopis privredne komore Srbije, N°73, pp. 30-32.[Step, 2012, Century of drought or century of irrigation, Magazine of the Chamber of Commerce of Serbia, No 73, pp. 30-32]

[54] Nacionalni akcioni plan ublažavanja posledica suše i degradacije zemljišta, 2015. Ministarstvo poljoprivrede i zaštite životne sredine, Republika Srbija, Beograd. [National Action plan for mitigation of the consequences of

There was a severe drought in April, July and August 2007. During these months air temperatures were extremely high (35 - 45 ºC), which caused 258 forest fires on the area of 33,000 ha and lower production of corn for 32.4 % than previous year. Only forest fires caused damage of 40 million Euros.

Drought occurred in 2011 caused serious damages in agricultural production. There were droughts in Eastern, South-eastern and in Central Serbia. According to SPI index, drought was a severe and extreme one. The drought was most intensive in August and September.

One of the driest years was 2012, because there was very small amount of rainfall and maximum daily temperatures were over 35 ºC during the period between May and August. The most seriously affected areas were Vojvodina and Central Serbia. There were 5 heat waves (in some places there were 8 heat waves), with average duration of each wave from 6 to 10 days. Weak precipitations, high air and ground temperatures along with increased water consumption in August caused drought again at the end of the summer[55].

According to the information provided by the Chamber of Commerce of Serbia and the Institute of Agricultural Economics in Belgrade, the damage caused by the drought in 2012 was more than 2 billion $, and in 2011 about 500 million $.[56]

1.1.1.5 Epidemics of Contagious Diseases

Large outbreaks occurred in our geographic region in different historical periods: typhus, which caused great damage to Serbian Army and people during World War I, the epidemic of smallpox in Yugoslavia in 1972 and the epidemic of tularemia in the area the former Yugoslavia during the civil war and aggression on our country in the '90s of the last century.[57]

The devastating typhus epidemic broke out in in Valjevo in December 1914, where the Austrians concentrated the 3000 diseased in the Valjevo hospital. Serbian troops liberated Valjevo and found many wounded and patients with typhus in the hospital. This typhus outbreak in Serbia was among the largest in the world. British Colonel, Dr. Hunter wrote: "The 1914/15 typhus epidemic in Serbia was the most sudden to emerge, the fastest to spread, the greatest in intensity, and the fastest-stopped epidemic in history." Dr Richard Strong, head of a US medical mission concluded that "the epidemic of typhus that took place in Serbia in 1915 was one of the scariest in the modern world"[58]. During the First World War in Serbia the disease killed about 150,000 or even 200,000 people. All 595 Serbian doctors were ill and 122 of them died.

Just in the period of intense campaign for eradication of smallpox the epidemic occurred in Yugoslavia in 1972, the largest post-war outbreak in Europe. An outbreak was detected on

drought and the terrain degradation, 2015, Ministry of Agriculture and Environmental Protection, The Republic of Serbia, Belgrade]

[55] Climatological Analysis of the Year 2012 for the Territory of the Republic of Serbia, 2012. Republic Hydrometeorological Service of Serbia, Belgrade.

[56] Џелатовић М.,., et.al: Економске импликације природних катастрофа са посебним осврtом на стање у Србији. Екологика, год. XX, бр. 70, стр. 118. (2013)[Dzelatovic M., et.al:Economic implications of natural disasters with special emphasis on the situation in Serbia, Ecologica, the year XX, No 70, p.118 (2013)]

[57] Infectious Agents as a Security Challenge: Experience of Typhus, Variola and Tularemia Outbreaks in Serbia Prof.Dr Elizabeta Ristanovic, MS, PhD, БЕЗБЕДНОСТ Часопис МУП РС, Београд, 2/2015

[58] Strong, RP. (1920). Typhus Fever With Particular Reference to the Serbian Epidemic. Cambridge: Harvard University Press

March 14, 1972. The epidemic affected a total of 175 persons, and 35 (20%) of them died. There were 99 (56.6%) male patients and 76 (43.4%) female patients. Most patients were registered in the Republic of Serbia (174 ill persons, 124 of them in the Province of Kosovo and Metohia and 1 person in Vojvodina; 35 people died, 26 of them in the Province of Kosovo and Metohia and 1 person in Vojvodina), while in Montenegro 1 person was ill. Out of 175 patients, 105 of them (60%) were previously vaccinated, 66 (37.7%) were unvaccinated, while for 4 of them (2.3%) vaccination status was unknown. It is necessary to emphasize big difference in the fatality rate among previously vaccinated (8%) and unvaccinated persons (35%). There were 52% or 91 people out of hospitals, while 84 patients (48%) were infected in hospitals. With all the problems that occurred in the work, some organizational, technical and other weaknesses, and lack of practical experience, it can be said that Yugoslav health service quickly and efficiently carried out the task of combating smallpox outbreak, which was large by number of cases (175) and geographical dispersion (25 foci) causing a severe disruption of life and economy in the country.[59]

Tularemia (rabbit fever, Francis disease, soldier's disease) has sporadically occurred in Serbia. The first outbreak was recorded in late 1998 in Sokobanja region. The epidemic spread and lasted during 1999 and 2000[60]. Smaller outbreaks of tularemia occurred in Southern Serbia in 2010 when 16 persons were affected in Pčinja district, mostly preschool, elementary and high school children. An epidemic of tularemia with 30 people affected occurred at the end of 2014 in the area of the municipality of Gadzin Han. According to Public Health Institute of Kosovo, 1,469 cases of tularemia have been recorded since 1999. From 1 January to 10 February 2015 206 cases of tularemia were registered, and the epidemic was declared. [61]

1.1.1.6 Large-scale Fires

Forest fires are frequent and outspread on the territory of Serbia. They can occur in any time of time year, but there are three critical periods: March-April, July-August and September-October. 880 forest fires which affected area of 16.459,78 ha in the period 2000-2009, were registered on the territory of the state forests used by Public Company „Srbijasume". Territory distribution of the forest fires in Serbia is uneven. Largest number of the forest fires occured on the territory of Vojvodina (60%), on the territory of Kosovo and Metohia (10%) and on the territory of Central Serbia (30%)[62]. Significant forest area were affected by the fires in the past decades. The year 2007 particularly stands out because more than 22,000 hectares of the forest were destroyed then.

[59] Ristanovic E, Gligic A, Protic-Djokic V, .Atanasievska S, Jovanovic D, Radakovic S. (2014) Smallpoxvirus – potential bioweapon and actual biothreat: ex-Yugoslav lessons. 19th Congress Balkan Military Medical Committee, Plovdiv, Bulgaria, 7-10th May 2014. Abstract book. p.155 (awarded as best presentation)

[60] Lako B, Ristanovic E, Prodanovic R, Spasic M, Djuric R. (2001).First epidemic of tularemia in FR Yugoslavia. The ASA NEWSLETTER.2001; 01-5(86):19-20 Medical and Public Health management. JAMA 281:2127-2137. Odbrana Media Center, Belgrade. ISBN: 978-86-335-0458-4

[61] Infectious Agents as a Security Challenge: Experience of Typhus, Variola and Tularemia Outbreaks in Serbia Prof.Dr Elizabeta Ristanovic, MS, PhD, БЕЗБЕДНОСТ Часопис МУП РС, Београд, 2/2015

[62] Gajović, V. & Todorović, B. (2013). Spatial and Temporal Distribution Analysis of Fires in Serbia for Period 2000-2013. Journal of the Geographical Institute „Jovan Cvijić" SASA 63(3), 297-312.

Table 6. Burnt forest area in the period 2004-2011 on the territory of Serbia. Source: "http://webrzs.stat.gov.rs/"http://webrzs.stat.gov.rs, 2012

	2004	2005	2006	2007	2008	2009	2010	2011
Private forests	87	22	146	14.360	152	957	223	1.329
State forests	115	30	348	7.801	423	253	280	707
TOTAL	**202**	**52**	**494**	**22.161**	**575**	**1.210**	**503**	**2.036**

Forest fires are important threatening factors and they cause enormous damages. Total damage caused by forest fires in the state forests of the Republic of Serbia in the period 2000-2009 exceeds 36 billion dinars.[63]

Table 7. Damage inflicted to the state forests by forest fires in the period 2000-2009

	Dinars
Costs of fire suppression	44.498.395
Damage caused by fires	34.199.158.808
Costs of rehabilitation, growing and protection of forests	2.211.105.203
TOTAL	**36.454.762.406**

Forest fires manifest their consequences in a long period after the fire occurence in the following ways: they influence upon biological diversity (the loss is irrecoverable); rare, endangered and vulnerable plant and animal species disappear (that influences upon reduction in species and genetic diversity); the scenery and beauty of the ambience changes (ambiental diversity); the terrain is affected (physical and chemical features as well as micro-biological composition of the terrain change); thre are changes in the climate and micro-climate as well as in the water balance (rough disruption of hydrological regime, smaller supplies of water and floods).[64]
Forest fires destroy agricultural crops, houses, infrastructure (bridges, lines etc.) and sometimes even people are killed. Forest fires influence upon losing of the organic matter from the ground and it causes return of carbon into atmosphere, intensified global warming as well as return of carbon dioxide into atmosphere. The following quantity of gases caused by forest forests was emitted in the period 1990-2004: 148.420 tons of CO2 , 380 tons CH4, 3.500 tons of CO and 60 tons of NOX[65].
Landslides and various forms of intensive erosion occur at the fire sites.
The forest affected by forest fires, i.e. the damaged and physiologically weakened trees, become the source of excessive propagation of the harmful insects and plant diseases.

[63] Алексић, П., Јанчић, Г. (2011): Заштита шума од шумских пожара у Јавном предузећу „Србијашуме". Шумарство, број 1-2, страна 95-110[Aleksić,P., Jančić, G. (2011): Protection of forests against forest fires in the Public company"Srbijasume"]
[64] Ibid
[65] Кадовић, Р., Медаревић М., Кнежевић, М., Бајић, В., Главоњић, Б., Белановић, С., Петровић, Н. (2007): Резерве и динамике угљеника у шумским екосистемима Србије. Зборник радова Шуме и промене климе, Министарство пољопривреде, шумарства и водопривреде Србије – Управа за шуме, Шумарски факултет, Београд, стр. 179-193. [Kadović, R., Medarević, M., Knežević, M., Bajić, V., Glavonjić, B., Belanović, S., Petrović, N. (2007): Reserves and dynamics of carbon in forest ecosystems in Serbia. Collection of papers *Forests and Climate Changes*, Ministry of Agriculture, Forestry and Waterpower Engineering of Serbia- Department for Forests, Forestry College, Belgrade, pp. 179-193]

1.1.2 Photo documentation

Earthquakes

Pictures 1-4 Earthquake consequences in Kraljevo, November 2010

Picture 5 Demolition of Public Health National Institute in Kraljevo damaged in earthquake in December 2010

Picture 6 Facility damaged by earthquake, Kraljevo, November 2010

Floods

Pictures 1-2 Obrenovac, May 2014

Picture 3 Historic part Tesnjar in Valjevo municipality

Picture 4 Serbian Army members saving people from floods consequences in village of Preljina near Cacak

Picture 5 Serbian Army members evacuating citizens from Obrenovac, May 2014

Picture 6 Military Academy cadets building defensive bulwark in Sabac, May 2014

Picture 7 The Kolubara riverbed after the flood wave passing, May 2014

Landslides and Escarpments on Slopes and Descents

Pictures 1&2 Destructive consequences of landslides in the village Bogdanje near Trstenik (Serbia).

Picture 3. Local community Tekija, Kladovo municipality, September 2014

Picture 4 Serbian Army members in process of clearing rubble and yards in local community Текија, Kladovo municipality, September 2014

Pictures 5 & 6 Krupanj, consequences of landslides and floods

Pictures 7& 8 Landslides in Pocerina

Blizzards and Snowdrifts

Picture 1 Snowdrafts in the area of Zrenjanin, January 2014

Picture 2 Power line in the area of Majdanpek, December 2014

Picture 3 Nature affecting consequences of snowy storm in Eastern Serbia, December 2014

Picture 4 Serbian Army members evacuating citizens to Zrenjanin, January 2014

Picture 5 Serbian Army members erecting fallen down power lines in the area of Knjazevac, December 2014

Picture 6 Serbian Army members providing aid to under snow line of vehicles near Backa Topola, February 2014

Picture 7 Ice on the Danube, January 2017

Picture 8 Ice on the Danube, Zemun, January 2017

Hail

Pictures 1&2 Hail in Arilje

Picture 3 Hail in Pancevo

Picture 4 Hail damaged cars in Pancevo

Drought

Pictures 1&2. Drought in Serbia, July2012

Picture 3 Eco-drought in Serbia

Epidemics of Contagious Diseases

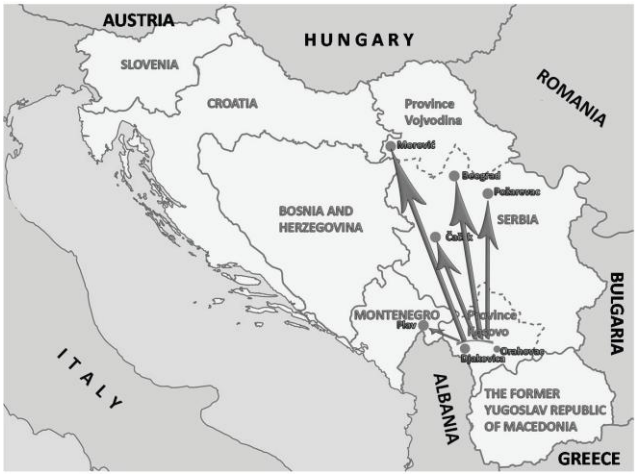


Figure 1 Smallpox in Yugoslavia - Spreading of disease from primary focal point in Kosovo

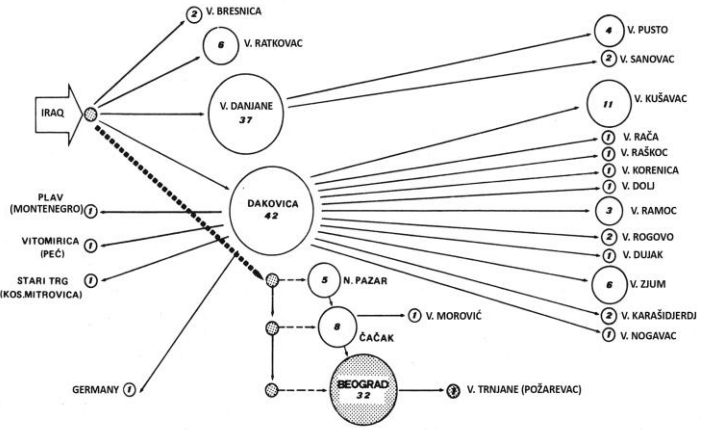


Figure 2 The origin and spread of smallpox epidemic. Source: Dovijanić P, *et al. Social-medical character of combating against smallpox outbreak in Belgrade*. Proceedings of the Symposium Smallpox Outbreak in Belgrade. 1972. p. 15. [In Serbian]

Picture 3 Different clinical manifestations of smallpox in Yugoslavia A: early hemorhagic variola with purpuric skin changes; B: ordinary form: variola pustulosa confluens, 9th day of the illness; C: intrahospital infection; 4 -months old baby died on the 14th day of the illness. (Photo: V. Šuvaković, M.Kecmanović; source: *Variola in Yugoslavia in 1972*. Proceedings of the Yugoslav Symposium on Smallpox, Primošten: 1972. [In Serbo-Croatian])

Picture 4 Ulcer on arm - Tularemia

Picture 5 Lymph node enlargment - Tularemia

Large-scale Fires

Pictures 1&2 Forest fire in Serbia on Tara, August 2012

Pictures 3&4 Serbian Army members extinguishing forest fire on Tara, September 2012

Picture 5 Helicopters extinguishing forest fire on Tara, September 2012

Picture 6 Consequences of forest fire on Tara, September 2012

1.2 Analysis of the Process of Risk Management in the Republic of Serbia

Strategic dimension of the protection and rescue system in the Republic of Serbia is established in an integral way by adoption of the National Protection and Rescue Strategy (2011) and it has been normatively regulated by the Law on Emergencies (2009). The starting point in the new system is the principle by which the crisis is to be solved at the place of its occurrence; consequently, significant part of responsibility has been transferred to local governments, but it is not followed by necessary legal institutional upgrade of the system, material and technical investment as well by the appropriate personnel measures.

Adoption of the Law has not caused the expected reaction in the sense of its execution. Due to absence of political will to deal with the protection and rescue matters as well as for some other reasons, the Law has not brought the expected results so far.

From the moment of the Law adoption there have been small number of the attempts to systematically consider the problems and make a deeper critical analysis and more serious empiric research of the ways in which the system really does function in practice in all its organizational, institutional, normative, material and other aspects, as well as in all the phases of crisis, i.e. emergencies (prevention, preparation, reaction and rehabilitation). The problem relates both functioning of the system and its efficiency on local level. This is an attempt to analyse the system of emergency management in Serbia within the project *Analysis of Civil Security Systems in Europe- ANVIL* within the Programme FP17 financed by the European Commission,[66] to describe and make systematic and critical analysis of the normative and legal regulation of emergency management as well as role of local governments, and to make an analysis of the economic effects of emergencies to local governments.[67]

The abovementioned facts imply a much deeper problem than it can be seen in the quotes from the given documents. Namely, the basic reason for generating of the bad strategic documents, nonexistence of the doctrinaire documents and sketchy legal solutions lies in poor quantum of knowledge about the protection and rescue issue. The reason for justifying such a claim can be found on all levels of management in the state administration. Although the Law on Emergencies precisely demands "training" on the level of elementary and secondary education, it has never begun to live in practice.

1.2.1 The Established Practice for Risk Management

The protection and rescue system in the Republic of Serbia has derived from the regulations of the Constitution of the Republic of Serbia.[68] Besides other issues, the Constitution defines competence of the state and municipality to take care of the environmental protection and *protection in case of natural and other disasters*.

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[66] Kešetović Želimir, "Country Study: Serbia", report within ANVIL project - European Union's Seventh Framework Programme FP7/2007-2013 under grant agreement n°28467, 2013, available on http://anvil-project.net/wp-content/uploads/2014/01/Serbia_v1.0.pdf

[67] Радовић В. анд Јовановић Л., 2011. "Анализа утицаја ванредних ситуација на економски развој локалне самоуправе у Србији", Ecologica 62.[Radović V. and Jovanović L., 2011"Analysis of influence of the emergencies upon economic development of local government in Serbia"]

[68] "*Official Gazette of RS*", No 98/2006

Various system laws in the Republic of Serbia set the obligation of "organization of protection against natural and other bigger disasters and creation of the conditions for their elimination, i.e. reduction of their consequences".

National Strategy for Protection and Rescue was adopted in 2011. The basis for the Strategy creation was the Law on Emergencies, which points to nonexistence of the adequate personnel who can provide analysis of the system on strategic level and make connection among the documents which arrange and direct the system. Besides the Law, the basis for creation of the National Strategy can be also found in other national and international documents such as: National Programme for Integration of the Republic of Serbia into European Union, National Strategy of Sustainable Development, Strategy of National Security of the Republic of Serbia, Millenium Aims of Development which have been defined by the United nations members and Hyogo framework for action 2005 - 2015: *Development of Resistance of the Nations and Communities to Catastrophies*.

National strategy provides fulfilling of the recommendations given by the European Union for development of national protection system: establishment of institutional, organizational and personnel conditions for providing protection in emergencies; education of well-trained personnel; forming and training of the existing firefighting and rescue units in all places where they should do new jobs; development of the capabilites to, in case of a catastrophy, respond in the most efficient way, including elimination of the consequences caused by terroristic attacks; providing the material aid for support of implementation of the National Strategy; training of the firefighting and rescue units of MIA, firefighting units in companies and voluntary firefighting associations, civil protection units (specialized and the general purpose ones); training of the citizens for acting in emergencies, of volunteers etc.

The aims of the Strategy development show that the framework for the system development has been planned to be a comprehensive one in order to make a platform which would provide the guidelines for keeping susteinability of protection and rescue system.

It has been planned for the national strategy to be implemented through the action plan for its realization which will be made within six month from the day of the National Strategy adoption. The action plan should define detailed realization of strategic activities as well as the persons in charge of its realization, indicators of success, time frame for its realization and necessary financial means.

New framework for reduction of risk in case of disaster was made in 2015 under the name Sendai Framework for Disaster Risk Reduction 2015-2030, which gave the basic guidelines relating arrangement of protection and rescue system, i.e. guidelines for its development.

Risk Management National Programme[69] in case of natural disasters was adopted in December 2014. The Action Plan for implementation of the Republic of Serbia Risk Management National Programme in case of natural disasters (2016-2020) has been completely harmonized with the Sendai Framework for Disaster Risk Reduction 2015-2030, adopted on 18 March 2015 during the Third World Conference for Disaster Risk Reduction.

[69] http://www.obnova.gov.rs/uploads/useruploads/Documents/Nacionalni%20program%20upravljanja%20rizikom%20od%20elementarnih%20nepogoda.pdf

The Law on Emergencies establishes the basis of the integral protection and rescue system. The most important advantage of the Law is the fact that it puts the local government units into focus. It is logical if we take in consideration the fact that natural disasters and other accidents first affect the protected values on the territory they occured on. Contrary to the Constitution and the Law on Local Governments which only in general authorize local government to organize protection of the field of emergency situation mamangement, the Law on Emergencies as the basic law defining this field defines this field, duties, right and obligations of the local governments in details. It is defined in the Law that the local government units are one of the subjects in protection and rescue system on the territory of the Republic of Serbia in accordance with the Law and other regulations, programmes, plans and other documents which define organization, development, preparation and use of the forces and means for protection and rescue, as well as taking the protection and rescue prevention measures.

Protection and rescue principles are established and, as one of the protection and rescue principles, there is the principle of graduality in engagement of the forces and means according to which the forces and means to be used first are the ones from the territory of the local government. It means that they respond to an emergency at the place where it occurs, i.e. in the local community, and that the Republic forces and means are engaged only in case capacities of the local community are not sufficient. This approach is totally correct, but since there are not the provisions for regulation of the obligations of following and activating of the protection and rescue forces on the Republic or regional level, there is disproportion relating the time of responding and providing help. The result is lack of response which puts the local government units in a bad position due to lack of people and means. The problem can be solved by making the protection and rescue plans which still do not exist in practice.

The bylaws relating emergencies provisions of which are related to the entire system have closely defined the necessary elements important for the system functioning. These bylaws are the following instructions, regulations and ordinances:

- **Instruction on Methodology of Risk Assessment and Protection and Rescue Plans in Emergencies „Official Gazette of RS“, No 96 issued on 5 October 2012,**
- Statute on Performing Evacuation "Official Gazette of RS", No 22 from 31 March 2011
- Regulation on Contents and Way of Making Protection and Rescue Plans in Emergencies "Official Gazette of RS", No 8 from 11 February 2011,
- Regulation on Obligatory Means and Equipment for Personal, Mutual and Collective Protection against Natural Disasters and other Accidents "Official Gazette of RS ", No 3 from 24 January 2011,
- Regulation on Composition and Way of Work of the Emergency Staffs „Official Gazette of RS“, No 98 from 24 December 2010,
- Regulation on Amount and Right to get One-time Financial Aid „Official Gazette of RS“, No 98 from 24 December 2010,
- Regulation on Use of Belongings for the Needs of Protection and Rescue and the Way of Exercising the Right to Get Compensation for their Use - „Official Gazette of RS“, No 10/13 from 30 January 2013,
- Rule book on Organization and Way of Engagement of the Special Civil Protection Units "Official Gazette of RS ", No 26 from 15 April 2011,

- Rule book on the Way of Collection and Payment Dates Relating the Means to be Directed as a Dedicated Revenue Fund Budget for Emergencies "Official Gazette of RS ", No 14 from 4 March 2011, No 28 from 26 April 2011,
- Rule book on Contents of the Information about Dangers, Measures and Actions in Case of Accident - " Official Gazette of RS ", No 18 from 9 March 2012,
- Rule book on the Way of Assessment of the Value of the Construction Part of the Objects and the Way of Calculating Compensation for Shelters „Official Gazette of RS", No 78 from 10 August 2012,
- Rule book on the Way of Making the Plan of Protection against Accident „Official Gazette of RS", No 82 from 22 August 2012,
- Rule book on Kinds and Quantity of Hazardous Matters, Facilities and other Criteria based on which the Plan of Protection against Accidents is Made and Measures which are to be Taken to Prevent the Accident and Limit the Effects upon Life and Health of People, Material Goods and Environment -„ Official Gazette of RS" No 08/13 from 24 January 2013.

The field of fire protection which is arranged by the basic Law on Fire Protection "Official Gazette of RS", No 111 from 29 December 2009 as well as numerous bylaws is closely connected with Emergency Management. Namely, the local government units, within their competencies defined by the Constitution and Law on Fire Protection, organize and provide the conditions fire protection measures realization and provide help in elimination or reduction of the consequences caused by fire and they make the acts for improvement of the fire protection. The local government units make the Plan of fire protection units, define implementation of fire protection measures in spatial and urbanistic plan of local government and provide consent of MIA relating implementation of fire protection measures for certain objects in the process of issuing the utilization aproval.

There are a number of laws which are connected to emergency management and their provisions put certain activities in the local government competence. For example, The Law on Waters ("Official Gazette of RS", No 30/2010 and 93/2012) puts certain competencies relating protection against harmful effects of second-order waters (measures and works for protection against ice, erosion and torrents and for removing of consequences of such effects of water) under competence of local government units.

Instruction on Methodology of Risk Assessment and Protection and Rescue Plans in Emergencies is a document which in more details defines elements and way of Risk assessment from the aspect of presence of risk in case of natural disasters and other accidents in the Republic of Serbia.

Risk assessment relating natural disasters and other accidents is the basic document for making the Protection and Rescue Plan in emergencies on the level of the Republic of Serbia and the Protection and Rescue Plan in emergencies on the level of the state administration, autonomous provinces, local government units, commercial companies, other legal entities and other organizations and the risk assessment is made by all the subjects defined by the Law on Emergencies. Those in charge of making the assessment should form an expert team for the Assessment making and the team should be composed of experts in their respective fields which are important for protection and rescue, i.e. risk assessment.

The Assessment is the document which identifies danger, source and form of possible threat, possible effects and consequences, assessment of threat-risk, considers the forces, means and

prevention measures as response to dangers caused by natural disasters and other accidents, considers protection and rescue of lives and health of people, animals, material, cultural property and environment.

The assessment defines position and features of the territory, possible vulnerability of critical infrastructure, identification of the danger, risk assessment, assessment of necessary forces, means and prevention measures for protection and rescue in case of natural disasters and other accidents.

The assessment contains: Introduction; Position and features of the territory; Assessment of critical infrastructure from the aspect of its vulnerability to natural disasters and other accidents; Identification of the danger and assessment of natural disasters and other accidents risk; Assessment of necessary forces, means and prevention measures for protection and rescue; Conclusion.

1.2.2 Assessment of Risk Management Aspects

Having in mind theoretical and practical postulates of protection and rescue system, it can be concluded that these are the fundamentals for arrangement of risk management system in case of natural disasters and other accidents in the Republic of Serbia.

Principal characteristics of the documents regulating this field are:

1. Protection and Rescue Strategy:

Principal characteristics of Protection and Rescue Strategy from the aspect of its influence upon establishment of risk management are:

- The strategy has involved existence of the need for risk management in an acceptable way;
- Necessity of establishment of risk management system has been precisely pointed out in each element of the Strategy;
- It makes connection between the postulates of risk management system and the European Union documents;
- Policy of risk reduction should be accepted by all the parties interested in the issue;
- There is need for eastablishment of National platform for disaster risk reduction as a national mechanism for emergency situations;
- The fundamentals for disaster risk reduction and increase of resistance to disasters can be found in being familiar with dangers as physical, social, economic and ecological threats certain communities and the community as a whole can face, as well as in being familiar with the long and short changing threats and vulnarabilities. Response should correspond that knowledge;
- The adopted standards and methodology of the natural disasters and other accidents risk assessment and identification are in accordance with the EU recommendations;
- Consequences about risks they can face as well about possible options and measures that can be taken in order to reduce threat and improve preparation;
- Contents and topics from the field of protection and rescue and risk reduction in case of disaster should be introduced into national curricula in all educational institutions;
- There is functional connection between science research organizations and the key actors of protection and rescue integrated system;

- Cooperation with media in the field of promoting the policy of risk reduction in case of disasters and reporting before, during and after emergencies;
- Development of awareness and culture of citizens' security in the field of protection, rescue and disaster risk reduction.

Conclusion on ranges of the protection and rescue national strategy:

- It has been made in accordance with the Hyogo framework for action 2005-2015;
- It does not follow the Sendai framework 2015-2030 postulates and that is why it can be considered as outdated and dysfunctional;
- Strategy must have sustainability for a longer period of time and it has to predict making of the doctrinaire documents which will follow the changes on medium-term level;
- Legal solutions arise from the strategy and doctrinaires;
- The strategy must be based on risk management and founded on systematic foundations of protection and rescue system;
- It should predict modular organization of the system thus enabling adjusting to the changes of the system parts, without disturbing those who do not need the changes;
- It should enable compatibility with the documents in the surrounding countries and European Union;
- The system should be established on the quality and coordination with positive world and European standards;
- Specially educated staff is a necessity and they should possess knowledge and vision about the way of making such documents in accordance with time and society needs.

Risk Management National Programme in case of natural disasters and the Action Plan for implementation of the Republic of Serbia Risk Management National Programme have been harmonized with the Sendai Framework for Disaster Risk Reduction 2015-2030 and they are directed towards building of the appropriate long-term risk management system in case of natural disasters in the country.

2. The Law on Emergencies

The Law on Emergencies defines the basic tasks of protection and rescue system: 1) programming and planning of the measures and activities relating protection and rescue; 2) protection as a group of prevention measures directed to strengthening resistance of the community, elimination of possible threat causes, reduction of the natural disasters effcts, prevention of other sorts of accidents and, in case they do occur, reduction of their consequences; 3) coordination when establishing, making and carrying out the National Protection and Rescue Strategy; 4) rescue and help which involve operational activites to be taken in order to rescue people, material goods and environment; 5) reduction and elimination of direct consequences of natural disasters and other accidents which means that mesaures and activities must be taken in order to establish necessary conditions for life of the citizens in the affected area; 6) organizing, equipping and training of protection and rescue forces; 7) organizing, equipping and training of the state agencies, commercial companies, other legal entities and enterpreneurs for protection and rescue; 8) organizing and training of the citizens in the field of personal, mutual and collective protection; 9) giving and asking for help and cooperation with other countries and international organizations; 10) management, leadership and coordination of the subjects and forces of protection and rescue system in emergencies; 11) other activities and tasks in protection and rescue field.

From the aspect of the influence upon establishment of risk management system principle characteristics of the Law on Emergencies are:

- The Law should arise from the guidelines contained in strategic and doctrinaire documents;
- The Law must keep pace with the contemporary solutions arising from experience of the surrounding countries;
- The Law must be adapted to the needs and capabilities of the society;
- The existing Law contains majority of the elements by means of which protection and rescue system can be arranged;
- The Law must not be in conflict with other laws;
- The Law must regulate all segments of protection and rescue system through the system of bylaws;
- The law sets the postulates of functioning which keep the character of the system on all levels of management;
- The Law must be implementable on the level of local government unit.

Conclusion on the ranges of the Law on Emergencies:

- Since the existing Law represents the basis for making the Strategy, it does not have a developmental capacity;
- It regulates the unique protection and rescue system on territory of the entire country;
- It defines the subjects of protection and rescue system;
- The system of defining the concepts is unacceptable from the aspect of the rules for defining and adequacy for the needs of its understanding;
- It defines competencies of the state agencies, regions and local government units, as well as competencies of the commercial companies, other legal entities and individuals;
- The Law defines emergency risk leadership; the relation with emergency risk management has not been established, and consequently the connection between management and leadership bodies has not been developed on different levels of management in normal and emergency situations;
- Making of the vulnerability assessments and protection and rescue plans are defined and that makes the foundation for risk management in case of natural disasters and other accidents;
- Civil protection elements and way of their engagement in emergencies are precisely defined;
- Planning and programming of protection and rescue system is defined in a special issue, as well as the way of financing, but it has never begun its life in practice in a unique way except for the one on the level of budgeting in the Republic budget. The units of local governments do not have a common attitude towards budgeting of the system on their respective territories, and that is why there are significant differences in the amount of the allocated funds.

Bylaws have resulted from the Law and they have several general characteristics:

1. The entire bylaws documentation has not been made resulting in the effect of "tied hands" of local government units in sense of taking the necessary steps for the system forming;

2. The adopted bylaws are mostly of general character, without the necessary details which should regulate the important elements of the system and
3. The solutions in certain bylaws are outdated and do not follow contemporary trends and need.

3. The Instruction on Methodology for making the Risk Assessment in case of Natural Disasters and other Accidents

Based on the National Standard A.L2.003 Social Security – Risk Assessment in Protection of People, Property and Business- published in 2010 by the Standardization Institute of Serbia, i.e. its annex *Emergencies*, a part of methodology for vulnerability assessment in case of natural disasters and other accidents. It is labeled here as Attachment 1: Methodology of Vulnerability Assessment. The standard has been made within the commission A292 Security and Resistance (then A223 Social Security) on the basis of the international standard ISO 31000 Risk Management.
Having in mind the abovementioned facts, a conclusion can be made that the methodology has completely or mostly been made in accordance with the international and national standards but in accordance with the national needs as well.

From the moment of adoption of the Instruction with Methodology in 2012, certain percentage of the activities relating creation of risk assessments and protection and rescue plans has been done. Small number of local governments has approached the problem of the assessment making in a proper way. They have sent qualified people to get licenses and started the process of their making. A part of local governments has chosen ''outsource"for these jobs, while most of the local governments have not started the activities at all.
When natural disasters are concerned, it is important to emphasize that the existing methodology for risk assessment considers the following dangers:

1. ND-1 Earthquakes;
2. ND-2 Escarpments, landslides and erosions;
3. ND-3 Floods;
4. ND-4 Stormy wind;
5. ND-5 Hail;
6. ND-6 Snow blizzards, snow drifts and ice;
7. ND-7 Droughts;
8. ND-8 Epidemics;
9. ПН-9 Epizooties.

Even plant diseases are mentioned in a part of the text, but they are omitted from the methodology part.
It is also important to say that the methodology considers three kinds of technical and technological dangers as well. They should be considered together due to possibility of multi-risk.
Characteristics of the approach to risk management in case of natural disasters and other accidents in the Republic of Serbia are:

1. There are methodological tools for making the risk assessments and protection and rescue plans which, in their very structure, demand revision and simplification;

2. The existing system has all the elements for making of high-quality and comprehensive assessments and for transparent quantification of all information and scenarios;
3. The basis of the idea for the system making was the belief that protection and rescue system would in parallel produce the personnel with knowledge about risk management;
4. The work on risk management within protection and rescue system has been reduced on random actions in cases when there are conscientious individuals with a vision in the system, i.e. in cases of ''fear'' of inspections;
5. In cases when risk assessment is completed, no further implementation and materialization into management process are performed;
6. The key persons in management chain (The Staff Commander, Deputy, Head, Staff members etc) in most cases do not have knowledge, motivation or need to deal with the matters relating risk assessment. That is why the entire procedure is reduced to fulfillment of legal form;
7. Level of training and readiness of all the actors in protection and rescue system is very low from the aspect of their work in emergencies;
8. As for types of elementary education and expertise, there is enormous variety among personnel in the management bodies and that contributes to the level of incompactness of the formed bodies;
9. The persons trained in the educational system possess theoretical knowledge without empirical basis;
10. Positive methodology for risk assessment entirely respects the existing project and all other documentation which can influence upon certain risks and which is regulated by some other law;

The previously mentioned documents make a new foundation for building of protection and rescue system based on Vulnerability Assessment in case of natural disasters and other accidents, which guarantees development and building of the system in accordance with real needs dimensioned according to the dangers which really threaten territory of certain subject.

Having in mind the fact that an accident first occurs on the territory of a local government unit and that the law recognizes that, the reason for transfer of majority of competences to the local government unit is justified. Bearing in mind the abovementioned facts, the local government unit has the need and competence to generate the documents necessary for the protection and rescue system building in order to materialize the system.
Operationalization of protection and rescue system and rescue on level of a local government unit is done by creating the following documents:

A) Enactments and decisions:

- The decision on organization and functioning of civil protection
- Act on naming the trained legal entities important for protection and rescue
- Act on forming the emergency staff

B) Planning documents:

- Vulnerability assessment in case of natural disaster and other accidents
- Protection and rescue plan in natural disasters

- Plan and program of development of protection and rescue system and rescue on territory of the respective local government unit

By making the abovementioned documents, the system is getting the framework for its practical implementation within a unique protection and rescue system in the Republic of Serbia.

It is necessary to harmonize these documents with the documents of higher level of management. In that way, emergency management is enabled, irrespectively of the level of involvement of the higher level forces.

1.3 Analysis of the Competent Institutions

The Law on emergencies recognizes Sector for Emergency Situations (SES) as a unique body within Ministry of Interior Affairs (MIA) in which all the emergency services from MIA and Ministry of Agriculture and Environmental Protection are integrated.[70] Sector for Emergency Situations is a specialized organizational unit of MIA which coordinates activities of all the state and civilian institutions involved in crisis and emergencies management on all levels of political territorial organization.[71] General organizational scheme of SES is shown in the Figure 1.

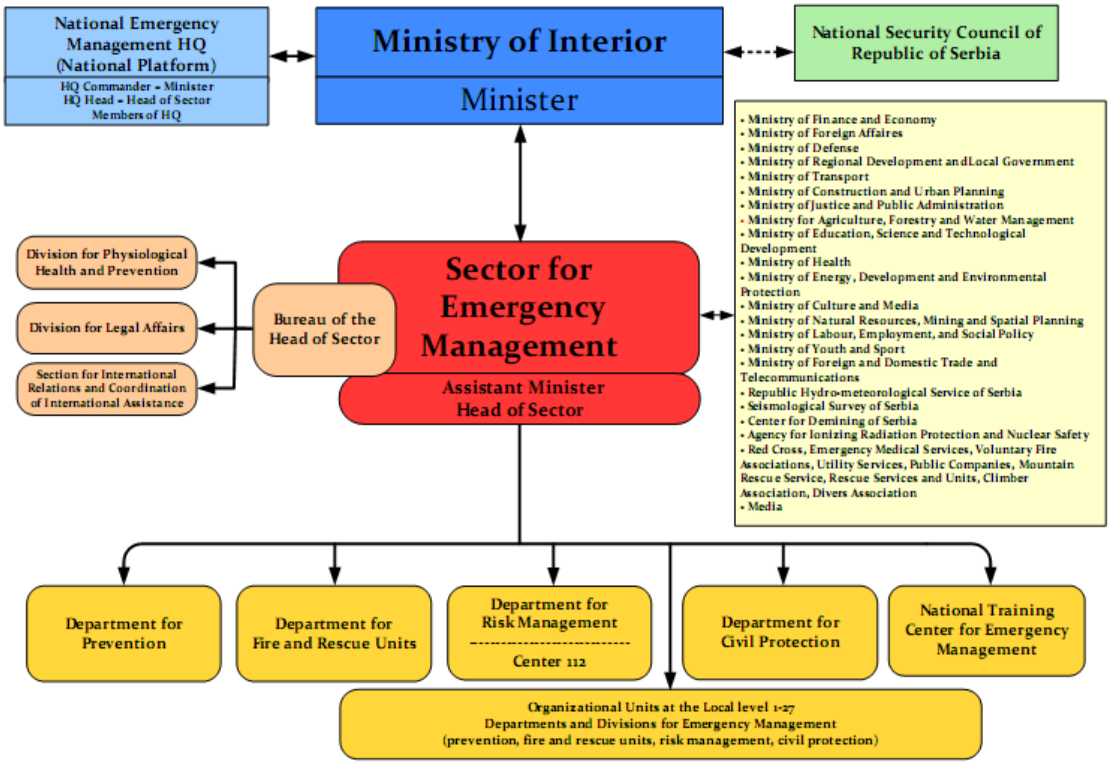

Figure 1. Organizational scheme of Sector for Emergency Situations[72]

[70] Владимир Нинковић, Желимир Кешетовић: Комуницирање система заштите и спасавања у ванредним ситуацијама изазваним елементарним непогодама, CM: Communication and Media Journal 35 (2015) 109–126.[Vladimir Ninković, Želimir Kešetović: Communicating of the protection and rescue system in emergencies caused by natural disasters, CM: Communication and Media Journal 35 (2015) pp. 109–126]

[71] Ibid

[72] Available on: http://prezentacije.mup.gov.rs/svs/HTML/organizacija.html

National Assembly is responsible for adoption of the Protection and Rescue National Strategy, while the Government is responsible for all system aspects of civil protection (adoption of plans, risk assessment and other documents, giving the order for general mobilization of civil protection units, monitoring etc.).[73]

This approach is based on use of civil agencies and operations, while military capacities are engaged on the demand of SES when other resources are not sufficient.[74] Besides SES, other ministries, agnecies and special organizations have their role in risk management within their competencies and there are some specific situations in which they can be the key actors (for example, Public Health Institute in cases of pandemic).[75]

Every administration management level is responsible for preparation and response to a crisis within its constitutional and legal mandate and the operational capacities.[76] The units of local government, town or municipality have primarily operational role, while a region is mediator between local and province or national level of authority.[77] As for the national level, SES deals with strategic issues, planning, coordination and monitoring of the system.[78]

Sector for Emergency Situations has organizational units on regional and local level which act within the staff for emergency situations.[79] Local staffs for emergency situations are permanent bodies (they have permanent members) which are formed by the local authorities for the area of the local government unit.[80] In case of a special crisis, the local staffs can be strengthened by experts from various fields.[81] The staffs consist of commander, the deputy and members.[82] The staff commanders are mayors or municipality presidents.[83] The town or municipality deputy commander is deputy mayor, or municipality president deputy or member of the town or municipality council.[84] Representatives of the state agencies organizational units, local government bodies, public companies, health institutions, centres for social work, Red Cross, Mountain Rescue Service, associations of citizens etc. are also members of the staffs.[85] Besides the already listed, there is also the staff head who is representative of the competent service.
Having in mind composition of the staffs[86], it is clear that work and functioning of the staffs are often made significantly difficult due to frequent personnel changes in the

[73] Владимир Нинковић, Желимир Кешетовић: Комуницирање система заштите и спасавања у ванредним ситуацијама изазваним елементарним непогодама, CM : Communication and Media Journal 35 (2015) 109–126. [Vladimir Ninković, Želimir Kešetović: Communicating of the protection and rescue system in emergencies caused by natural disasters, CM: Communication and Media Journal 35 (2015) pp. 109–126]
[74] Ibid
[75] Ibid
[76] Ibid
[77] Ibid
[78] Ibid
[79] Ibid
[80] Ibid
[81] Ibid
[82] Ibid
[83] Кешетовић, Ж. (2014). Анализа надлежности и капацитети јединица локалне самоуправе у области управљања ванредним ситуацијама, Стална конференција градова и општина [Kešetović, Ž., (2014), Analysis of competencises and capacities of the local government units in the area of emergency management, Permanent Conference of Towns and Municipalities]
[84] Ibid
[85] Ibid
[86] Ibid Most of the staff members are the persons appointed there for political reasons.

city/town/municipality leadership, leaders of the town/city management bodies, public and public utility commercial companies and other legal entities as well as due to insufficient experience and level of training for performing the jobs in the conditions of emergency situations.[87] The National Training Centre is in charge of the staff commanders' education. It often happens that, due to political changes, some persons do not stay for a longer period of time at the position of a staff commander after completed education.[88] In fact, political background of the staff leaders and members results in personnel problem, because protection and rescue of people is done by the persons to whom it is an extra job.

[87] Ibid
[88] Ibid