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ANALYSIS OF THE SCALE, FREQUENCY, GEOGRAPHICAL CONCENTRATION, SEASONALITY AND PREREQUISITES FOR DISASTER EVENTS IN THE CROSS-BORDER REGION

JULY 2019

estat research and consultancy

ROMANIA - BULGARIA Interreg

This report has been commissioned by the Directorate-General for Fire Safety and Protection of the Population - Ministry of the Interior and prepared in the context of a public procurement with the subject: "Risk Analysis in the Cross-Border Region", in implementation of the project "Joint Volunteering for a Safer Life" "JVSF under the Cross-border Cooperation Program Interreg V - Romania-Bulgaria 2014-2020.

Name of the project	"Risk Analysis in the Cross-Border Region"
Author of the document	ESTAT ldt.
Date of publication	22 July 2019
The content of this material does not necessarily represent the official position of the European Union	

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ABBREVIATIONS

CBR – cross-border region
DGPBZN - General Directorate "Fire Safety and Protection of the Population”
EU - European Union
FMEA - Failure Mode Effect Analysis
GDP - gross domestic product
GIS - Geographic Information System
LAU1 - local administrative unit - municipality
MOEW - Ministry of Environment and Water
NSI - National Statistics Institute
NUTS III - Planning Region
RPN - Risk Priority Number (including priority risk)
RPND - comprehensive risk factor normalized for demographic factor
RPNF - comprehensive risk factor
RPNL - complex risk factor normalized for solvency of a particular municipality
RPNLD - comprehensive risk factor, normalized for the ability of the population to cope with emergencies
SMEs - small and medium-size enterprises

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1. INTRODUCTION

The purpose of the report is to present a systematic approach to risk assessment and risk management in the cross-border region (CBR) Silistra-Calarasi (Bulgaria-Romania), as a precondition to conducting an in-depth analysis of district and municipal disaster protection plans and a follow-up analysis of the CBR emergency preparedness. The risk analysis will focus on studying the hazards from floods and forest fires, based on collected statistical and historical information, spatial data and reports on the scale, frequency, geographical concentration, seasonality and preconditions for the occurrence of disasters.

The report will identify the most important risk areas, as well as the availability of and measures undertaken for prevention and protection of the population from disasters and accidents. The analysis of preventive measures against natural and man-made disasters is a mandatory element in the process of managing ecological and technogenic systems through an organized approach, which includes two interrelated phases of disaster protection: threat and risk assessment, as well as review of the available prevention measures, including awareness and timely warning of the population prior to the occurrence of a crisis event; and crisis management, including analysis of administrative and material capacity, corresponding to the risk assessment for the given municipality or district area, measures for effective communication and warning, preparedeness of the administrative and voluntary organisaitons, as well as assessment of the population's ability to act and cope in the case of crisis occuring.

The main goal of the present report is to analyse the riks and assess the level of risk management, to define and compare the risk for disaster prevention on the level of individual municipalities (when possible) and to assess the steps for minimalizing the consequences, in cases where disasterous events are inevitable. The report will serve as a base for comparing complex riks levels (discussed in the report "Analysis of District and Municipal Disaster Protection Plans for Pilot Area (Silistra region - Calarasi County") with the available prevention measures across municipalities (via analysis of regional and municipal plans for disaster prevention plans and protection of the population), which will allow for prioritizing municipalities with high risk potential as well as for assessing the adequacy of the plans for joint action in the cross-border region. In addition, the report will analyse ways to most effectively communicate potential risks to both the population and the institutional and non-governmental voluntary organisaitons, as well as provide information about available forms of preparation and training in case of disaster occurring.

Several main reasons exist to justify the importance of disaster prevention. The most obvious one is the fact that disasters are not concerned by country borders and can have cross border scale. They can have negative effect on local and regional policies in the crossborder region, especially in areas such as industrial policy, agriculture and infrastructure. The economic consequences from the disaster events can negatively impact growth.

The best precondition for developing effective disaster prevention policies is the in-depth understanding of the different types and characteristics of disaster events. Project “Joint Volunteering for a Safer Life” (JVSF) under the Interreg V - Romania-Bulgaria 2014-2020 Cross-border Cooperation Program, in accordance with which the present report and subsequent reports are being developed, aims at reducing or limiting the negative effects related to disasters in the cross-border region by:

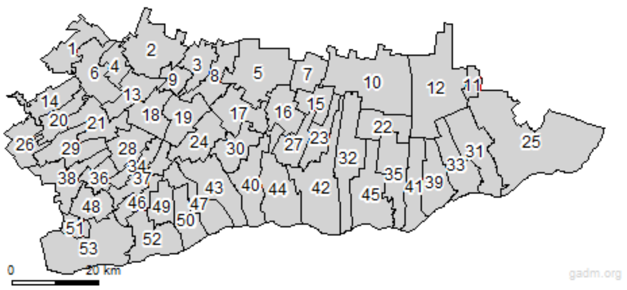
- gaining better understanding of knowledge-based disaster prevention policy in the cross-border region (TGR);
- creating links between relevant actors and policies at all stages of the disaster management cycle;
- improving the effectiveness of existing risk management methods and tools in disaster prevention.

Characteristics of the cross-border region

The eligible area of the Program covers NUTS III administrative regions or NUTS III and LAU1 equivalent regions located at the border between the two partner countries and covering the following regions:

In Bulgaria: Silistra District (Alfatar, Glavinitsa, Dulovo, Kaynardja, Silistra, Sitovo and Tutrakan municipalities)

In Romania: The administrative division of the territory (as of 31 December 2000) includes 3 cities and 2 municipalities, 50 communes and 160 villages. The county capital is Calarasi (Fundulea, Dragos Voda, Lehliu-gara, Nicolae Balcescu, Dragalina, Stefan Cel Mare, Perisoru, Sarulesti, Fundeni, Valcelele, Vlad Tepes, Lupsanu, Gurbanesti, Valea Argovei, Plataresti, Sohatu, Stefan Voda, Independenta , Frasinet, Borcea, Frumusani, Alexandru Odobescu, Nana, Vasilati, Ulmu, Jegalia, Ceacu, Unirea, Luica, Model, Soldan, Curcani, Budesti, Dichiseni, Dorobantu, Rosetta, Gradistea, Manastirea, Ciocanesti, Calarasi, Mitreni, Chiselet , Ulmeni, Spantov, Cascioarele, Oltenita, Chirnogi).



The Bulgaria-Romania cross-border cooperation area, falling within the scope of the analysis, covers 7939.1 km^2 with a total population of 403 483 people. The eligible area in Bulgaria is 2.6% (2851.1 km^2) of the total territory of the country. Respectively, the covered area in Romania is 5.088 km^2 or 2.13% of the total territory.

The cross-border region is located in Southeastern Europe, in the northeastern part of the Balkan Peninsula. The geographical structure of the cooperation area includes plains, hilly areas and the Danube river basin. The total area of the CBR is 7 934.3 km^2.

The Silistra region encompasses the eastern plateau sub-region of the Danube plain, with the predominant relief being flat. The climate is moderate continental and falls mainly in the Danubian climate sub-region. **Calarasi county** is part of Sud - Muntenia (South - Muntenia) - a development region in Romania. Like other development regions, the area has no administrative powers, its main function being to coordinate regional development projects and to manage EU funds allocation and absorption. The region is located entirely in the historic district of Muntenia, headquartered by the Calarasi Development Agency. The whole territory is located in the southern part of the Bărăgan plain and is crossed by small rivers with deep valleys. On its southern and eastern sides is the valley of the Danube River, which on the eastern side divides into several branches, forming islands. On the west side are positioned the Arge and Dembovitsa rivers, forming a wide valley before flowing into the Danube.

The northeastern area of the cross-border region is parted by the Danube river and the far northeastern part of the Danube plain in Bulgaria. The area is characterized by moderate continental climate. The wind can be categorized with prevailing northeast-northwest circulation, accompanied by snowfall and ice during the winter. Precipitation (450-550 mm) is below average levels (650 mm). The climate of the area in the plain-hilly part is moderately warm and arid, and in the lowland - moderately hot and arid.

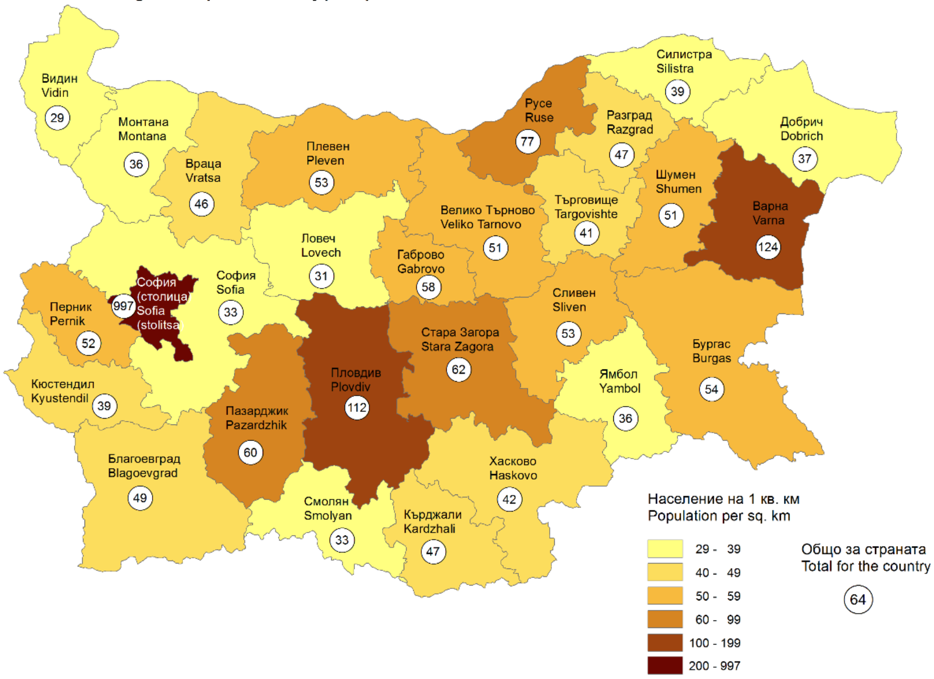
CBR water reserves include both surface and groundwater, and in particular the Danube river basin. Apart from the Danube, there are no high-water rivers in the Silistra region. There is only one significant artificial body of water - the Antimovo Dam, Tutrakan Municipality, as well as some shallow eutrophic lakes, the most important of which is Srebarna Lake. Karst lakes can be found often, with highly volatile water regime.

The cross-border region is not particularly rich in natural resources. The Silistra region has limited amont of mineral resources. On the valley slopes of the dry land, rock sections are revealed for building materials - limestone. Careers for the extraction of Cretaceous soft ornamental limestone for lining are found in the regions of Irnik (Sitovo municipality), Podles (Glavinitsa municipality), Zlatoklas (Dulovo municipality). Deposits of kaolin with a reservoir thickness of about 18 m (prospective for exploitation) have been studied at Kolobar village. On the banks of the Danube there are deposits of inert materials (gravel, sand).

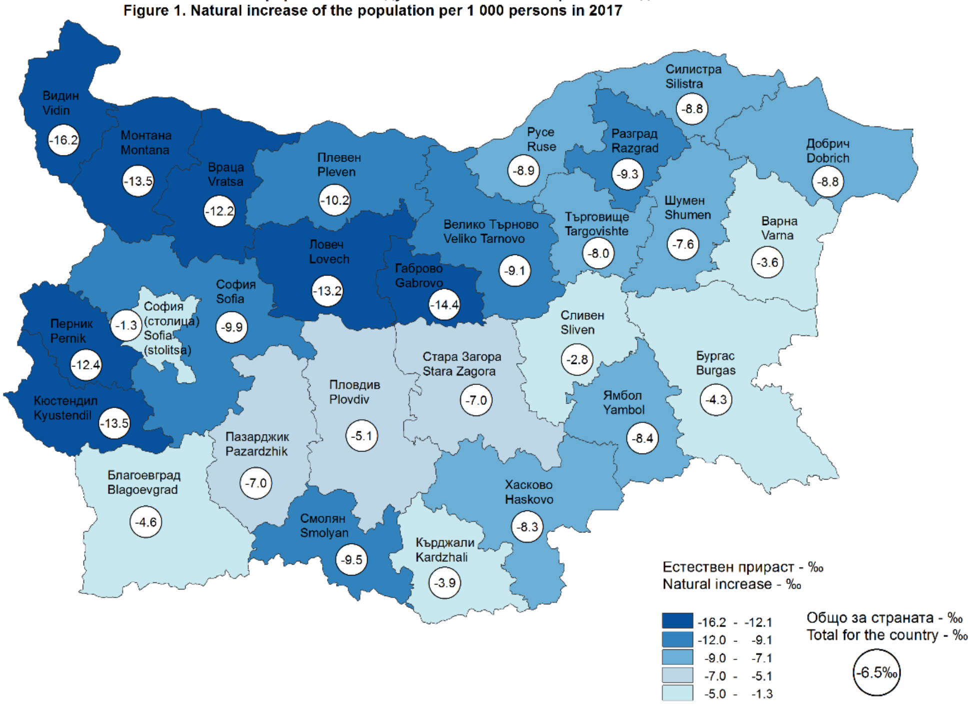
1.1.Demography

The structure of the population varies. The population of Silistra region is 119 474 people, with an average density of 41.96 people / km2. The district includes 118 settlements, united in 7 municipalities.

Фиг. 2. Гъстота на населението на 1 кв. км към 31.12.2017 година
Figure 2. Population density per sq. km as of 31.12.2017



Фиг. 1. Естествен прираст на 1 000 души от населението през 2017 година
Figure 1. Natural increase of the population per 1 000 persons in 2017



The population of Calarasi county is larger, 311 084 people, with the city of Calarasi being the most populated (76 147, as of 2018), followed by Oltenita (27 561). The demographic potential of cross-border region is different for the two countries, but the main trend is the one of population decline. In recent years, the population of the Bulgarian side has been aging in line with the national trend. As a result, human capital for economic development, especially in urban areas on the Bulgarian side, is diminishing. Similar processes can be observed in the Romanian side.

Population – Calarasi county

	Total	**Men**	**Women**
Total population for Calarasi County	**311 084**	**152 699**	**158 385**
Total urban population	**124 638**	**59 943**	**64 695**
Calarasi	76 147	36 587	39 560
Oltenita	27 561	13 152	14 409
Budeshti	7 617	3 739	3 878
Fundulea	6 692	3 255	3 437
Lechli-Gara	6 621	3 210	3 411
Total rural population	**186 446**	**92 756**	**93 690**

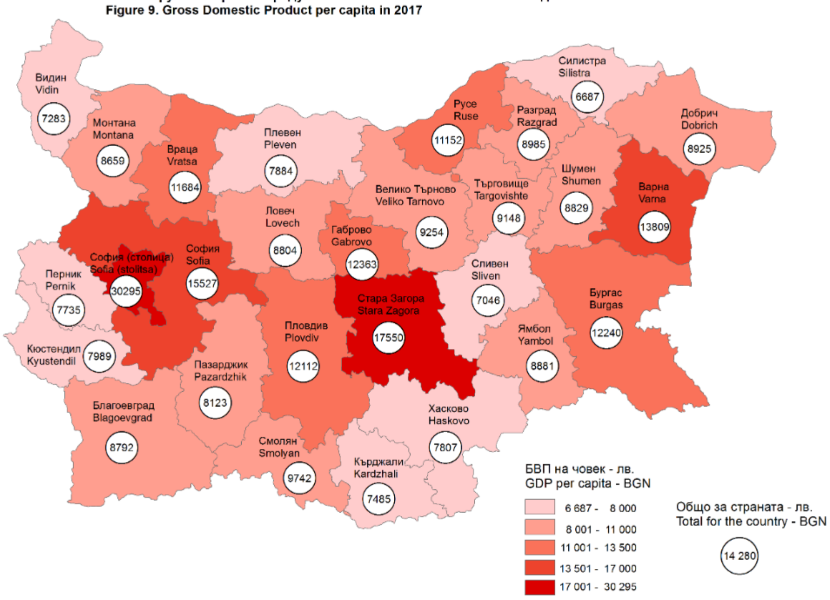
1.2. Economic profile

Agriculture and forestry, food industry, wood processing and mechanical engineering are the main economic activities, providing employment in the Silistra region. The economic profile of the Calarasi county is clearly dominated by agriculture, metallurgy is also an important industry. The characteristics of the industrial vary across the two countries, part of the CBR. A greater concentration of industrial activity is registered in Romania, mainly in the city of Calarasi and close to the other bigger cities/municipalities. In the case of the Bulgarian industrial sites, large enterprises are only four, located in the city of Silistra.

Close to 4 000 enterprises from the non-financial sector operate in the Silistra region (or 1% of those in the country). In terms of employment, 35 438 people work in these enterprises, distributed by municipalities with the highest share in Silistra - 53.1%, followed by the municipalities of Dulovo - 20.0%, Tutrakan - 12.4%, Glavnica - 6.8%, Sitovo - 3.4%, Kaynardja and Alfatar - 2.2%.

Economic activity in the district is not particularly high, with the level of entrepreneurship (32 companies per 1000 people) being significantly lower than the national average. The share and number of micro-companies (91.5% of all enterprises, employing 39% of the workforce) prevails, with an increase in their number during the recent years. A downward trend is observed in all other categories of companies. The industrial sector in the Bulgarian part of the CBR includes sub-sectors, such as agricultural machinery, electronics, food processing, woodworking; food and beverage production; etc.[1]

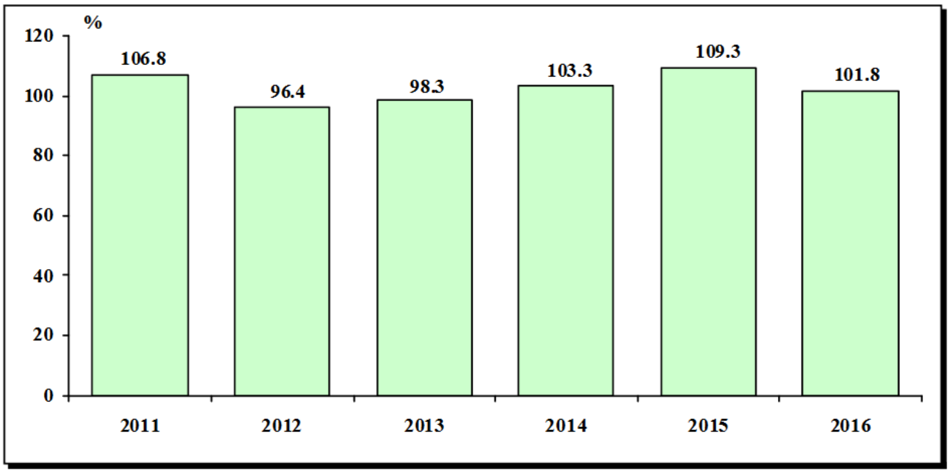
Фиг. 9. Брутен вътрешен продукт на човек от населението за 2017 година
Figure 9. Gross Domestic Product per capita in 2017



On the Romanian side of the CBR, dominant sub-industries include: metallurgy, food processing and textiles. The industrial production is diverse and is based on traditional activities, including raising poultry, animals, industrializing milk and meat; fish farming; cogeneration of feed; paper production; production of building materials and others: woodworking, metallurgy, gas production and storage, transportation and storage of oil and petroleum products, glass and fiberglass production, biodiesel production. The main industrial products include meat and meat products, clothing, milk and dairy products, steel, crude oil, precast concrete, furniture, paper, glass, mixed feed, sugar.

[1] Socio-economic data, National statistical institute, 2019

Industrial production for the 2011-2016 period (previous year =100-)



In 2017, 4 896 companies, classified by number of employees, operated in Calarasi county:

- 0-9 employees: 4,293 companies
- 10-49 employees: 512
- 50-249 employees: 77
- 250+ employees: 14

Classification by type of economic activity:

- Industry: 462
- Construction: 405
- Wholesale and retail; repair of motor vehicles and motorcycles: 2 020
- Transportation and storage: 351
- Hotels and restaurants: 162
- Information and communication: 113
- Financial intermediation and insurance: 45
- Real estate transactions: 68
- Professional, scientific and technical activities: 331
- Administrative and support activities: 120

- Education: 29
- Health and social assistance: 72
- Performing cultural and leisure activities: 59
- Other services: 72
- Other (not included above): 587.[2]

Evolution of the primary socio-economic indicators, on County level in Calarasi, April 2019:[3]

- *decrease* in industrial production in March 2019 by 4.9% compared to the previous month; and by 25.4% compared to industrial production in April 2018;
- *increase* in the net nominal average yield by 0.5% compared to the previous month; accordingly, by 12.5% compared to April 2018;
- *decrease* in registered unemployment at the end of April 2019 by 0.3 percentage points compared to the previous month and by 0.6 percentage points compared to April 2018;
- *decrease* in the use of accommodation net index in tourist accommodation by 1.2 percentage points compared to the previous month and an increase of 5.5 points compared to April 2018;
- no change in the number of building permits issued (42) compared to the previous month and an increase of 6 compared to April 2018;
- *increase* in the number of births and a decrease in the total number of deaths, marriages, divorces and deaths under 1 year of age, compared to the previous month, no change compared to the previous year.

The majority of enterprises in the CBR are represented by small and medium-sized enterprises (SMEs), with only a small proportion of large companies. Private initiative has been very dynamic in the SME sector in recent years. The main reason for this is the promotion of free competition and employment opportunities. Today, the vast majority of employment opportunities are created by SMEs. For Bulgaria the share of SMEs is over 99%. Overall, SMEs in the CBR have a stable position in the internal market, but very few export abroad.

Marking an upward trend in the structure of the economy within the CBR, services account for the largest relative share of the economy. Agriculture has traditionally been developed in the region. On the Bulgarian side, the areas of agricultural land and forests comprise respectively 58.57% and 33.19% of the total territory. The main crops grown are cereals,

[2] Romanian National Institute of Statistics, 2019
[3] Ibid

orchards, fruits and vegetables, grapes and more. Livestock in the region covers all types of animals. Agriculture faces a number of constraints: dispersed ownership, reduced arable land, outdated facilities, lack of investment and new technologies, deficiencies in integration with the food industry, and more.

In Romania the share of agricultural land and forests is also highly respresented in the territory mix. The size of the forest fund in Calarasi County is 22,000 ha. Although generally increasing, economic growth rates remain insufficient to overcome the significant lag in cross-border cooperation between Bulgaria and Romania, compared to average EU levels. Appropriate interventions are therefore needed to improve the overall economic potential in the CBR.

1.3. Environment

- **Air quality**: The air conditions in the CBR are considered relatively good. The main causes for pollution include fuel emissions used in industry and households, for heating, as well as exhaust gases from vehicles. Over the last few years, the levels of pollution are on the decline.
- **Water:** The analysis of the collected data shows that the ecological status of surface waters can also be estimated as relatively good. The main reason for water pollution in the region is the lack of sewage system for many of small and medium-sized municipalities. Groundwater is contaminated in some areas mainly by nitrates, phosphates and others. On the Romanian side, the main wastewater receiving bodies are lakes and rivers. Since the CBR area shares costs of the Danube river, joint water management and flood risk assessment offers an excellent opportunity for cooperation.
- **Soil**: The soil condition in the CBR is adequate, despite difcculties in counteracting soil destruction, erosion. Soil erosion occurs in coastal and partly forested areas. Limiting the use of pesticides, integrating "green" agriculture and improving control of air and water pollution, has led to an improvement in the environmental situation in recent years. Reducing soil erosion in the region could be an additional area of cooperation in the CBR.
- **Biological diversity**: The great abundance of flora and fauna and the diversity of habitats and ecosystems can easily be affected by chaotic economic activities. The establishment of protected territories and additional plans for incuding new ones are key aspects for preserving the richness of the region. The Srebarna Nature Reserve, located on the Bulgarian side of the CBR, is one example of protected area.

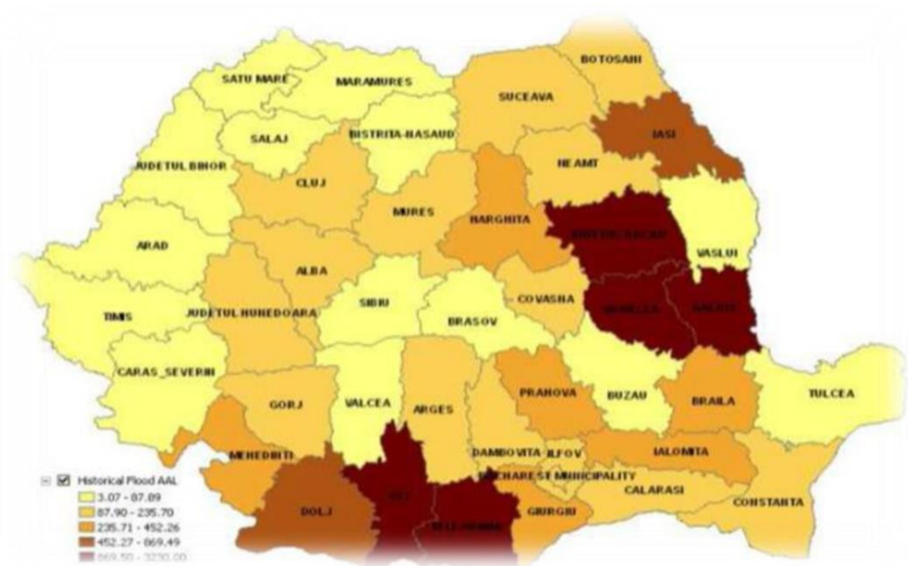
1.4.Macro-level risks of floods and forest fires in Bulgaria and Romania

Existing national and regional (at NUTS II, III levels) flood risk assessments in the CBR provide a general overview of the existing risks, which can be categorized as low-to-moderate, with the latter rising in the area of the Danube River basin.

(„Regions with significant potential risk of floods in the Dunabe river basin“) Source: Ministry of environment and water, Bulgaria, 2019.

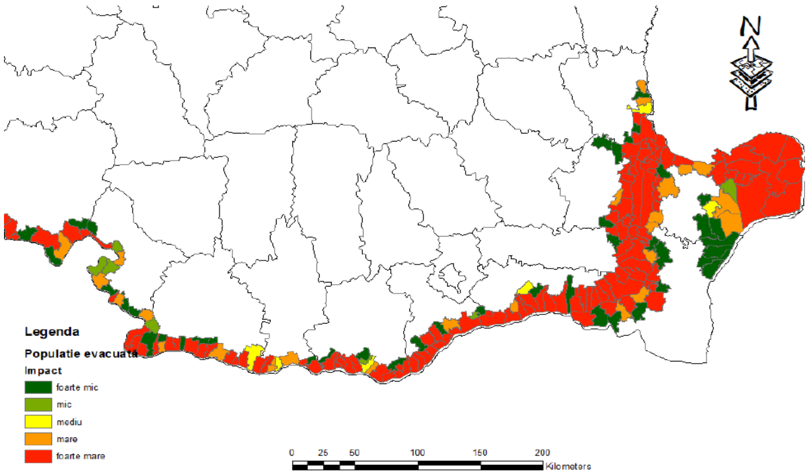
Floods are among the most common natural disaster events in Romania. The flood risk assessment, analyzed in the context of the implementation of the EC Floods Directive, takes into account the approximate number of potentially affected residents; type of economic activity in the potentially affected area; IPPC installations (see Annex I to Directive 96/61 / EC on integrated pollution prevention and control) which may cause accidental pollution in the event of a flood; potentially affected protected areas, etc.

During the 1960-2010 period, about 400 significant floods occurred, 39 of which are considered significant historical events, based on hydrological criteria and criteria that take into account the extent of the negative effects of the floods. This includes 36 significant historic events for inland rivers and 3 for the Danube, with 375 areas identified as possessing significant risk of inland floods - 24 along the Danube. During this period, 237 casualties were registered (6.6 average casualties / events).[4]



Source: National Risk Assessment – RO RISK, 2016, National Inspectorate of Emergency Situations, Romania.

Recent history of floods occurring in Romania demonstrates the major impact of this hazard on both population and infrastructure - floods in 2005 and 2006 affected more than 1.5 million people (93 deaths), destroying an important part of the infrastructure and causing and estimated damage of about EUR 2 billion.



Source: National Risk Assessment – RO RISK, 2016, National Inspectorate of Emergency Situations, Romania.

[4] National Risk Assessment – RO RISK, 2016, National Inspectorate of Emergency Situations, Romania.

In terms of the **risk of forest fires** and historical data on the occurrence of fires, the Silistra region falls below national average. The total forested territory of the district covers an area of 63,276 ha or 1.51% of the forested territory of the country. The forested part of the forest fund is 59 348 ha, with relatively low afforestation - 20.85%. By category forest areas are divided into coniferous - 0.80%, deciduous - 92.99% and independent areas - 6.21%. Over 8% of the total forest area falls under class I for fire danger.

In the 2006-2015 period, 48 fires were registered in the forest territories of the Silistra region, with a total of 472.8 ha. damaged. The average annual size of a fire is 9.25 ha - 1.63 times below the national average. The average annual rate of burning of forest territories is 0.07%, or 3 times below the national average. By type of forest fires are divided into peak - 1,17% and low - 98,83%. The years with maximum values of fire activity are 2007 and 2012, when the size of the burned area exceeded the average for the period - 4.7 and 1.8 times respectively.

Analysis of previous evaluations and studies show that:

- On average, 0.008 forest fires occur on an area of 1000 ha, annually;
- On every 1000 ha, 0,75 ha are burned in the forest areas.[5]

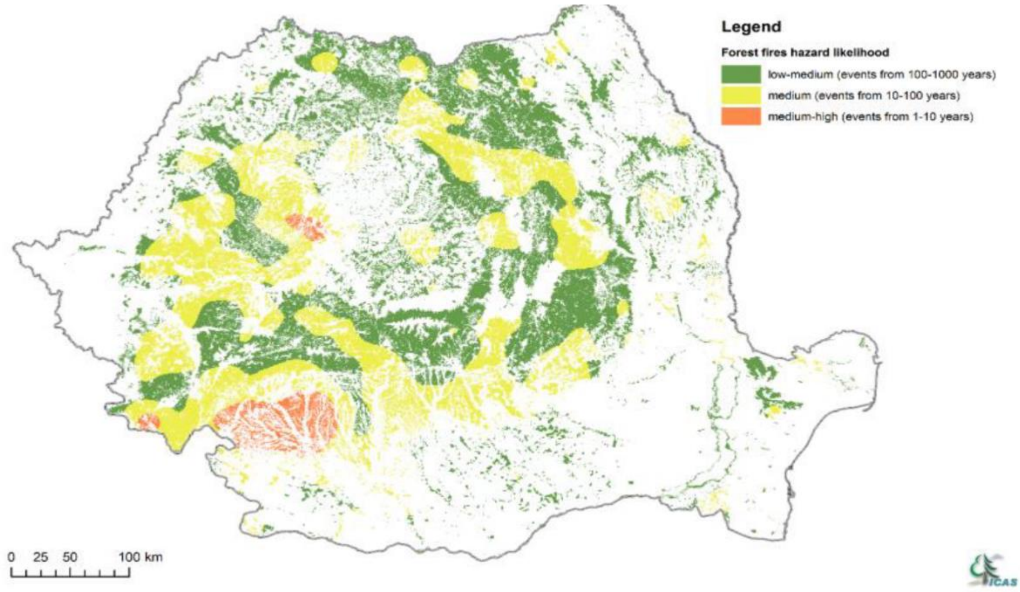
In Romania, forests are usually located in the steepest and more inaccessible areas, in the context of worsened soil conditions. Forest fires occur mostly during the dry periods, especially in forests, located in the hilly subcarpathian region. Regarding the time and location of the fires, it was found that the highest registered rates are usually during the spring season (51%), followed by summer (25%), fall (18%) and winter (6%). The seasonality of fires is correlated with dry periods, as well as with agricultural practices for burning plant waste. The size of the forest fund in Calarasi County is 22,000 ha.

Human presence and activity are the main causes for forest fires. This statement is also supported by the intracannual and spatial distribution of fire, which is more common in hilly areas in spring and autumn when agricultural burns occur for vegetation management. In the summer, most forest fires occur in the plains when burning stubble is common in the mountains, due to increased human activity in unpopulated areas.

On the territory of Romania, the likelihood and frequency of forest fires has doubled to 341 events / year over the last decade, compared to the historical (1956-2005) average of 175. Climate change is a possible cause of the reported increase. The average area burned has increased by 25%, from 5.2 to 6.5 ha over the same period. Trends in increasing frequency of forest fires and forest areas are consistent with studies showing that climate change is

[5] Lubenov, K., 2016, Assessment and mapping of forest fires risk in the country

associated with an increased risk of fires. The likelihood of forest fires occurring in the territory of Romania is illustrated below:



Source: National Risk Assessment – RO RISK, 2016, National Inspectorate of Emergency Situations, Romania.

2. Model approach to risk assessment

The selected approach to risk analysis, related to the scale or vulnerability, frequency, geographical zoning and prerequisites for the occurrence of disasters, in the cross-border region is also complemented by analysis of disaster management and planning, as well as by analysis of the prevention and public awareness activities.

The current project foresees development of maps of the threat and risk of floods and forest fires. The availability of spatial information data (public) and maps proved to be very limited and, at times, inaccurate. Nonetheless, the available information can be spatially referenced to the municipalities in the CBR. For this purpose, the collected data were analysed and summarized, thus producing risk maps, using the RkFMEA method. In addition, the method was used to normalize the risk levels according to age dependency (via demographic data).

The chosen and adapted model for data collection, risk analisys and risk mapping, based on which the specific conclusions and recommendations for improving governance were made, includes several phases:

2.1. Building an information database for disaster events in the CBR

The added value of the methodological approach to the analysis is the fact that it allows for the accumulation of a database, which, through regular update, could be integrated to support risk prevention in the future. Data are collected at the municipal level, analysed and summarized in table form, indicating the source and period. The data are then summarized according to the threat classification. The most challengeing aspect in the current tast has proven to be the lack of specific information on the status of existing prevention measures, as well as specific plans for future prevention measures. **The main sources of information used include**:

- publicly available data from district and municipal development plans and disaster protection plans;
- data from the Bulgarian and Romanian National statistical institutes;
- data from the General Directorate Fire Safety and Protection of the Population, Bulgaria;
- General Inspectorate for Emergency Situations, Romania;
- Danube Region Basin Directorate;
- Ministry of Environment and Water of the Republic of Bulgaria;
- Other relevant analyses, studies and assessments on national and local level for Bulgaria and Romania, including publications by non-governmental organizations and other stakeholders.

Historical data and more recent (where available) information for disaster occurrence in the CBR were used for the purposes of the of the risk assessment. In this context, account should be taken of the fact that the availability of the necessary information is limited and there are serious difficulties in attempting comparability - different criteria are used such as the number of casualties, the amount of damage, the number of events that have occurred over a period of time. Data on the physical and economic consequences of disasters have to considered as, at best, indicative.

2.2.Methodology for risk analysis and assessment

A primary goal of the analysis is to provide comparable, clear and actionable insights with regards to potential disasters and damages, as well as to assess the preparedness for disaster occurrence in the municipalities of the cross-border region. The most comprehensible and easy-to-use approach is through the GIS municipal maps in the CBR. To achieve this, the proposed method for assessing the risk for the population of the various threats is proposed, using a single system for expert assessment and analysis of the available data.

The proposed RkFMEA method and data collection is used to map threats and risks and to identify areas that are susceptible to specific risks. It also provides useful information to the public and is an important planning tool for the authorities and other stakeholders.

2.3. Types of risks

Many types of risk exist, as well as many different definitions of the term, depending on the area of life to which they relate. Hereinafter, the subject of analysis will be the risk to human health posed by natural and man-made threats. The material risks will also be taken into account, **but the main task of the analysis is protection of the population in the event of disasters and accidents**.

The definition of Risk, in the context of this report is: *risk is the likelihood of a disaster, resulting from a natural crisis or man-made event, that would have a serious impact on human health and life, as well as will result in material and/or environmental damage to a specific area*.

2.4. Methodology for risk management

За да се разбере и изучи всяка рискова ситуация, тя преминава през три важни етапа:

- ***Risk analysis:*** In the case of risk analysis, the main objective is to review the poterntial negative consequences, which may manifest as a result from the realization of certain threats. In this case, and in the context of ensuring the safety of the population, a negative consequence could be the deterioration of the health of one or more people, an accident or failure of a technical system or device, pollution or destruction of an ecological system, death of a group of people, or an increase in mortality rate in the population, material damage from realized hazards or increased safety expenditures.
- ***Risk assessment***: The risk assessment results is “quantifying” the risk. During this phase we seek specific answers to questions, such as “What is the probability for realization of the threat?” and “What would be the weight of the realized threat?”.
- ***Risk management:*** The core idea of risk management is the creation of certain conditions and the taking of measures, which keep the risk at level, which is as low as reasonably possible, thus ensuring that its existence does not threaten the environment to a degree, which is unacceptable for the organisms living in it.

2.5. ESPSON classification and weighting of the existing threats and risks

Statistics on past crisis events and data on the distribution of the weight of these crises, part of the integrated threat and risk assessment, are collected in different ways by the various administrative bodies. However, European legislation provides for comparability in the CBR.

ESPON HAZARD WEIGHTS for Europe %

Natural Threats	Weight %
Avalanche	2.30
Drought	7.50
Earthquakes	11.10
Extreme temperatures	3.60
Floods	15.60
Forest fires	11.40
Landslides	6.20
Stormy sea rise	4.50
Tsunami	1.40
Volcanic erruptions	2.80
Winter storms	7.50
Total natural threats	73.90
Technological threats	
Aircraft	2.10
Major accident threats	8.40
Nuclear power plants	7.80
Petroleum products – transport, Storage, handling	7.80
Total technological threats	26.10
Total	100.00

2.6. Threats, studying past events

The main threats for the CBR are identified based on a combination of analysed information, collected and structured from available statistical information; historical and socio-economic indicators; quality information contained in municipal and district development plans; flood risk management plans and protection plans in the event of disasters in the region. The complete analysis, in tabular form, describing the correlation between different databases and sources, is provided in Appendix 1. The basic data on the flood and forest fire threats were further verified during discussions and stakeholder interviews. The so-called natural, environmental threats, ranked by their significance for the damage from past events are: floods, forest fires, landslides, winter storms, drought, extreme temperatures, storms, earthquakes.

The technological threats identified by the study are: nuclear power plant, radioactive contamination, threat of major accidents at chemical plants and enterprises and storage facilities with toxic materials, threat of storage, processing and transportation of petroleum products.

It is evident from the identified types of threats that the classification of ESPON is largely valid for the purposes of the current analysis, and can thus be applied. In addition, the identified threats correspond to categories used by the statistical institutes of both Bulgaria and Romania, which allows the use of statistical data available in the municipalities.

After the initial analysis of past disaster events, specific types of threats from the EPSON classification will be used, depending on the characteristics of any given municipality.

2.7. Subject of the risk analysis and assessment

The risk should be localized, depenending on the area of impact and the threat assessment. The vulnerability, likelihood of occurrence, damages and prevention measures available have to be assessed for the specific location. Subject of the analysis and monitoring are threats and risks to human health that affect municipalities, that are vital to the functioning of the economy or that can cause material and damage to the population of significant proportions. A single objects or individual risks are not considered and will not be discussed because, it is not practically, technically and financially feasible.

To perform this, the necessary data to be analysed should be on the level of individual municipalities, collected and evaluated at that specific level. Thus, the unit area which will be subject to the assessment of threats, vulnerabilities, damages and risk levels will be the territory of the municipality.

2.8. Assessment of damages and definition of thresholds

International practice and EM-DAT reporting standarts for crisis occurrence require the meeting of certain thresholds and criteria, including:

- 10 or more persons reported dead;
- 100 persons reported injured or affected;
- Disaster status announced (official announcement of crisis situation);
- Request for international assistance.

The risk assessment methodology for the floods, adopted by the MOEW and meeting the requirements of the Floods Directive, provides the following criteria:

№	Criteria by category	Unit			
	Level		Low	Medium	High
	Human health				
1	Affected citizens	Number	300	1 500	3 000
2	Affected elements of critical infrastructure or affected public buildings (hospitals, schools, etc.)	Number	1	3	6
3	Wells and pumping stations for drinking water supply	Number	4	18	38
	Commercial activity				
1	Summarized economic value of damages	BGN	700 x.	3 000 x.	7 000 x.

For this project, a threshold of 100, directly and indirectly, affected residents for a municipality will be used as a consequence of an event that may have occurred in any of the threats identified here. This reporting classification is for crisis events only. For the purposes of risk management, a criterion is required for a preliminary assessment or prognosis of possible damage in the event of a specific crisis event for the identified threats.

The financial criteria for damages was selected following a careful review and analysis of the possible criteria. It is defined as a (a) percentage of the estimated damage for a given disaster and a territorial unit, (b) to GDP for that territorial unit, with the lower limit being 5%, the average interval being 5% to 10% and the higher one being taken over 10%. However, the basic criteria for 100 people as potentially affected or for one facility, which affects 100 people will be met at the administrative LAU1 level, which corresponds to a municipality for Bulgaria.

Material damage is only an indicator of the ability of the municipality's population to cope with the consequences and damage of a possible crisis or disaster. Using this comparative indicator, it is possible to compare the risk to human health on equal terms with other municipalities, subject of the present analysis.

Additional factor which determines the ability of a municipality's population to cope with the consequences and damage of a possible crisis event is the ratio of the incapacitated to the employable population of that municipality. With low employment, coupled by high number of children and elderly people, it will be harder for them to cope with occurring disaster. This is measured by the age dependency ratio, which shows the number of people in the 'dependent' age (population below 15 and 65 and over) per 100 persons aged 15 to 65 years. With a presented ration of up to 45%, the municipality is considered "very active", "relatively weaker" is the range of 46% to 55%, while a range above 55% is thought as "very weak". For comparison, this coefficient for Bulgaria for 2015 is 52.4%, which practically means that for every person aged between under 15 and over 65 year, there are less than two persons in active age. For comparison, in 2005 this ratio was 44.5%.

Financial and material damage will be brought into these financial dimensions and the health risk will be normalized with their help, thus there will be a commensurate risk for all municipalities, suject of the analysis, regardless of their wealth and demographic characteristics. The first phase of the database uses financial assessments of disasters, together with the expert evaluation of experts from the municipality for estimated values for possible damage.

2.9. Risk management methods

The conducted analysis of the related international practices and applications in the field of preventive activity and risk management shows that prevention, especially when considered at the level of individual municipalities, together with presence of institutional support and development at this level, are priorities for achieving efficiency and effectiveness, feasibility of action and sustainable development.

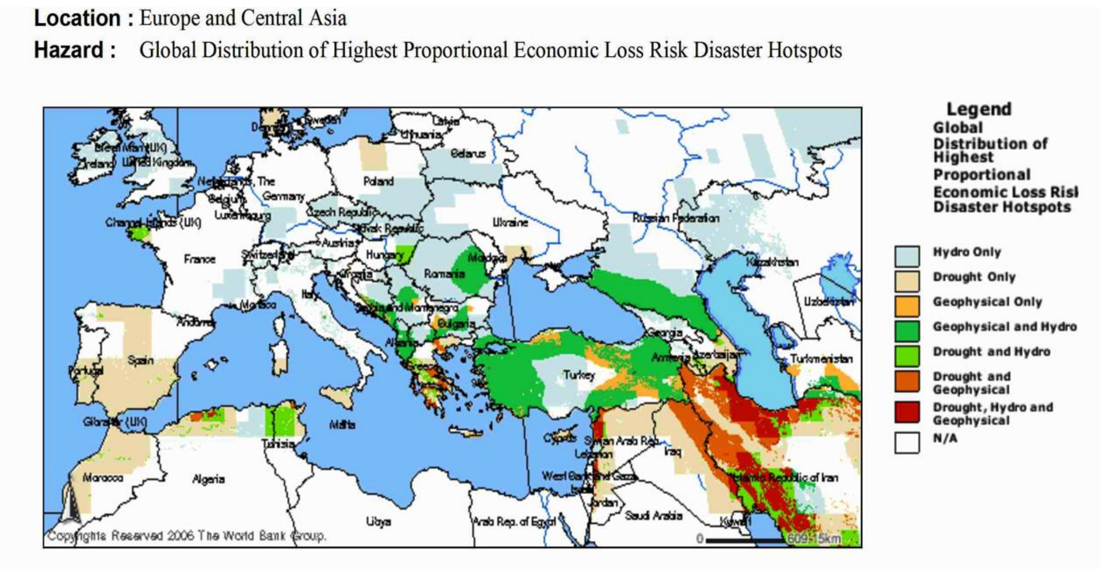
2.10. Gobal macro-level risk management

Standard risk management approaches, or more precisely risk monitoring, are largely based on past crisis and disaster statistics. They concentrate on managing global and regional policies and aim to take into account and plan measures to counteract at international, national and regional levels, and to monitor global climate change and the effectiveness of global measures taken. Based on these statistical surveys and accordingly derived multi-layer geoinformation systems, planning of the measures at national and regional level or at the macro level of management is made. Individual measures and policies at the local level - municipality or mayoralty, remain a priority for defining and resolving at local level, but neither the resources, nor the planning of the measures, nor the effect of these measures are taken into account by the monitoring and management systems until they occur as statistical indicator, at least, at NUTS3 level.

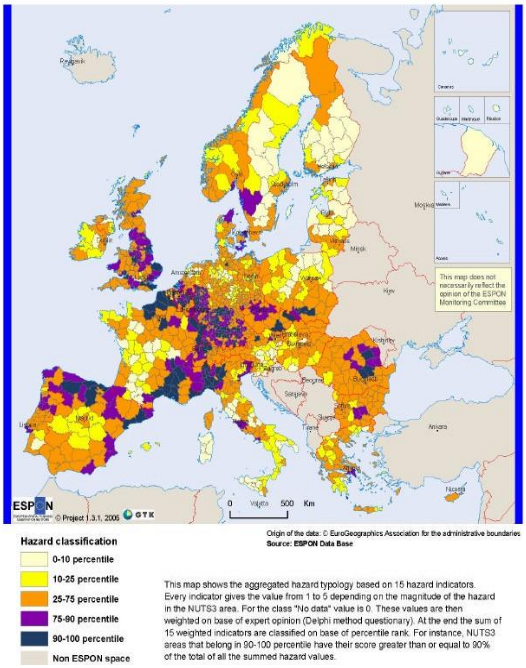
This type of risk management is a macro-top-down method which requires very serious planning and resource provisioning, and an administratively strong and functioning system to meet the needs of effective measures at the municipality level. These are most effectively translated into specific disaster protection plans, which should be put in place at the municipal level. This method however does not make it possible to specificaly take into account the effectiveness of risk mitigation measures, nor to assist in risk analysis at the mayoral and municipal level, nor does it allow the management of resources to reduce the risk directly related to the risk itself and to specify protection plans.

Below are two examples of geoinformation risk monitoring systems - the first is a well-funded initiative by the World Bank, the second is the application of the EPSON methodology by the European Union.

Global natural risk, according to damages occurred



Integrated threat map



The other approach to risk management is at the micro level - from the bottom up. This means analyzing the risk, identifying the risk areas and possible damages, and planning the measures and resources for their implementation at the lowest level - mayoralty and municipality. This is in line with the policy of decentralization of local authorities, and above all the requirement and practice that local, mayor and municipal authorities should be responsible for taking preventive measures and that they are the main factors in assessing the damage and taking measures after the occurrence of a crisis and accidents, with the preparation of specific disaster protection plans. At the municipal level, all information on crisis events and preventative measures is collected and summarized by all institutions and organizations involved in crisis events or owners of facilities and installations that can cause a crisis or disaster in the event of certain natural disasters, or poor maintenance and maintenance. This is also the level that is responsible for the physical visual monitoring of risk factors, and for for the planning of prevention measures and resources, as well as for their implementation.

The meeting point of the two approaches to risk management occurs at NUTS3 level. Geoinformation systems and databases built on the basis of preventive and resource-based risk management allow to monitor the dynamics of risk change, depending on the preventive measures taken, in the short and long term, as well as to effectively manage the resources for implementation of preventive measures at the municipal and regional level.

2.11. Preventive and resource-based risk management

In general, the risk is the likelihood of an accidental occurrence in a place with certain consequences. Random events cannot be managed, but actions related to increasing or reducing the effects of a random event can. The municipal disaster protection plans require a risk analysis at the municipal level and the planning of preventive measures, as well as an action plan in the event of a crisis. The risk analysis shows what the main threats and vulnerable communities are in the event of a crisis and is the main prerequisite for a concrete and effective defense plan. The planning and implementation of preventive measures are part of the protection plans. And that in itself is an effective form of risk management.

Risk management refers to the management of human activities leading to a reduction or increase in the amount of damage and casualties that would be caused by natural disasters and to the management of activities leading to a change in the likelihood of a natural disaster event occurring, if possible. This is the management of preventive measures.

Preventive measures management is standard as a process management approach, but also requires control of the implementation of risk mitigation activities and monitoring and verification of the achieved risk change and subsequent new analysis, planning and implementation.

3. FMEA and R^KFMEA

3.1. FMEA

Choosing a risk management model and technology requires effective management at the lowest possible level of governance, data management and collection - building a hierarchical structure at municipality level, followed by database development and presentation of the data in an appropriate format for visualizing and managing of GIS database. To be presented in the GIS and to be able to compare data and summaries of threats and risks, they must be numerically expressed. The digital risk assessment method is FMEA. The FMEA engineering method stands for Failure Mode Effect Analysis. It assesses the vulnerability to a defect or system failure and what it can cause to the entire system, the likelihood of it occurring, and the control and monitoring measures. The three factors are R, P and N, respectively, and are valued from 1 to 10. The original FMEA method has an “N” factor included, which determines the degree of effectiveness of the control function that is taken to check or detect any cause of accident or defect. By modifying this factor as a factor for the effectiveness of a measure or action taken, or of those to be undertaken to reduce the risk of a specific natural crisis event, it already enables a comprehensive risk assessment, including the measures already taken, the likelihood and vulnerability of the measures taken in the presence of a crisis event. This is one of the basic principles enshrined in the R^kFMEA system .

3.2. R^kFMEA, L and D factors

Any selected approach should offer a unified method for risk analysis and assessment, and for the evaluation of specific factors. Web-based applications and approaches to regional networks are typical for such systems. These basic systemic principles and considerations are set out in principles and applications in R^kFMEA[6] as methods and tools for risk analysis and risk assessment and management of preventive measures.[7] R^kFMEA is a management system, based on bottom-up approach for data collection, risk analysis and assessment, planning and the management of prevention measures. The system is based on the FMEA method, and standardized sets of quantitative factors with values from 1 to 10 are used.

R^kFMEA adds two important factors for risk assessment and analysis and for management - that of the existing control or prevention measure with their effectiveness, proposed future safeguards and their effect. The system also adds the opportunity for economic evaluation, planning and budgeting of future prevention and resource management measures. **The acronym R stands for Resource Management.**

R^kFMEA provides a quantitative risk dimension that allows for a comparison of risk, including the effect of the current and existing preventive measure or action (RPN - Risk Prioriy Number), and in addition provides an integrated risk factor (RPNF) representing the risk with the emergency and the necessary investment for the prevention and management of resources. The current analysis will not specify the complex risk factor F, but the chosen approach enables the description of the proposed new prevention measures and the subsequent updating of the data. If these or new measures are implemented, this will be reflected in the factor N. In addition to R^kFMEA, two other factors are added for integrated risk assessment, taking into account the solvency of the municipality and its demographic condition - the factors L and D. They are also with values from 1 to 10 - 1 to 3 in case material damages are estimated to be less than 4% of the GDP of the municipality; 4 to 6 for values of 4% to 10%; 7 to 10 for the damages over 10% of GDP; and 10 for damages of 30% or above. The demographic factor D is for the age dependency coefficient, its value being from 1 to 3 for the coefficient below 45%, 4 to 6 for values from 45% to 55% and 7 to 10 for values over 55%.

All R^kFMEA factors are divided into three levels: low, good or negligible are colored in green; medium, acceptable, attention-grabbing – in yellow; and high, dangerous, unacceptable,

[6] Kanev, 2010
[7] Kanev, 2011

urgent attention required – colored in red. The complex factor RPNLD integrates or “normalizes” the risk assessment with the population's ability to cope with disaster events.

Management also requires feedback or performance monitoring. The R^kFMEA contains the time factor and the database built on the information collected allows to monitor and show the change in risk or the most important management factor - the trend of the risk and the effect of the measures taken.

R^kFMEA allows assessing vulnerabilities, damages and policies, even when they are not explicitly identified. In this case, expertise or on-site assessment, historical background data or available knowledge are the factors that make it possible to assess risk, measures and actions. R^kFMEA is a dynamic, flexible and sophisticated model for preventative and resource-based risk management.

3.3. R^kFMEA data collection

The method for collecting and processing data for risk assessment, describing prevention, calculating integrated risk and normalized risk with a population coping factor is shown by detailed calculations and risk assessment in the attached tables for each municipality in both areas integrated for all threats (see Annex 1). RPN factors are selected based on document review, expert assessment and analysis of secondary information of past events according to the data collected (see Annex 1) and referenced to the corresponding values using guidance tables. The important thing is to choose the right range and to illustrate it accordingly - in green, yellow or red, and to assign specific factoe number.

The assessment of the damages relies on expert opinion, based on past experience of similar events, studies, strategies and developments for a particular municipality or threat. Values are approximate, as no exact value is needed for the purposes of the analysis. For affected residents, this means directly and indirectly affected, for example, for one directly affected, on average, there are at least three more indirectly affected. This applies directly to those affected by the flood, for instance, as well as to those indirectly affected (e.g. relatives, assistants, shelters, closed gardens and schools, hospitals, students and staff, patients and relatives, etc.).

Material damage is the direct damage for the restoration of destroyed or damaged property, infrastructure, direct and indirect damage for the restoration of the environment, direct and indirect damage from the shutdown of production facilities, establishments, etc., the value of rescue work, cleaning, benefits, temporary disability, delivery of materials, water and more. Again, this is provides a very rough estimate.

Information on the measures available to warn and prevent the adverse effects of threats is very important. Assessing their effectiveness is one of the main factors for objectively evaluating the risk. With effective measures in place, with the same threat with the same degree, present, it will have much less adverse effects than one without precautionary measures (or the risk in the first case will be lower).

When assessing the preventive measures available, the extent of their support should be taken into account, if necessary. An unsupported facility cannot perform its functions properly, in which case the evaluation of the effectiveness of the measure should be increased by one or two units in the negative direction. Upon further completion of the data, if a new safeguard is implemented, it will have a positive effect on the risk, under the same other conditions as compared to the previous period.

3.4. Identifying complex risk factors with R^kFMEA

The RPN gives the value of the risk, or its digital assessment, in this case specifically of human health risk. The risk levels, based on RPN factor, are as follows:

- High for factor above 250;
- Moderate for factor range 50-250;
- Low or negligible for factor under 50.

These factors are also assigned the corresponding colors mentioned above - red, yellow and green. The next two factors, L and D, are to evaluate the ability of the municipality to take on this risk, or more precisely the extent to which the municipality, with its resources and population, will be able to cope with this particular risk. The final assessment is normalized with the risk levels.

The “L” factor, for the ratio of material losses to GDP of the municipality, and factor "D", for the population's ability to cope with a disaster, depending on its age, has the following values:

Factor L GDP	L value	Factor D Age	D value
Loss/GDP%<=1%	1	<30%	1
2%	2	=30%<40%	2
=2%<4%	3	=40%<45%	3
=4%<5%	4	=45%<50%	4
=5%<6%	5	=50%<53%	5
=6%<9%	6	=53%<55%	6

=9%<10%	7	=55%<65%	7
=10%<20%	8	=65%<80%	8
=20%<30%	9	=80%<100%	9
over 30%	10	=100%>100%	10

The levels of complex risk, integrating the assessment and ability of the municipality to deal with material damage, according to its demographic characteristics, separately, are RPNL and RPND. Their levels are:

- High for factor over 1700;
- Moderate for factor range 200-1700;
- Low or negligible factor under 200.

The levels of complex risk, integrated with both factors RPNLD are within the following ranges:

- High for factor over 11900;
- Moderate for factor range 800-11900;
- Low or negligible factor under 800.

These factors are also assigned to the corresponding colors mentioned above - red, yellow and green.

3.5. R^kFMEA summary data

Databases are consequently built, based on the described methodology and tables above, to create risk GIS. The summarized data in tabular form also serve for municipal management activities. In GIS, they are for the municipality level and up. The system allows, if necessary in the future, for the aggregated data to be compared with previous years and subsequent years, thus displaying trends in risk change (RPN, RPNL, RPND, RPNLD). Risk reduction - factor <1 is in green, unchanged - factor = 1 and risk increase - factor> 1.

3.6. Integrated risk calculation

The methodology for calculating integrated risk follows the Delphi method in the EU ESPON project. According to this methodology, different types of threats are assigned different percentages by which the risk factor is multiplied and the resulting derivatives are collected. This method is also applied here to summarize the risk data, depending on the possible occurrence of the threats in a municipality. Integration is for all factors - RPN, RPNL, RPND, RPNLD.

The types of riks, which are taken into consideration and their weigh is presented below:

Integrated risk factor - weighting

Weight %	Crisis evetn - threat
11.10%	Earthquakes
7.50%	Drought
11.40%	Forest fire
2.30%	Others
1.40%	Tsunami
15.60%	Floods
6.00%	Landslides
4.50%	Water level rise
2.80%	Volcanos
7.50%	Winter storms - snowfall
3.60%	Extreme temperatures
2.10%	Aircraft
8.40%	Industrial accidents
7.80%	Radioactivity
7.80%	Oil and gas, accidents, storage and transportation

The integration then to the next level (region/district) is done by simply arithmetically deriving the risk factor for each municipality. The same procedure is followed for integration at each subsequent level. This is how the multilayer databases are obtained and the maps for preventive risk management are displayed.

3.7. Risk management maps

The developed risk maps are derived from the data collected and summarized via the application of the R^kFMEA methodology, described above. The risk maps include the estimated complex risk based on RPN, complex assessed risk based on complex factor RPNL, RPND, RPNLD.

The same three-colored principle is applied - red for high values and hazardous risk areas, yellow for moderate or unchanged levels, and green for safe or decreasing levels. For the purposes of the current analysis, the most appropriate and informative, based on the most saturated amount of analysed and available data, risk maps are the ones based on RPN and RPNLD. If no geo-referenced damage estimation data are available, then is is best to rely on normalized levels of risk to the demographics of the respective municipality, thus using mainly the maps based on RPND.

4. RISK MAPS

The data for Silistra District are more detailed, with more up-to-date municipal-level population protection plans, which allows the RPN and RPND calculation tables to be completed in detail. Geo-referenced municipal damage estimation data are extremely insufficient and the L factor is difficult to calculate.

For the Calarash region, the data is even scarcer, despite the extensive country-wide risk analysis, under the National riska assessment (RO-RISK project), carried out in 2016, which is huge in scope and with a very rigorous scientific focus that does not allow for a comprehensible comparison of the CBR situation. Data on existing plans to protect the population at municipal level (commune) are largely missing. The main source of comparable threat and risk data is the aggregated data in the English report to this project - "National Risk Assessment - RO RISK". Prevention measures, especially those of a technical nature proposed for flood prevention, are described in detail in the report, but there is only one municipality, relevant for the scope of the CBR, subject of the present report. There are more details in the regional plan for flood protection of Calarasi for some municipalities along the Danube on the status and availability of dikes. For unclear municipalities, the N factor is considered to be neutral 5, which is the meaning of any protection measure that is considered to be available administrative capacity and alert and alert systems. For municipalities in Romania, an age dependency coefficient was used based on local community statistics data from 1 July 2017, with dependent ages for the population aged 0 to 14, including those aged 60 and older. *The small discrepancy with the statistics for the municipalities in Silistra does not affect the overall picture of the normalized risk and its comparison for the TGR* .

Silistra region municipalities:

Alfatar Glavinica Dulovo

Kainardzha	Sitovo
Silistra	Tutrakan

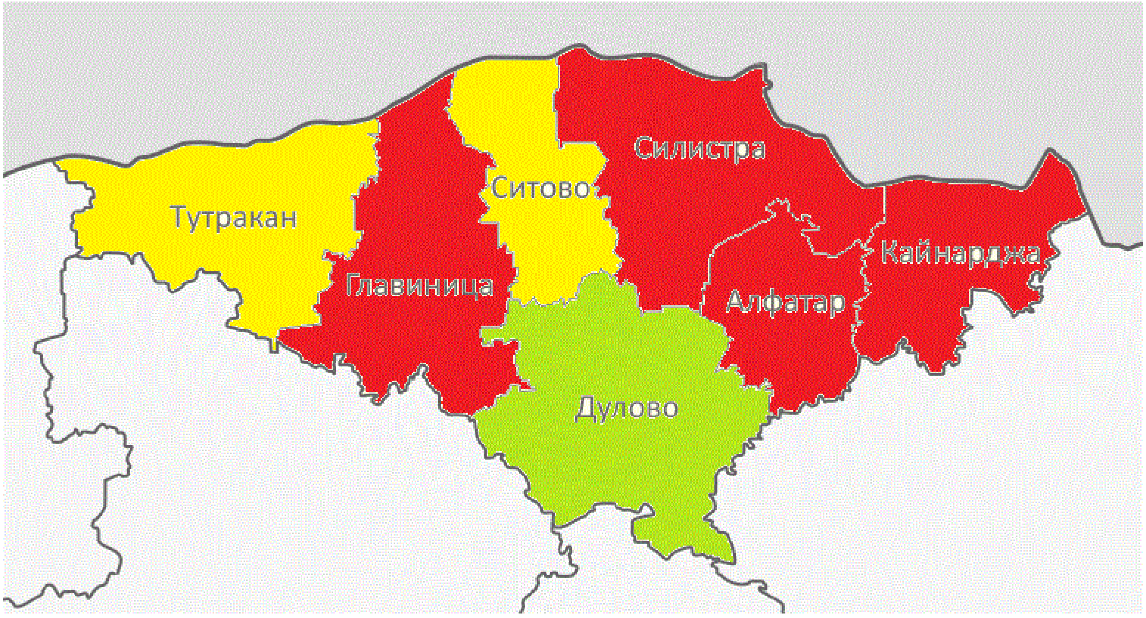
Municipalities/communes in Calarasi county (the assigned number corresponds to the maps):

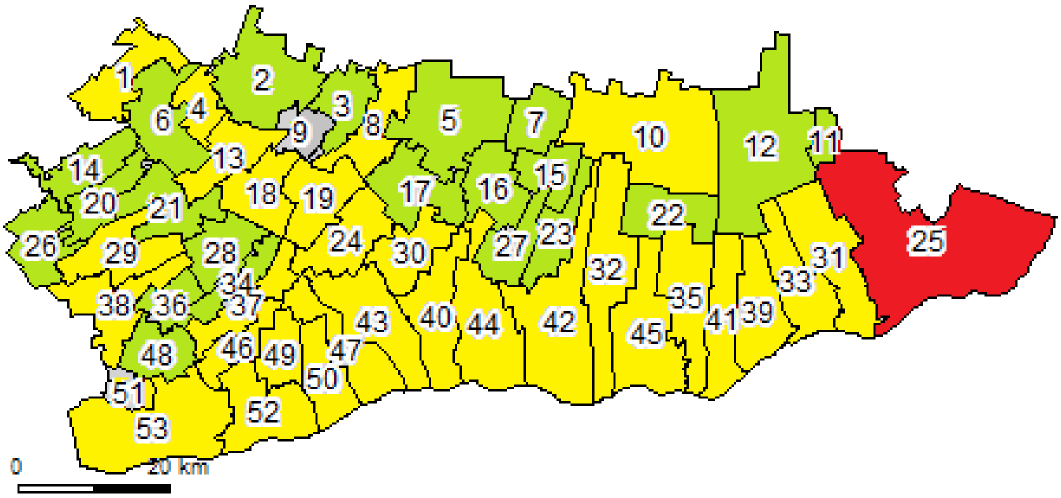
1 Belciugatele	19 Valea Argovei	36 Soldanu
2 Ileana	20 Plataresti	37 Curcani
3 Lehliu	21 Sohatu	38 Budesti
4 Tamadau Mare	22 Stefan Voda	39 Dichiseni
5 Dor Marunt	23 Independenta	40 Dorobantu
6 Fundulea	24 Frasinet	41 Roseti
7 Dragos Voda	25 Borcea	42 Gradistea
8 Lehliu-gara	26 Frumusani	43 Manastirea
9 Nicolae Balcescu	27 Alexandru Odobescu	44 Ciocanesti
10 Dragalina	28 Nana	45 Calarasi
11 Stefan Cel Mare	29 Vasilati	46 Mitreni
12 Perisoru	30 Ulmu	47 Chiselet
13 Sarulesti	31 Jegalia	48 Radovanu
14 Fundeni	32 Ceacu	49 Ulmeni
15 Valcelele	33 Unirea	50 Spantov
16 Vlad Tepes	34 Luica	51 Cascioarele
17 Lupsanu	35 Modelu	52 Oltenita
18 Gurbanesti		53 Chirnogi

4.1. Threat maps – floods and forest fires risk

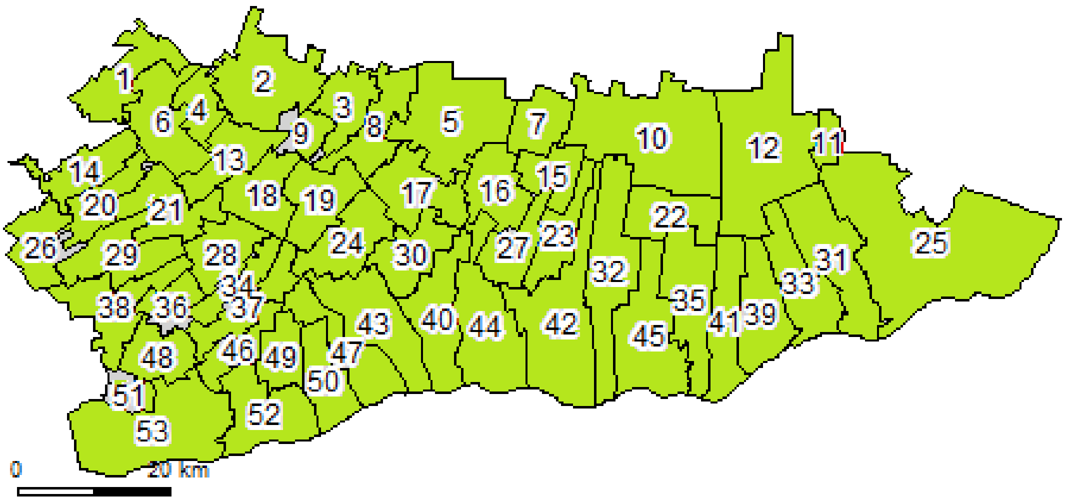
4.1.1. Threat maps - floods

Municipalities in the red are considered to be in most serious threat of floods, in the yellow the threat is more moderate, while in the green it is considered tolerable.



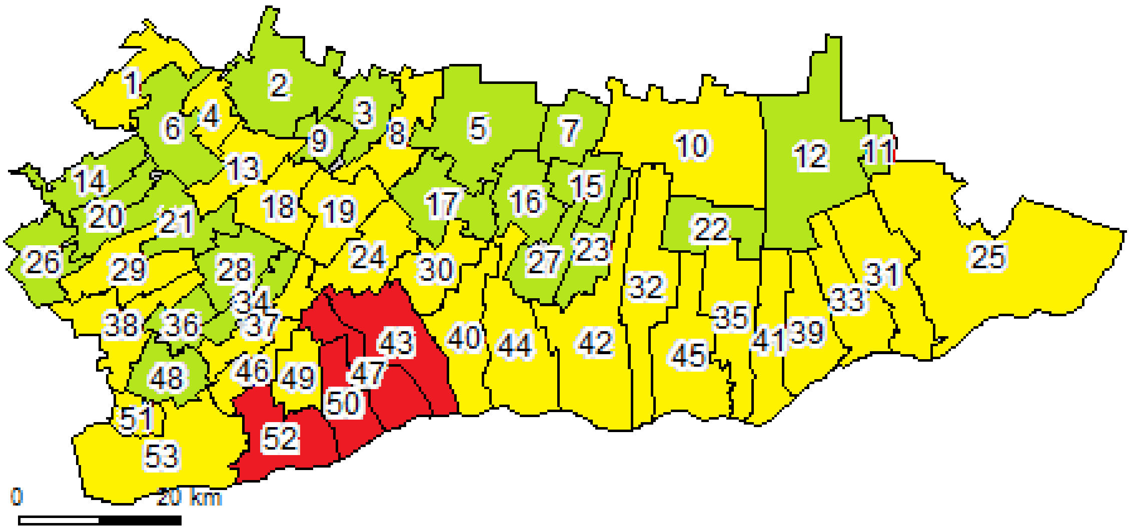


4.1.2. Threat maps – forest fires



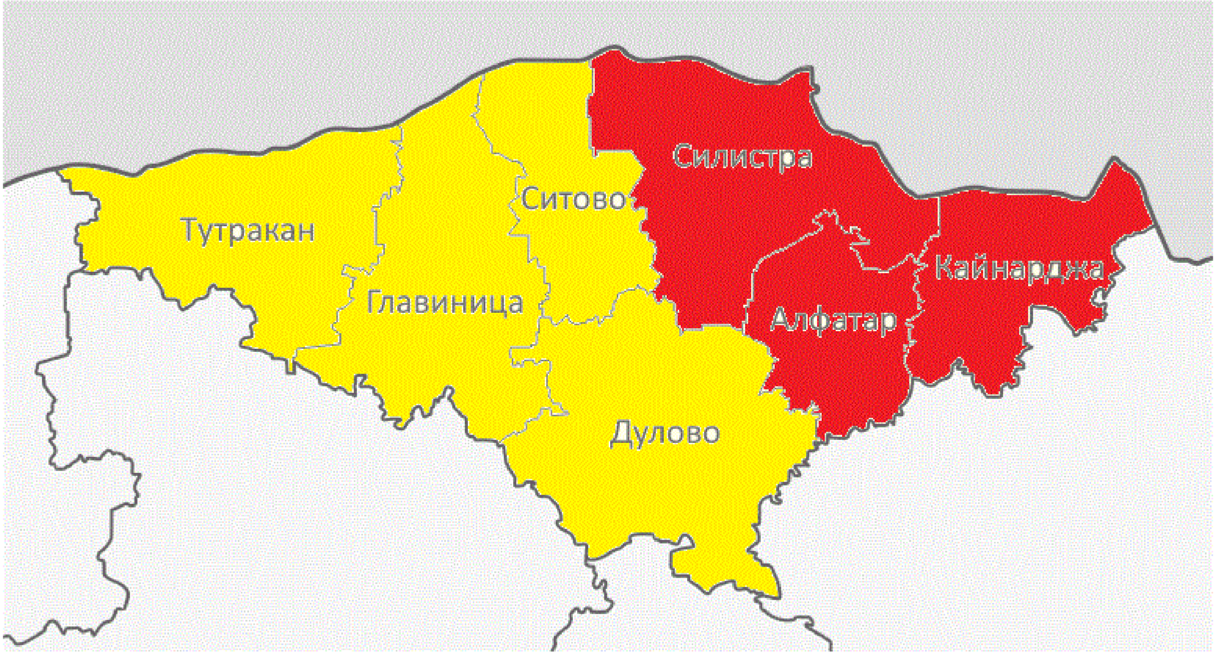
4.2. Municipal risk maps - floods

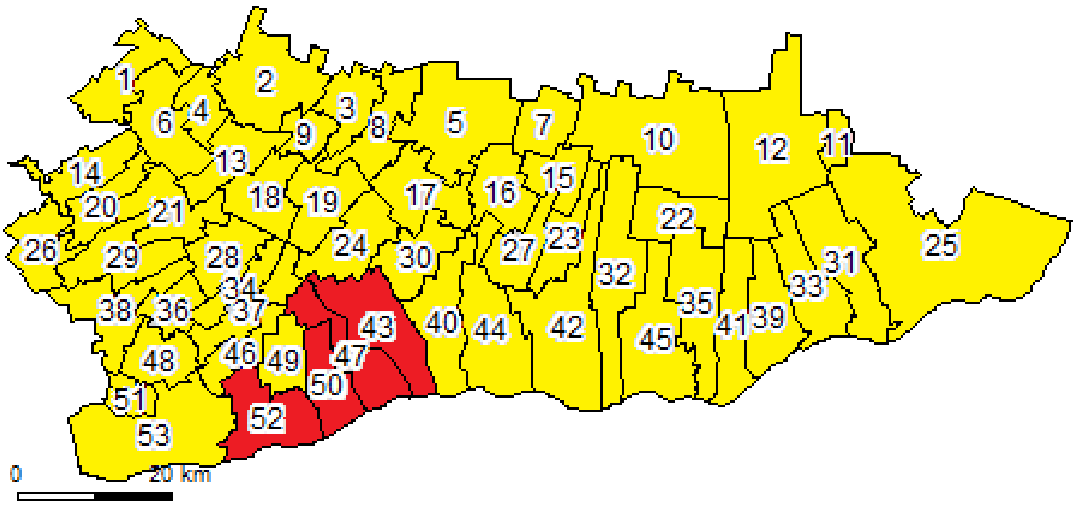
4.2.1. Maps, RPN risk levels



The illustrated differences in the levels of risk and threat in Calarasi are due to the fact that prevention factors are set in place - the presence of dikes and their maintenance. There are dikes and barrages built along the Danube and Arad valleys, but some of them are not maintained and the risk level is high in these municipalities.

4.2.2. Municipal maps with normalized risk for demographic factor RPND

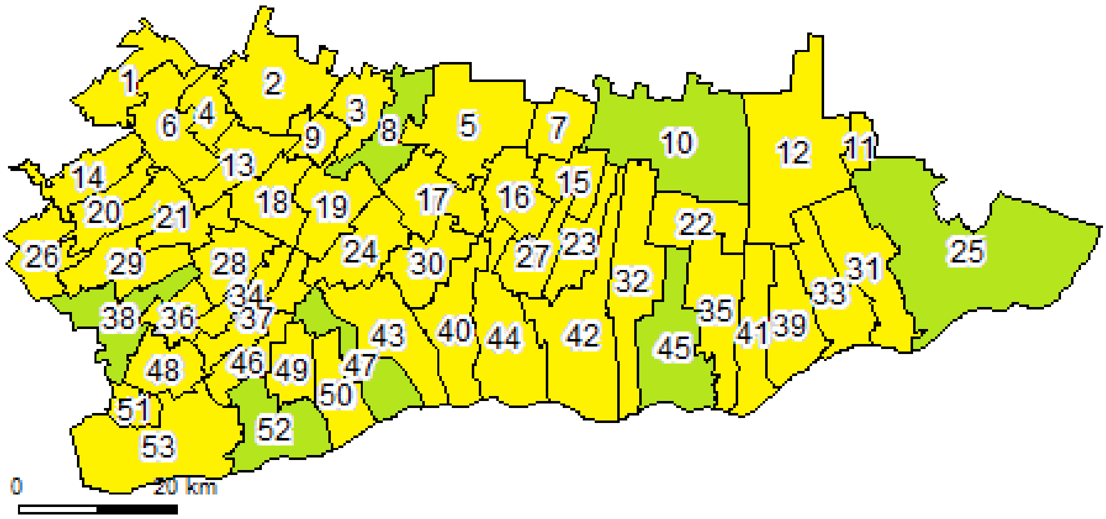




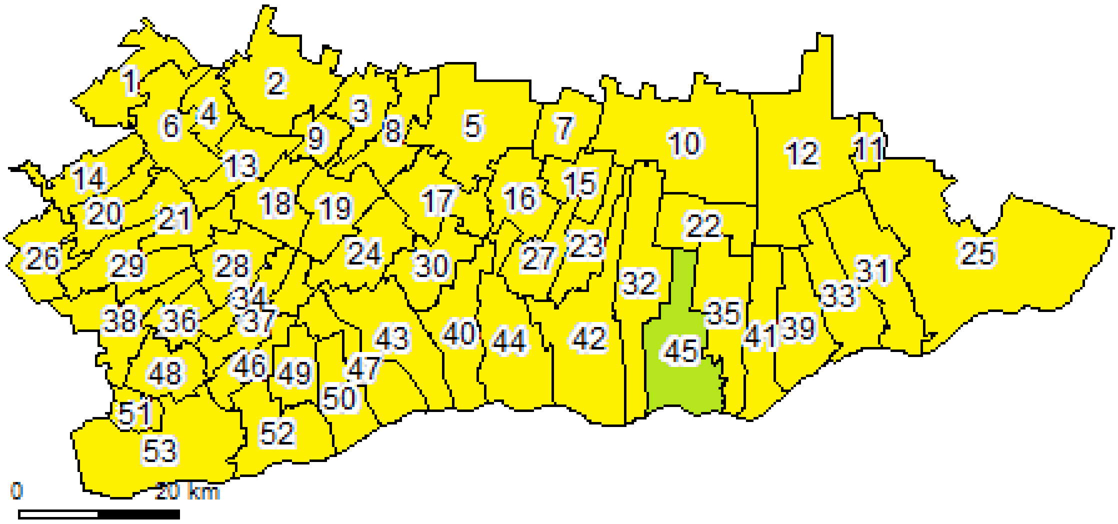
The entire population of the Calarasi district is at moderate or high risk of flooding, despite the lower risk level for some municipalities, estimated without the influence of the demographic factor in the respective municipality.

4.3.Municipal risk maps – forest fires

4.3.1.Maps, RPN risk levels



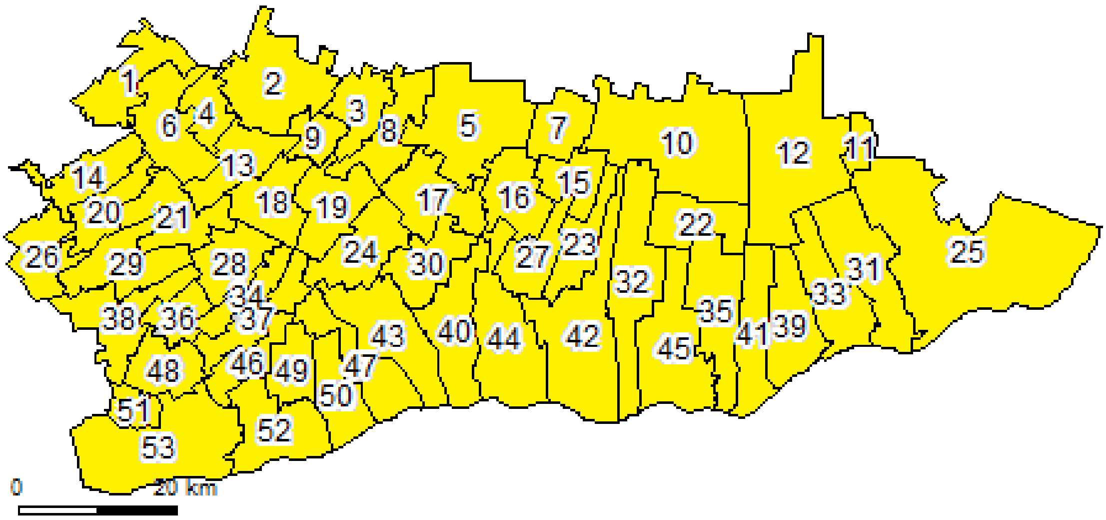
4.3.2. Municipal maps with normalized risk for demographic factor RPND



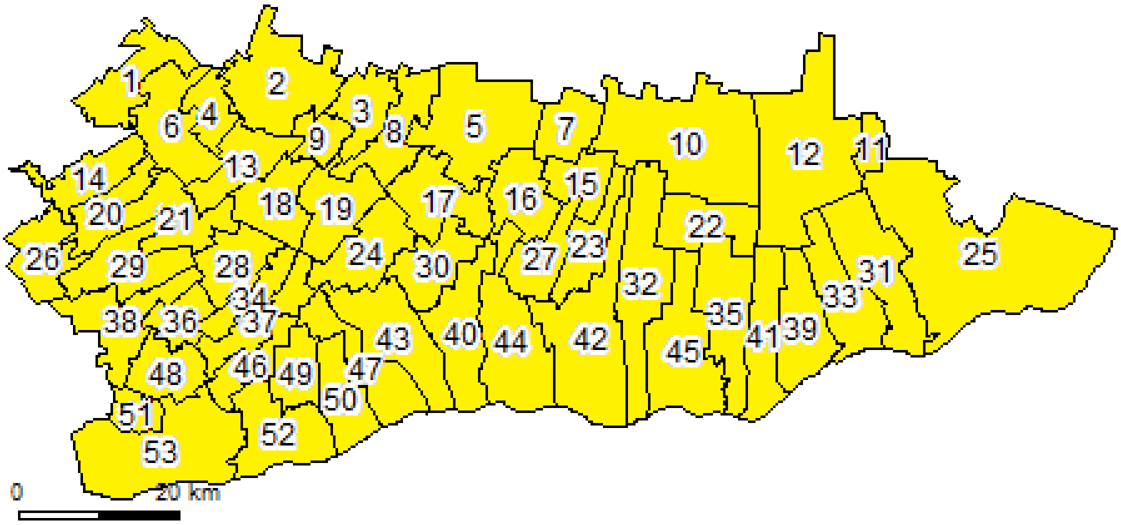
4.4. Integrated municipal risk maps for floods and forest fires

The integration is done only for forest fire and flood threats, taking into account the arithmetic mean of RPN and RPND for each municipality.

4.4.1. Maps – RPN risk levels



4.4.2. Municipal maps with normalized risk for demographic factor RPND

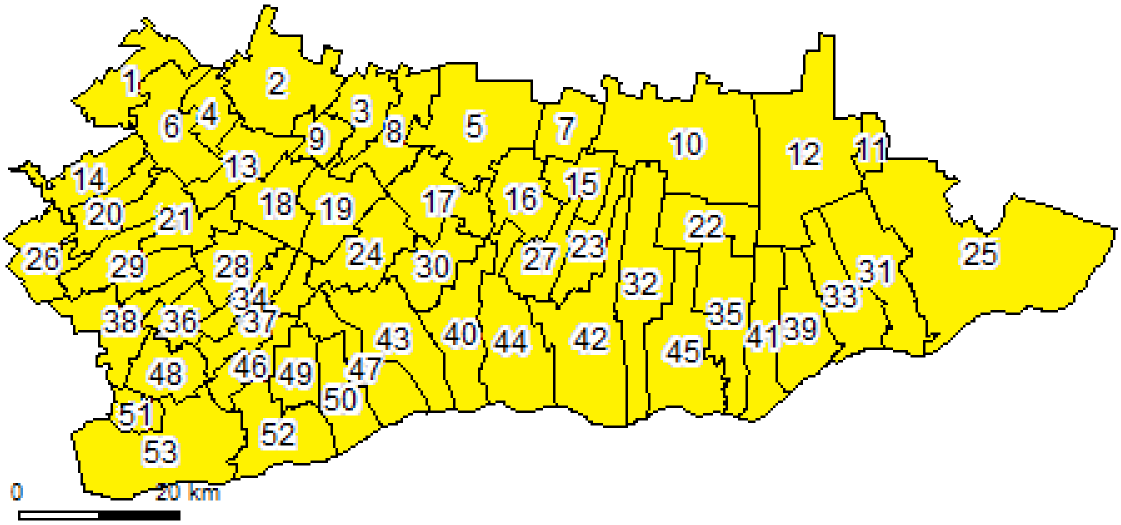


All municipalities have moderate normalized risk, but the highest is Oltenitsa, followed by Manastirea. The lowest is Stefan Zell Mare and Perisoru.

4.5. Municipal maps with integrated risk – all threats

The integration is done according to the weight of each threat by the ESDP model and classification. A significant proportion of these threats are not available to the municipalities concerned, and their risk values are negligible. Accordingly, the integrated risk for all threats is lower than the maximum for individual threats in some municipalities.

4.5.1. Maps – RPN risk levels



4.5.2. Comparison of municipalities with normalized risk and RPND demographics

Община	RPN	RPND
	Всички заплахи	
Силистра област		
Алфатар	113	1 021
Главиница	96	771
Дулово	55	442
Кайнарджа	92	738
Силистра	102	812
Ситово	82	737
Тутракан	90	718

Integrated risk maps for all threats and RPND normalized for demographics are the same as those for the RPN risk level. There are significant differences in the levels of this integrated risk across municipalities. The table shows the integrated metrics for RPN and RPND. Again, although the levels of risk are comparable, in normalized risk they stand out as more susceptible to different threats and with higher normalized risk, the municipalities of Alfatar and Silistra, while in Romania they are Oltenitsa and Manastirea, regardless of the different and high level of risk without being normalized to the demographics of the municipality. The human health risk (population risk) maps shown here for different threats to particular municipalities, but for all of them floods and forest fire risk levels are estimated in both formats - risk assessment together with the effect of existing prevention, if any, and if necessary – RPN; and for normalized age - dependent risk, RPND. The latter normalized risk shows the extent to which the population of a given

	Община	RPN	RPND
		Всички заплахи	
	Calarasi област		
52	Oltenita	122	854
43	Manastirea	103	824
47	Chiselet	100	803
53	Chirnogi	96	765
18	Gurbanesti	81	726
24	Frasinet	81	726
29	Vasilati	81	725
30	Ulmu	81	725
40	Dorobantu	80	724
50	Spantov	102	716
51	Cascioarele	85	678
42	Gradistea	83	665
44	Ciocanesti	83	665
38	Budesti	82	657
3	Lehliu	73	655
16	Vlad Tepes	73	655
21	Sohatu	73	655
46	Mitreni	81	648
28	Nana	72	648
49	Ulmeni	92	646
19	Valea Argovei	81	646
2	Ileana	80	638
31	Jegalia	79	634
1	Belciugatele	78	626
13	Sarulesti	78	626
48	Radovanu	69	624
45	Calarasi	104	622
8	Lehliu-gara	89	622
4	Tamadau Mare	87	612
17	Lupsanu	76	607
25	Borcea	87	606
9	Nicolae Balcescu	75	603
10	Dragalina	84	590
14	Fundeni	73	582
15	Valcelele	73	582
20	Plataresti	73	582
26	Frumusani	73	582
27	Alexandru Odobescu	73	582
39	Dichiseni	83	582
6	Fundulea	82	577
32	Ceacu	72	575
34	Luica	71	567
23	Independenta	70	561
33	Unirea	79	555
36	Soldanu	69	555
35	Modelu	79	550
41	Roseti	79	550
5	Dor Marunt	66	528
7	Dragos Voda	75	527
37	Curcani	75	524
12	Perisoru	82	489
22	Stefan Voda	68	478
11	Stefan Cel Mare	74	447

municipality is able to "absorb" or cope with the risk posed by any of the threats. This shows that the risk is really higher in municipalities with bigger share of elderly population. Thus, it is advisable to adopt the RPND risk assessment approach, as it provides an objective picture of the municipality's population and its capacity to deal with the risk or how serious the risk is in this case.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

Different, by means of scale and manifestation, various levels of risks of floods, forest fires, earthquakes, landslides, extreme temperatures and drought can be observed in the analysed cross-border region. Silistra region is often characterized by more threats from forest fires and floods, while Calarasi county is dominated by the risk to the population of floods and droughts. According to the analysis, both most threatened and the least able to deal with the existing risks are the municipalities of Alfatar and Silistra, on the part of Bulgaria. In the Romania, the identified “weaker” municipalities are Oltenitsa and Manastirea. Calarasi county is also characterized by higher risks for the population from industrial accidents.

The analysis of statistical and qualitative information shows an increase in flood disasters, caused by torrential rainfall, but data for the last dacade shows a decrease in casualties and, as it is clear from the data, some reduction of the caused damages.

In certain cases, the municipal plan for protection of the population are up to date but lack detailed risk analysis (or do not mention results from such). The measures undertaken to reduce the risk levels and to control their implementation are available for the Bulgarian part of the CBR, while there is no complete and updated plan for protection at county level, for Calarasi, nor for the level of individual municipalities. Nevertheless, the overall plan, for Romania, though not current, lists specific flood protection measures and their status. In the Bulgarian part of the CBR, Alfatar municipality is most aware of the risks and the only one to detailly describe the availability of a voluntary organization (though additional analysis showed that voluntary organizations are present in other municipalities as well), while fire safety related measures are available in all municipalities of the Romanian part of the CBR (*regional and municipal disaster protection plan for the Silistra-Calarasi CBR are subject of further analysis within current project*) .

5.2. Dissemination of information regarding environmental and technological risks in the cross-border region

The level of awareness of local and regional authorities, the population and other stakeholders is yet to reach sufficient levels, necessary for adequate response to disasters and emergencies, as well as for effectively manage situations and prevent further casualties and material damage. One of the main measures for reducing potential damages and consequences of a crisis is the awareness of the population and public organizations about the levels of risk and possible locations and manifestations of a crisis event, as well as about the actions of the population as individuals in these cases.

5.3. Recommendations

- Comprehensive risk analysis at local, municipal, level and planning for prevention and crisis response. Regular, at least once a year, monitoring of the implementation of the measures, taking into account their effectiveness in protecting the population and limiting potential damages.
- Analysis of the capacity of the local community to understand the existing threats, risks and their potential/capacity to adequately respond to such threats/risks.
- Regular exchange of information, particularly related to measures taken and implemented for prevention. This should be done at least once a year, which in turn will mobilize all participants/authorities to constantly update their data and measures at least once a year.
- Exchange of positive experience/practices of soft prevention information measures (e.g. local TV broadcasting and radio channels, local social networking groups, etc.) between public authorities, voluntary organizations and other stakeholders.
- Orgnization of joint events, such as flood evacuation and mobilization for extinguishing and limiting the spread of forest fires.
- Training of bilingual staff for more effective communication between institutions of the CBR, for authorities, non-governmental and voluntary organizations for joint action in the event of a crisis.
- Conduct simulated joint evacuation and rescue exercises in the event of a flood, fire or earthquake.

6. ANNEX 1: RISK ASSESSMENT METHODOLOGY AND COLCULATIONS

Template data entry

column	2	3	4	5	6	7	8	9	10	11	12	13	14	17	18	19	15	16
Data	Municipality	Type of major threat	Type of threat	Where and what can be done	Vulnerability R	Assessment: number of affected	Assessment: possible damage	Probability (P) of occurring	Available preventive measures	Assessment of the effect of prevention (N)	**RPN**	Factor L	Factor D	**RPNL** Ability to handle risk * damage	**RPND** Ability to handle risk * demographic factor	**RPNLD Complex risk factor for coping**	Proposed future prevention	Sample Value of future measure
Type of data / how to fill	Name / Code Selection menu	Natural or Technological Choice of menu	Selection menu	Free text / description	Index of 1 to 10; choice of menu	number	A rough estimate in Euro	Index of 1 to 10; choice of menu	Free text / description	Index of 1 to 10; choice of menu	Automatically calculated	Automatically calculated	Automatically calculated	Automatically calculated	Automatically calculated	Automatically calculated	Free text information	A rough estimate in Euro
Example	Tsarevo / BGS13	natural	floods	Spill in the lower reaches and mouth of Veleka, road, bridge, beach and camping overwhelmed, overwhelmed tourists without access of light vehicles over the bridge.	6	1000	2000000	7	Information from passing people and synoptic forecast rainfall	**9**	**378**	3	8	1134	3024	9072	Monitoring system upstream level	100 000

Indicators municipal level, Silistra

Threat and severity%							
Municipality	Residents	Dependent	Active	Age dependency factor		Protection plan	Volunteers
Silistra region	111 957	46 753	65 204	72%	**8**	-	
Alfatar	2704	1278	1426	90%	9	Available, 2015, no concrete measures	Available
Glavinica	10 243	4346	5897	74%	8	Available, 2012	Available
Dulovo	27 643	10 974	16 669	66%	8	Available, 2012	N/A
Kainardzha	5115	2140	2975	72%	8	Available, 2017, mainly administrative measures	Available
Silistra	47 130	19 613	27 517	71%	8	Available, 2017	N/A
Sitovo	5110	2268	2842	80%	9	Available, 2017	Available
Tutrakan	14 012	6134	7878	78%	8	Available, 2014	N/A

Floods

Source	Description	R score	Source P	Probability P	N source	Description	Rating N	Rating RP	Damages (source)	Damages, including estimated amount in EUR	Total municipality	Scraps plan	RPN	RPN weight	RPND	RPND weight
OPZPB	Flooding from rainfalls, Alphatar, improvement after dikes installation	8	OPZPB; NSI reference	7	OPZPB	Levee in Alfatar	4	56	OPZPB	7 people died; flooded houses and ground floors			224	34.944	2016	314.496
OPZPB	Flooding from the rainfalls, Danube overflow of dams, many reservoirs with potential spill	7	OPZPB; NSI reference porn	7	OPZPB	Danube embankment, cleaning, inspection	4	49	NSI	1300000	Houses with ground floor and along the Danube		196	30.576	1568	244.608
OPZPB	Floods from rain	3	OPZPB; NSI reference porn	3	OPZPB	No specific unless disclosure	4	9	OPZPB	There is no			36	5.616	288	44.928
OPZPB	Floods from rain	7	OPZPB; NSI reference porn	7	OPZPB	No specific unless disclosure	5	49	OPZPB	210000	Houses with ground floors		245	38.22	1960	305.76
OPZPB	Floods from rain, river and dams	7	OPZPB; NSI reference porn	7	OPZPB	No specific unless disclosure control dikes and cleaning	5	49	OPZPB	500			245	38.22	1960	305.76
OPZPB	Floods from rain and river	7	OPZPB; NSI reference porn	6	OPZPB	No specific unless disclosure control dikes and cleaning	4	42	OPZPB				168	26.208	1512	235.872
OPZPB	Floods from rain and river	7	OPZPB; NSI reference porn	6	OPZPB	No specific unless disclosure control dikes and cleaning	5	42	OPZPB				210	32.76	1680	262.08

Forest fires

Source	Description	R score	Source P	Probability P	N source	Description	Rating N	Rating RP	Damages (source)	Damages, including estimated amount in EUR	Source	Forest area municipality	Scraps plan	RPN	RPN weight	RPND	RPND weight
OPZPB	Many forest area	6	NSI Fires	5		There is no fire department in the municipality	7	30			248 564	104 837	Weak for forest fires	210	23.94	1890	215.46
OPZPB	1/3 forest area	5	NSI Fires	5	OPZPB	Includes specific measures; Heli site; water sources	5	25			507 126	166 154	Weak for forest fires	125	14.25	1000	114
OPZPB	1/4 forest area	4	OPZPB NSI	5	OPZPB	N/A	5	20			570 037	140000	There is almost nothing	100	11.4	800	91.2
OPZPB	1/5 forest area	4	OPZPB NSI	5	OPZPB	N/A	5	20			314 950	64,150	Basic administrative	100	11.4	800	91.2
OPZPB	1/7 forest area	3	OPZPB NSI	5	OPZPB	N/A	5	15			515 891	68,273	Basic administrative	75	8.55	600	68.4
OPZPB	1/8 forest area	3	OPZPB NSI	5	OPZPB	N/A	5	15			271000	34047	Basic administrative	75	8.55	675	76.95
OPZPB	1/6 forest area	4	OPZPB NSI	5	OPZPB	N/A	5	20			440000	74000	Basic administrative	100	11.4	800	91.2

RPN	RPND		RPN	RPND		RPN	RPND
All threats			**Only floods and forest fires, ESPON classification**			**Average for floods and forest fires**	
113	1021		59	530		217	1953
96	771		45	359		161	1284
55	442		17	136		68	544
92	738		50	397		173	1380
102	812		47	374		160	1280
82	737		35	313		122	1094
90	718		44	353		155	1 240