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# ANALYSIS OF NATURAL HAZARDS IN BULGARIA

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***Abstract:*** *The paper presents an overview of the main natural and man-made hazards in Bulgaria. A descriptive analysis of the major disasters in Bulgaria for the time period 2010 – 2015 is made. The survey is based on the existing administrative regions in Bulgaria as well as their corresponding districts. The total number of the hazards for the mentioned period is extracted and the economic impact is given.*

***Keywords:*** *natural hazards, descriptive analysis, disasters in Bulgaria*

## INTRODUCTION

A disaster is an event or a series of events caused by natural phenomena, incidents, accidents or other extraordinary circumstances that affect or endanger the life or health of the population, property or the environment. Disasters require taking measures, significant resourses, as well as the involvement or use of special forces.(Nat. plan,2010)

Over the past decade, statistics show an increase in the number of disasters caused by natural phenomena that have a negative impact on the country's population, infrastructure and economy.

In the last 10 years the Republic of Bulgaria has been affected by a large number of high-intensity disasters, which includes the country into the high risk areas with respect to hazards.

The aim of this work is to present a descriptive analysis of the most common natural disasters

in Bulgaria for the period 2010-2015. The information given can be useful for prediction of the future hazards as well as for policy makers and steakholders.

## EXPOSITION

### Natural hazards in Bulgaria

The most common natural disasters on the territory of the Republic of Bulgaria are the following:

***Earthquakes*** **-** The territory of Bulgaria is characterized by high seismic activity and is classified as the "second rank seismic-dangerous regions" on Earth. This territory is under the influence of both internal and external seismogenic regions with an expected magnitude of up to 8 on the Richter scale and an intensity of $9^{th}$ and higher on the Medvedev - Sponhoer - Carnik scale.
The most dangerous consequences on the territory of the country could be caused by strong earthquakes in one of the three internal seismic regions: Northeastern, Middle-Rhodian and Rila-Rhodopean.

As a whole, 98% of the territory of Bulgaria will be subjected to seismic impact with an intensity of 7 and higher degree, distributed as follows: 51% with intensity of 7th degree, - 28% with intensity of $8^{th}$ degree, and 19% may be exposed to $9^{th}$ and higher degree. These are populated areas with a population of about 6,340,000 people, representing 80% of the country's population, and about 26% of the building can be destroyed. In 8- and 9-degree areas on the MSK-64 scale there are about 5,900,000 people at risk, which is 74% of the country's population.

***Floods*** **-** The most common floods in Bulgaria arethe so-called rainy-river type. In many cases, there is a combined effect of the listed factors, one of which is almost always a pouring rain.
The most complex situation due to flood can be expected in the lowlands and along the Danube, Maritsa, Tundzha, Mesta, Iskar, Arda, Kamchia and other rivers. Significant floods can occur along the Danube River during intense snowshoe snowfall in the Alps in May, and in February and March as a result of icebergs, which threatens about 500,000 people and about 73,000 decares of farmland.
Catastrophic consequences may be caused form technogenic floods that have occurred as a result of the destruction of the dam walls of the Iskar, Batak, Trakiets, Ogosta and Topolnitsa reservoirs, the floodplains of which have 910 square kilometers and 650 000 inhabitants.
Floods cause enormous damage to human health, to the environment, to the cultural heritage and the economic activity in flooded areas.

***Landslides*** **-** Landslides are one of the major adverse phenomena that are formed from potential geodynamic danger. Up to now, more than 900 landslides have been registered in 350 settlements with a total area of 20,000 hectares.
The landslide processes in the regulation plans of the settlements are affected 2368 buildings, 20 826 m roads and 19 538 dca of agricultural land and forest funds.
The landslide processes are not evenly distributed throughout the country. They are concentrated in separate areas characterized by specific geological and tectonic structures. Several regions in the country with a higher concentration of landslide phenomena can be separated. Such regions are the Danube bank, the Black Sea coast, the Fore Balkan, the Sofia and Pernik valleys and etc.

***Fires*** **-** The occurrence of a fire in industrial sites and critical infrastructure leads to a threat to the lives and health of a large number of people, major material damage and environmental pollution. A large part of the risky sites are built in the capital and the big regional centres, where is about two thirds of the population of Bulgaria.

The relief features of the country are such that part of the territory is predominantly mountainous - woody character, as particularly critical are mountain ranges Strandzha-Sakar, Rila-Rhodope massif, Sredna Gora and the southern parts of Balkan Mountains, where previal forests of first and second degree of fire hazard and create prerequisites for the occurrence of large forest fires. From a fire point of view, the problem areas are Haskovo, Stara Zagora, Blagoevgrad, Sofia, Pazardzhik, Plovdiv, Yambol and Burgas, where a large number of fires have occurred in the last ten years, transformed into disasters that have developed on large areas and caused serious damage.

**Analysis of the major disasters in Bulgaria for the period 2010-2015**

An analysis of the prevailing natural disasters has been made by regions and their districts for the period 2010-2015. Table 1 presents the regions and districts represented and analyzed in this paper.

Table 1 – Regions and districts in Bulgaria

| Region | Districts |
|---|---|
| **North Western** | Vidin |
| | Vratsa |
| | Montana |
| | Lovech |
| | Pleven |
| **North Central** | Veliko Tarnovo |
| | Gabrovo |
| | Razgrad |
| | Ruse |
| | Silistra |
| **North Eastern** | Varna |
| | Dobrich |
| | Targovishte |
| | Shumen |
| **South Eastern** | Burgas |
| | Sliven |
| | Stara Zagora |
| | Yambol |
| **South Central** | Haskovo |
| | Kardzhali |
| | Pazardzhik |
| | Plovdiv |
| | Smolyan |
| **South Western** | Blagoevgrad |
| | Kyustendil |
| | Pernik |
| | Sofia district |
| | Sofia town |

Figures 1 and 2 give the total number of the natural disasters in Bulgaria and the damages in thousands of BGN for the period 2010-2015.

It is obvious that the most often happening hazard is the fire, which peak, is in 2013 with total number of 3010. For the same period – 2010-2015 the total number of all kinds of hazards is 15713 which percentage is given in Table 2. The same table presents as well the pecantage distribution of the damages that account 1259114 lev for the mentioned 5-year period totally.

Figures 3-6 summarize the main nature disasters by regions (according to Table 1).

From the Fig. 3 it can be seen that 2010, 2012 and 2013 are years with many floods especially in South Eastern and South Central Regions reaching numbers of more than 1250 (only for 2012 in South Eastern Region are more than 400). The percentage during this period for the respective regions is given in Table 3.

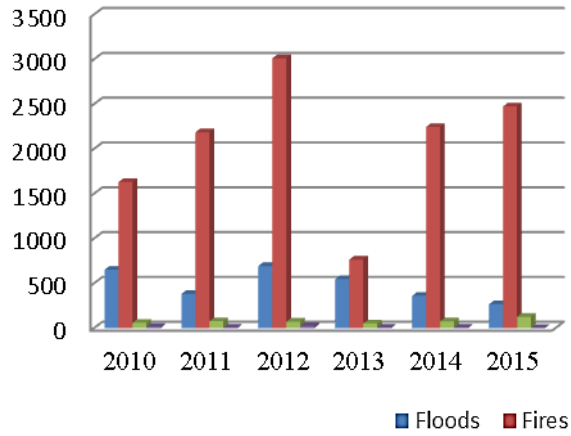


Fig.1.Total number of hazards within the period 2010-2015

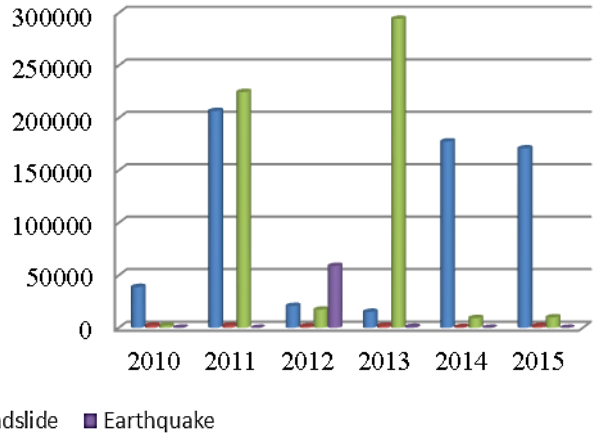


Fig.2. Total damages in thousands of lev within the period 2010-2015

Table 2. Percentage distribution of hazards and damages in Bulgaria for 2010-2015

| ***Hazards 2010-2015*** | ***Fires*** | ***Floods*** | ***Landslides*** | ***Earthquakes*** |
|---|---|---|---|---|
| ***Frequency, %*** | 78.3 | 18.4 | 2.9 | 0.4 |
| ***Damages, %*** | 1,3 | 50 | 44 | 4,7 |

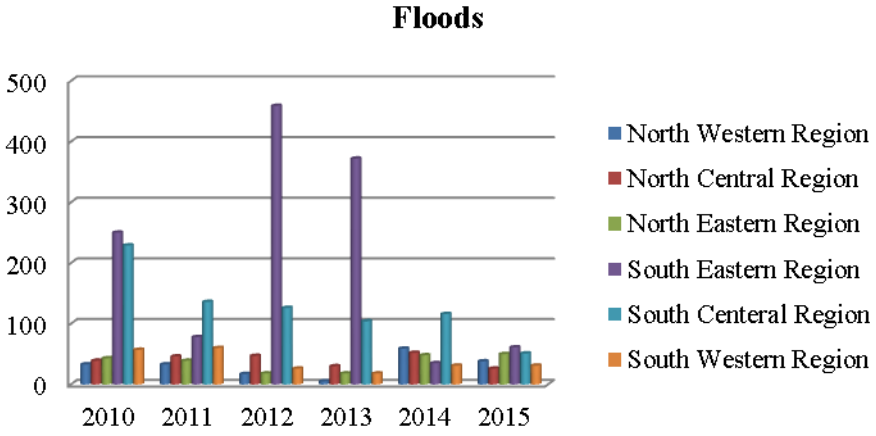


Fig.3. Floods in period 2010-2015 in different regions in Bulgaria

Table 3. Percentage distribution of floods for the period 2010-2015

| **Floods, %** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **Total number** |
|---|---|---|---|---|---|---|---|
| **North Western Region** | 17,9 | 17,9 | 9 | 2,7 | 32 | 20,5 | 185 |
| **North Central Region** | 16,25 | 19,15 | 19,6 | 12,5 | 21,7 | 10,8 | 240 |
| **North Eastern Region** | 19,9 | 18 | 8,3 | 8,3 | 22,2 | 23,3 | 214 |
| **South Eastern Region** | 19,9 | 6,2 | 36,6 | 29,6 | 2,8 | 4,9 | 1255 |
| **South Central Region** | 30 | 17,8 | 16,5 | 13,6 | 15,2 | 6,9 | 762 |
| **South Western Region** | 25,6 | 26,9 | 11,6 | 8,1 | 13,9 | 13,9 | 223 |

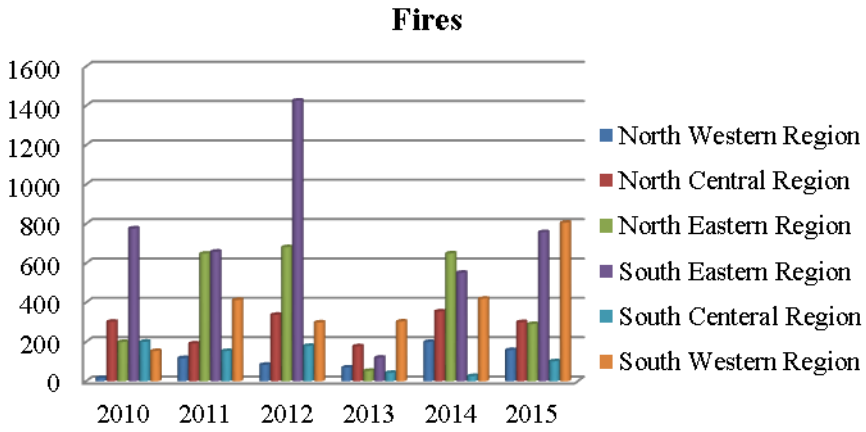


Fig. 4. Fires in period 2010-2015 in different regions of Bulgaria

Fig. 4 shows that the regions suffered mostly from fires for the respective time interval are South Eastern and North regions. The percentage distribution of the fires for all representative regions is given in Table 2. The corresponding total number of fires is specified as well.

Table 4. Percentage distribution of fires for the period 2010-2015

| Fires, % | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total number |
|---|---|---|---|---|---|---|---|
| North Western Region | 2,5% | 18,2% | 13% | 10,8% | 30,9% | 24,6% | 647 |
| North Central Region | 18,1% | 11,5% | 20,3% | 10,7% | 21,3% | 18,1% | 1667 |
| North Eastern Region | 7,9% | 25,7% | 27% | 2% | 25,7% | 11,7% | 2525 |
| South Eastern Region | 18,3% | 15,5% | 33,6% | 2,8% | 13% | 16,8% | 4293 |
| South Central Region | 28,4% | 21,8% | 25,4% | 6% | 3,8% | 14,6% | 707 |
| South Western Region | 6,4% | 17,2% | 12,5% | 12,6% | 17,5% | 33,8% | 2396 |

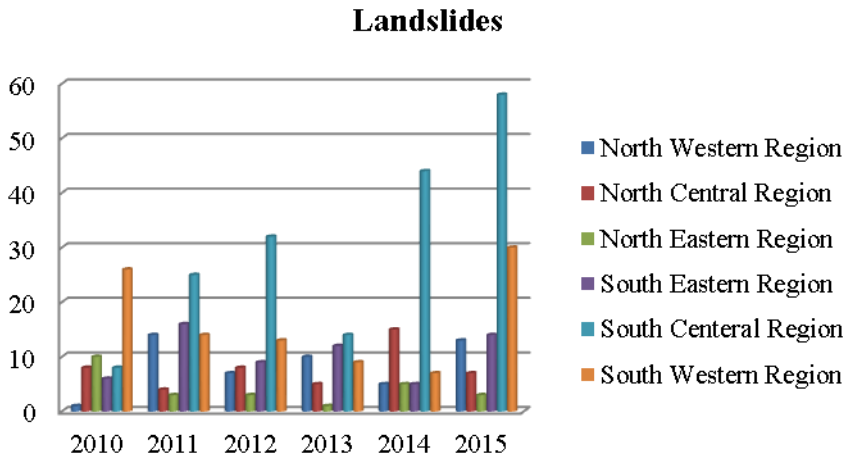


Fig.5. Landslides in period 2010-2015 in different regions of Bulgaria

Landslides are mostly happened in South Central and South Western Regions counting more than 180 for the represented period. The percentage for all Bulgarian regions by years for the same

period is stated in Table 5.

Table 5. Percentage distribution of landslides for the period 2010-2015

| Landslides, % | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total number |
|---|---|---|---|---|---|---|---|
| North Western Region | 2% | 28% | 14% | 20% | 10% | 26% | 50 |
| North Central Region | 17% | 8,5% | 17% | 10,6% | 31,9% | 15% | 47 |
| North Eastern Region | 40% | 12% | 12% | 4% | 20% | 12% | 25 |
| South Eastern Region | 9,7% | 25,8% | 14,5% | 19,3% | 8% | 22,7% | 62 |
| South Central Region | 4,4% | 13,8% | 17,7% | 7,7% | 24,3% | 32,1% | 181 |
| South Western Region | 26,3% | 14,1% | 13,1% | 9% | 7% | 30,5% | 99 |

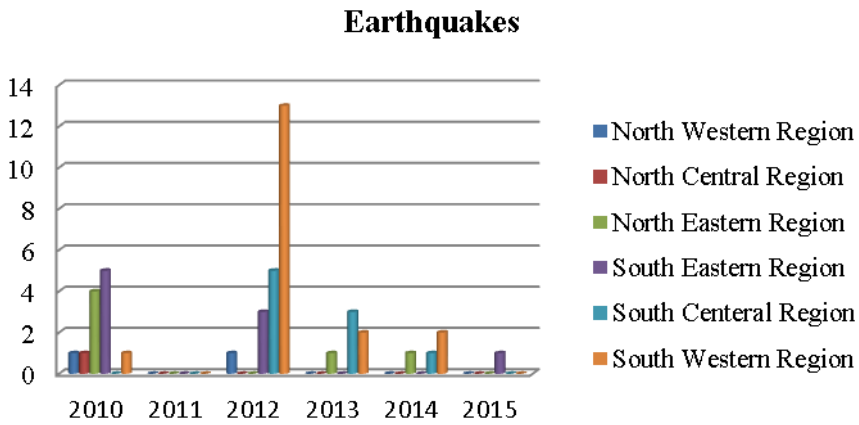


Fig.6. Earthquakes in period 2010-2015 in different regions of Bulgaria

According to the statistical data found (www.nsi.bg) 2010 and 2012 can be distinguished with higher seismic activity. In 2012 there were 13 earthquakes happened in South Western Region, while there no earthquakes in 2011. The percentage distribution presented for all Bulgarian regions for the period 210-2015 is given in Table 6.

Table 6. Percentage distribution of the earthquakes for the period 2010-2015

| Earthquakes, % | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total number |
|---|---|---|---|---|---|---|---|
| North Western Region | 50% | 0% | 50% | 0% | 0% | 0% | 2 |
| North Central Region | 100% | 0% | 0% | 0% | 0% | 0% | 1 |
| North Eastern Region | 66,7% | 0% | 0% | 16,65% | 16,54% | 0% | 6 |
| South Eastern Region | 55,5% | 0% | 33,3% | 0% | 0% | 11,2% | 9 |
| South Central Region | 0% | 0% | 55,5% | 33,3% | 11,2% | 0% | 9 |
| South Western Region | 5,5% | 0% | 72,2% | 11,15% | 11,5% | 0% | 18 |

## CONCLUSION

This work presents descriptive analysis based on the existing statistical data of the prevailing natural disasters in the period 2010-2015. The percentages of each of the major disasters for the existing administrative regions in Bulgaria and their corresponding districts are given for the mentioned period. The information offered may be used for further analyses and predictions and can be helpful for different steackholders and policy makers.

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