Republic of Serbia

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University of Belgrade
FACULTY OF SECURITY STUDIES

DISASTER RISK REDUCTION - MODELS AND PRACTICES AT INTERNATIONAL AND NATIONAL LEVEL

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DISASTER RISK REDUCTION - MODELS AND PRACTICES AT INTERNATIONAL AND NATIONAL LEVEL

Thematic Collection of Articles

PUBLISHER
University in Belgrade
Faculty of Security Studies

FOR THE PUBLISHER
Prof. Mladen Milošević, PhD
Dean of the Faculty of Security Studies

Marko Milenković, PhD, Senior Research Fellow,
Institute of Social Sciences, Belgrade
Aleksandra Milićević Kalašić, PhD, Associate Professor,
Singidunum University – Faculty of Media and Communications
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University of Belgrade – Faculty of Geography
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Danijela Vukoičić, PhD, Full Professor,
University of Priština in Kosovska Mitrovica, Faculty of Science and Mathematics

TRANSLATION AND PROOFREADING
Tamara Mandić

DESIGN AND LAYOUT
Željka Tičerić

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FOREWORD

Dear reader,

In today's world, few challenges demand our immediate attention as urgently as climate change and its effects on our societies and lifestyles.

Among various global pressures, climate change is the most urgent, posing an existential threat to our planet and humanity. It jeopardizes food security, public health, and economic stability, forcing millions into becoming climate refugees.

Europe frequently witnesses the destructive force of climate change, from unexpected cold snaps and unusually warm summers to increased wildfires, floods, and mudslides. Addressing these challenges requires a comprehensive, coordinated, and science-based response. This monograph contributes to this effort by exploring a range of issues related to climate change and disaster risk management, drawing on the expertise of over a dozen researchers from across the region.

At the heart of this initiative is risk management and reduction. Effective crisis and disaster management involves using historical data, assessing local risks, and integrating them into a cohesive plan that meets international standards. Implementing such a plan requires a robust early warning system, sustainable technological innovations, and investments in resilient infrastructure. In this regard, Governments must be encouraged to establish appropriate financial strategies and legislation to optimize macro and microeconomic approaches to disaster management.

This monograph also emphasizes the importance of addressing mental health in disaster risk reduction and management—after all, it is individuals and communities who endure these traumatic events.

Finally, tackling climate change also requires international collaboration, collective action, and cooperation among nations. To this end the European Union's Civil Protection Mechanism (UCPM), which enhances cooperation and coordination in response to disasters among EU member states and participating countries, is critically important. As EU Ambassador I am particularly thankful of Serbia's active contribution to UCPM. In 2023 Serbia provided invaluable support to Turkey by deploying search and rescue teams in response to the earthquake that struck there, whilst in 2024 Serbia deployed eight missions, supporting Greece and North Macedonia in fighting fires and tackling devastating floods in Bosnia Herzegovina.

I hope you enjoy this monograph, gain insights, and learn valuable lessons.

H.E. Emanuele Giaufret,
Ambassador and Head of Delegation of European Union
to the Republic of Serbia

FOREWORD

Our unpreparedness for natural disasters is completely unnatural. Natural disasters are becoming ever more frequent and have ever more devastating effects. It is becoming increasingly difficult for states to shift responsibility for damage and losses caused by natural disasters onto nature or supernatural forces. The responsibility of decision-makers and budget controllers for the consequences and effects of natural disasters is becoming increasingly clear.

According to the recently adopted Climate Change Adaptation Plan[1], the damage and losses caused by sudden (e.g., floods) and slow (droughts) disasters totalled 6.8 billion euros. 70% of this damage is due to droughts, and floods are second in terms of damage value. It is estimated that these damages and losses will amount to 10 billion euros by the end of 2024.

In the last 20 years, human thinking about the need for disaster preparedness and response has evolved more than at any other time in history. It is now widely recognised that risk is seen as the product of hazard, exposure and vulnerability on the one hand, and responsiveness on the other. At the same time, since 2015 and the Sendai Framework, all states and societies must (1) understand their risks, (2) strengthen state governance to manage risks, (3) invest in reducing identified risks and (4) recover in a resilient manner.

The damage and losses of the individual disasters are described in the papers in this Compendium. Fortunately, there have been no significant earthquakes in Serbia since 2010, but the earthquakes in Albania and Croatia are a stark reminder of what is sure to come, given only time. Fires break out in the region almost every year, and extreme winds, hail and other disasters also take their toll.

This collection is a contribution to the culture of risk reduction in the event of natural disasters and accidents in Serbia and the region. This culture of risk reduction must be cultivated in the present and future generations, as well as the culture of non-pollution, traffic, queues, ..., because as we saw in 2014, every object thrown into the river is a potential projectile aimed at the bridge or dam downstream.

The Republic of Serbia has come a long way, from the post-SFRY system to the establishment of institutions at the national level, first the Emergency Management Service of the Ministry of the Interior in terms of risk reduction and response capacity, and then the Ministry for Public Investments for resilient reconstruction works. The studies, plans and digital tools that Serbia has developed over the past 10 years, the investments in material resources for firefighting, water rescue and the like, as well as the extraordinary commitment of the Emergency Management Sector since its establishment, have contributed significantly to the resilience of the country

1 Government of the Republic of Serbia (2023). Climate Change Adaptation Program for the period 2023 to 2030, Official Gazette of the Republic of Serbia, no. 119 of 29 December. Retrieved 24 March 2025, from: https://pravno-informacioni-sistem.rs/eli/rep/sgrs/vlada/drugiakt/2023/119/1/reg

and society. In particular, the work in local self-government units to train and equip general disaster response units has meant that Serbia is now far better prepared and more resilient to disasters than it was in 2014.

The United Nations Development Programme, with support from the European Union and the Japanese Government, has helped Serbia to recover in a resilient way over the past 10 years, just as the fourth priority of the Sendai Framework requires. In addition to training sector staff for emergency situations and local general disaster response units, the programme has conducted studies[2], developed preventive infrastructure[3] and purchased new equipment[4] for use both in the country and abroad.[5]

However, people forget about trainings, resources depreciate, and studies and digital tools become obsolete. States and societies must have a system of continuous investment in disaster risk prevention and reduction. For such a system to exist, learning and a culture of risk reduction are necessary prerequisites, without which there is no resilient state and no resilient society.

Finally, it is very important to note that without inter-municipal, inter-regional and international cooperation, there is no real resilience of the state and society. Serbia, by amending the Law on Local Self-Government in 2018, has given municipalities and towns/cities the opportunity to join forces and help each other in risk reduction and emergency response, thus strengthening their capacities in matters of their original competence. Similarly, capacity and solidarity in the region should be strengthened, as practise shows that any assistance to a neighbour in need is a great catalyst of goodwill, a proof of maturity on the road to the EU and a numbing agent for regional tensions.

The United Nations Development Programme will continue to support the Republic of Serbia and its municipalities and towns/cities as well as the entire Western Balkans region in developing disaster resilience.

Žarko Petrović

Team Leader on Resilient Development

UNDP Serbia

2 Institute of Water Management "Jaroslav Černi"; Institute of Watercourse Management; Institute of Dams, Hydropower, Mining and Roads (2015). Study on Improving Water Protection in the Kolubara River Basin, Preliminary Report - Final Version. Belgrade: UNDP Serbia in cooperation with the Office for Reconstruction and Flood Relief of the Government of the Republic of Serbia. Retrieved on 24 March 2025 from: https://www.srbijavode.rs/images/aktuelnosti/Studija-%D0%9Aolubara-Prethodni-izvestaj-konacna-verzija.pdf

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EDITOR'S WORD

Disasters pose a significant threat to the comprehensive and long-term well-being of individuals, local communities and entire societies. Explaining and uncovering the concept, causes, evolution and consequences of disasters, as well as the institutional framework for addressing the conditions that contribute to the occurrence of disasters, is important for a comprehensive understanding and creation of a unique approach to the problem. Regardless of doubts and misunderstandings about the concept and phenomenon of disasters, it is clear that they are the result of numerous economic, social, cultural, institutional, political and even psychological factors that determine people's lives and shape the environment in which they live.

In this context, one should keep in mind the warning of the United Nations Development Programme (UNDP), an international organisation whose mandate includes disasters, that: "Regardless of how well prepared a country is and how sound its policy framework is, it is often confronted with hazards that develop into disasters with inevitable and very devastating consequences. If the processes of preparedness, response and recovery are only partially implemented and do not focus on strengthening resilience, the consequences of disasters can last for a very long time and affect the lives of entire generations. A developed awareness of potential risks and the ability to learn from events with undesirable consequences at all levels are important elements of preparedness and recovery. This improves the flexibility of the social system, which helps to withstand the shock and avoid collapse, minimise the impact of the disaster and achieve a quick recovery". Therefore, investing in disaster risk reduction and prevention makes more economic sense than dealing with the consequences of disasters. This requires a rethink by practitioners in the development of models - a shift from disaster response and recovery to risk prevention and mitigation.

The European Union (EU) is also committed to the effective implementation of a new paradigm based on risk prevention and mitigation, reducing community vulnerability and building resilience. It is committed to providing support to countries in Europe and beyond in the event of major disasters or humanitarian crises. The EU supports the development of national capacities for disaster management and a more comprehensive and strategic approach to risk analysis. Through its programmes and projects, it helps to identify national and local priorities for risk reduction, applying the principles of cross-sectoral cooperation. The EU clearly believes that greater efforts are needed to improve national and local models for dealing with disasters. The European Union is an institution that can fully develop all the instruments to support the new architecture of disaster risk reduction systems.

By analysing the achievements and efforts made at international and European level and the obvious need for further improvements in this area, we have initiated research and dialogue on disaster risk reduction. The publication presents the work

of domestic and foreign authors, which is divided into several thematic units: basic theoretical concepts and frameworks for action, economic, health and environmental dimensions. We hope that the selection of topics covered in the theoretical and technical studies will help experts, scientists and students to improve their research. The aim is also to help local self-governments in Serbia to strengthen social and institutional mechanisms and models to minimise the consequences of disasters.

We would like to express our deep gratitude to all the authors and reviewers who have invested their knowledge, time and labour to make this publication accessible to a wider scientific and professional audience.

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Ms. Jasmina Gačić, PhD,
Full Professor,

Mr. Ivica Đorđević, PhD,
Associate Professor,

Ms. Mirjana Laban, PhD,
Full Professor

BASIC THEORETICAL CONCEPTS AND FRAMEWORK OF ACTION

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SOCIO-HISTORICAL CONTEXT OF DISASTER RELATIONS

Ivica Lj. Đorđević, PhD[1]
Associate professor, University of Belgrade, Faculty of Security Studies

1 e-mail:djivica@gmail.com

SOCIO-HISTORICAL CONTEXT OF DISASTER RELATIONS

Summary: Understanding disasters and dealing effectively with their consequences requires an objective attitude and knowledge of the relevant facts. From the point of view of community sustainability, it is necessary to understand the whole process of the emergence of the field known today under the general name of risk management. Disaster Risk Reduction (DRR) is a policy of risk reduction through Disaster Risk Management (DRM) that applies the basic principles of DRR. If we follow the historical thread based on archaeological and anthropological research, we come to the conclusion that, in addition to their forms of organisation, humans have also built a system of protection against the hostile environment. Of course, the categorical and methodological apparatus corresponds to the state of civilisational development, so that we have a situation in which some important processes for which man did not have sufficient knowledge are attributed to higher powers (gods and their wrath). Based on the available literature, it can be said that the basic principles by which we come to a conclusion about the dangers our ancestors faced are very similar to those that guide us in analysing risk today. The qualitative difference is that today we are able to recognise and name most of the causes without mystifying them and attributing them to gods. Although the term force majeure is still often used in public to describe the causes of natural disasters, we know the mechanisms behind the course of events. Owing to to scientific and technological progress, in most cases we can recognise the risks we are exposed to and take appropriate measures to reduce the likelihood of them occurring. If we are unable to prevent the event, we usually have the opportunity to warn the population of the impending danger in good time so that they can get to a safe location.

***Keywords**: risk, disaster risk reduction, resilience, disasters, history, society*

INTRODUCTION

The aim of the work is to identify the factors that can contribute to increasing community resilience to disasters through a systemic approach to analysing existing conditions in order to reduce the risks from multiple natural and man-made causes. The analysis requires a differentiated approach adapted to the processes that have constituted the different communities and their historical heritage. The inspiration for this research is the fact that more people are affected by the consequences of disasters caused by natural catastrophes: 185.000,000 (CRED, 2023) than by classic violent conflicts: 108.400,000 (UNHCR, 2023). At the same time, the statistics show that the budgets of states earmarked for classic military spending are more than 15 times higher than the funds earmarked for the prevention of climate change leading

to disasters[2].

The idea is to determine the social factors that influence attitudes towards disasters and thus fill part of the gap that exists in the scientific and professional works of experts dealing with disaster risk reduction in Serbia. A review of the literature available in the Republic of Serbia shows that there are more studies dealing with the impact of disasters on affected communities than studies dealing with preventive measures. In contrast to English-language materials, where there are many anthropological studies on disaster risk reduction, this approach has not yet caught on in Serbia.

UNDERSTANDING THE NATURE OF THE PROCESS

In the social sciences, disasters are perceived as situations triggered by natural or technological causes with drastic consequences for the community. Through their research, anthropologists have drawn attention to the fact that disasters are not a matter of the moment, but the result of long-term processes and man's relationship with the environment, which increases the level of vulnerability to certain hazards. Humans create their own constructions based on current models of organising socio-economic activities, which often subordinate reality to ideological dogmas. The desire to maintain at all costs the dogma of an ideal organisational model based on the logic of consumption today contributes to the creation of an environment that exposes people to increased risk from catastrophic events. The glorification of scientific achievements and the often-uncritical attitude towards them means that people are exposed to various dangers in an even more drastic form. The ability to manipulate climate conditions creates conditions in which man begins to assume the role of creator of the living environment, ignoring the negative aspects of his actions. From deforestation to gain arable land, pollution from industrial plants, nuclear technology and genetically modified organisms, civilisation is increasingly exposed to the negative effects of its members' activities (Đorđević, 2013: 61). For a comprehensive understanding of disasters, it is not enough to analyse only the material forms of the events that cause them. The elements of social organisation and the ideological framework of attitudes to the environment significantly influence attitudes to planetary resources, the use of new technologies and attitudes to risk. The hierarchy of power is an important factor for analysing disasters in relation to a specific space with all the local specificities resulting from the customs and other socio-cultural elements that lead to disasters. (Đorđević and Nedeljković, 2019: 94; Hoffman and Oliver-Smith, 2020: 15–16)

Most researchers in the field of disaster risk reduction assume that disasters are the result of realised hazards. However, the reality is that disasters are not only a

2 According to OECD, SIPRI and Oxfam International data published by the authors of the publication: CLIMATE COLLATERAL - *How military spending accelerates climate breakdown*, we can see that funding for addressing the causes of climate change accounts for only 6.7% of total military spending in the period 2013-2020. (Buxton, 2022: 14).

consequence of hazards, but also of the general environment: socio-economic and political conditions resulting from current structures and long-term processes (Maskrey, 1989: 1-2). Disasters do not suddenly appear out of nowhere, there are usually warning signs or their occurrence can be predicted with a high degree of probability based on previous experience. The idea behind our study comes closest to the approach presented by Anthony Oliver-Smith in his study *Anthropological research on hazards and disasters:* disasters are the result of the interaction of natural, technological and human forces in a social and technological environment that has led to a corresponding degree of community vulnerability. (Oliver-Smith, 1996: 303). In this context, understanding the process and management of disasters requires a comprehensive approach based on scientific knowledge from the fields of political economy, ecology, history and sociology in order to properly determine the causes of vulnerability[3] and eliminate the conditions that favour the occurrence of disasters.

Disasters are a manifest form of the degree of sustainability of the socio-economic system of the community they affect. This is best illustrated when we compare the degree of vulnerability of developed and underdeveloped communities, but it also points to the major shortcomings of the global development model of modern civilisation. The Western-centred approach to studying the causes and occurrence of disasters is unable to provide a real answer to similar events in Third World countries because it is limited by the perception of context by researchers who are unable to understand the specifics of local conditions. The influence of external factors and their interaction with the internal conditions is often lost sight of, usually it is the case that externally imported causes set the course of events in motion that caused the disaster (Oliver-Smith, 2020: 19). Disasters caused by natural phenomena are not always just an objective factors, but are usually associated with social and individual circumstances that favoured the development of the events that led to the disaster.

An event that leads to a disaster is the result of a concurrence of different circumstances: history, culture, institutional action, individual awareness, natural or technical possibilities. The temporal and spatial determination of the conditions and environment that lead to a disaster is a complex process, the understanding of which contributes to a more effective management of the consequences. (Hoffman & Lubkemann, 2005: 316-317).

Disasters are the result of various factors and their mutual influence, and it is therefore impossible to create a single model that applies to all areas. Some researchers emphasise ecological aspects and the destructive effect of human activities on the living environment, others focus on the cultural characteristics of the area and ignore

3 Vulnerability related to the characteristics of the space and organisation of the community, i.e. the (non-) existence of systems that make it susceptible to the harmful consequences of hazards. Vulnerability is a characteristic of a person and/or a community in relation to a situation that impairs their ability to anticipate hazards, face them and recover from their consequences. (Singh et al., 2014: 71).

the actual physical effects. The most realistic approach would be to consider the relationship of humans to the environment through the prism of cultural patterns and socio-economic conditions that determine the community's functional model. Attitudes towards disasters and their consequences are a true indicator of the community's level of resilience to negative impacts from its natural and technological environment (Oliver-Smith, 2020: 31).[4]

ATTITUDES TOWARDS RISKS

Historically, people's attitudes to risks have changed in line with the development of the scientific view of the world.[5] A particularly important period is the development of mathematical logic and probability theory. As usual, the greatest achievements in probability theory were made thanks to the profit interests of big business, especially insurance companies, which were looking for ways to determine the level of risk in their operations. As far as our topic is concerned, significant research and scientific developments were inspired by the need to protect the interests of the ruler (the autocrat - the monarch) by securing his income from his subjects. Thanks to this, great progress was made in researching the mechanisms of droughts and combating floods (Covello & Mumpower, 1986: 519).

The ruler has always felt the need to ensure stability in the territory under his control in order to secure his position. There are various ways of achieving this goal. For a long time, dealing with higher powers (natural hazards) was solved by inventing rituals to appease the gods. For obvious phenomena such as floods and droughts, on the other hand, irrigation systems and dams were built to prevent flooding. The growth of residential areas is the trigger for the establishment of certain rules resulting from the phenomena observed in these structures. After major fires, housing construction standards and the responsibility of the builder, i.e. the owner of the housing, for the safety of tenants are established. With the increasing complexity of economic and social structures, there is inevitably a system of standardisation that spreads beyond national borders. The industrial revolution has brought with it a level of exploitation and pollution of natural resources that becomes intolerable from the point of view of social utility, and methods are used to protect the public interest from threats resulting from industrial processes (Covello & Mumpower, 1986: 519).

With the development of scientific community and the expansion of its field of action, many cause-and-effect relationships between different phenomena are being

4 Resilience in the given context is the ability of a community to successfully cope with sudden, unpredictable changes caused by an unexpected event. We can also say that resilience is the ability to respond to the system and adapt the community to the crisis conditions caused by sudden events (Zlatar - Gamberožić et al. 2021: 372).

5 Resilience in the given context is the ability of a community to successfully cope with sudden, unpredictable changes caused by an unexpected event. We can also say that resilience is the ability to respond to the system and adapt the community to the crisis conditions caused by sudden events (Zlatar - Gamberožić et al. 2021: 372).

discovered and ways are being found to take preventive action against negative trends. The human impact on climate change and the frequent occurrence of extreme atmospheric processes mean that action must be taken at a global level, as the effects and causes of natural disasters cannot be limited to the area of individual nation states. The need to limit the negative practise of exporting dirty technologies from developed to underdeveloped countries is becoming more and more obvious, as this not only leads to consequences in new target countries, but also spreads to the entire global space through geophysical processes. In this context, it should be said that there is a danger of instrumentalising the scientific community to justify the interests of big business and to divert attention from the main causes of the problem. The role of the media and its manipulative potential, as well as the combination of bureaucratic structures and profit-driven power centres seeking to control the institutional system, can be particularly problematic. On the contrary, the emerging global society can use the potential of ICT and global networks to enable humanity to counter negative trends and put new scientific achievements at the service of humanising human relations and living conditions (Đorđević, 2007).

Attitudes towards risk are changing under the influence of factors that bring technological innovations and a false sense of security, while at the same time creating new forms of threats that were previously unknown or less likely to materialise. (Oliver-Smith, 1996: 315-316). For a comprehensive approach, it is equally important to identify the complex relationships between individuals within a community as well as the relationships at the level of multiple communities that result from different socio-cultural characteristics. Attitudes towards disasters depend on the historical heritage, which is not limited to the geographical characteristics of the area, but also includes its geopolitical dimension. Adaptation to the physical environment also contains a metaphysical dimension, which is characterised by factors that are essential for the survival of the community under the given circumstances (Đorđević, 2017: 75-76). We need to overcome the Western-centred approach to disaster risk reduction, as most modern disasters occur outside Western Europe and North America.

Thank you to anthropologists and their ethnographic approach, the study of disasters has taken on a new quality based on understanding the attitudes of local populations towards environmental hazards. Based on archaeological findings, anthropology has established the link between cultural systems and customs created to cope with hazards from the immediate environment. Local communities have built their own systems of adaptation to the characteristics of the space, while the uncritical application of models based on other people's experiences can be counterproductive. The focus in disaster research, particularly on the immediate response to an event, often ignores an understanding of the factors that increase resilience to disasters. The anthropological approach makes it possible to recognise the conditions that lead to disasters and to differentiate them in terms of particularities, such as: religion, ethnicity, social hierarchy, age, gender and other characteristics that influence the

resilience of a community. Disasters should be studied as a process that culminates with an event that is the result of a combination of destructive potentials from nature and/or technological processes and a population whose vulnerability is increased by an inadequate social structure of organisation (Hoffman & Oliver-Smith, 2020: 17).

Finding regularities in the cyclical movement of disasters throughout history can contribute to appropriate responses in the present day. Past experiences can provide an answer to the question of what factors favoured adaptation, i.e., contributed to the disappearance of entire civilisations (and/or cultures). Archaeological research focuses on the material traces left behind in areas affected by disasters in the past, such as artistic representations, use and arrangement of the territory, remains of infrastructure and other findings. The results of such research can help to understand the factors that contribute to a society's resilience to disasters and provide answers to the following questions: what features contributed to recovery, and what led to the disappearance of some cultures. We complement the archaeological aspects with what we call political ecology, which examines the conjunctural relationships between cultural, ecological and political and economic aspects of the community. This sheds light on important aspects of the relationship between humans and the environment, which can be both the cause and the setting where disasters occur. Through the study of political and economic structures, one arrives at the factors that influence attitudes towards the environment and its misuse, leading to an increased impact of natural forces with catastrophic consequences.

Political ecology treats disasters as a situation resulting from the current socio-economic paradigm that causes geophysical extremes (earthquakes, hurricanes and floods) through human intervention in the environment. Human communities cannot be considered separately from their environment. Mutual interaction is a continuous historical process that leads to changes in ecological parameters. The satisfaction of community needs arising from cultural patterns is a prerequisite for the survival of the socio-economic formation, and the distribution of newly created goods also affects the different levels of vulnerability of certain social groups within the community. Political ecology, for example, establishes a link between population growth and the need for agricultural intensification, which leads to environmental degradation and increased vulnerability. The ecological situation and resilience to disasters is one of the sustainability tests for the existing functional model of the community. Given the degree of globalisation of human activity, we are already talking about issues concerning human survival on the planet, as consumer civilisation through excessive industrialisation creates the conditions for a global cataclysm (Oliver-Smith, 2020: 18-20).

In this context, it is necessary for researchers to focus on the internal social structures that determine the relationships between community members, as well as their forms of organisation that are important for dealing with disruption. The ideological framework shapes perception, affects the objectivity of assessment and

the relevance of conclusions in relation to the situation, it determines the attitude towards the potential of an accident and its interpretation, as well as the response to an accident. It includes, among other things: risk attitudes and disaster explanations, disaster response and post-disaster changes. The general impression that emerges from the available literature is that areas that have been spared natural and other disasters for a long time have an indolent attitude towards risks of this kind and therefore the consequences are far greater when the event occurs. Therefore, we can speak of a positive impact of past events on the community's attitude towards risks, through a change in the culture and mechanisms of the social structure created with the aim of increasing society's resilience to natural and other disasters.

COPING WITH DISASTERS

The UN has made considerable efforts to establish international mechanisms for dealing with natural and other disasters. But as we have said before, in practise we need to take into account local specificities when implementing recommendations and drawing lessons from the experiences of others. In addition to the significant differences in economic opportunities, there are also factors related to the nature of the political system, the level of corruption and the effectiveness of the application of adopted legal norms.

The current solutions should be adapted to the level of education of the population, the age structure and the vulnerable groups. When creating procedures, confessional aspects and economic opportunities should be taken into account in order to apply high standards in the field of protection against natural and other disasters. Of course, all solutions must be accompanied by appropriate activities that raise citizens' awareness of the dangers they are exposed to and the ways in which they can protect themselves from them. The United Nations Human Settlements Programme (UN-Habitat), which promotes the principles of good governance, can serve as a good framework for solving DRR problems (UNHABITAT, 2002). Applying the principles of UNHABITAT makes it possible to provide people with basic living conditions, but also to avoid the catastrophic consequences of natural and other disasters that can destroy the achievements of past labour and the cultural environment in which the community exists. The process of disaster risk management is not the exclusive domain of national institutions, but also includes the responsibility of other actors in the area under their jurisdiction. Both businesses and citizens should take a share of responsibility in their activities, primarily because of their own interests, which are reflected in the safety of property and their lives, i.e., well-being and survival. Community Based Disaster Risk Management (CBDRM) enables the operationalisation of a model based on the principles of UN Habitat. By applying the community-based disaster risk management model, the active participation of all stakeholders in identifying, analysing, treating, monitoring and assessing risks is achieved in order to reduce vulnerability to the consequences of natural and other

disasters (Osti & Miyake, 2011).

Active risk management and the outcomes of this process depend on many factors. Based on the available literature, we have identified the most important aspects that should be considered in disaster risk management:

- People's behaviour in emergency situations depends on their preparedness to respond, which mostly depends on their sense of belonging, identity in relation to the community they belong to and the immediate authorities.
- Preparation by the education system should take full advantage of modern technological solutions to bring the material closer to the audience. The form in which it is presented is as important as the content.
- Modelling can be a good tool, but the results depend on the information input and the objectives set. Technology can be the solution to many problems, but it is also the cause of many difficulties. There is a risk that critical information is compromised, which can lead to inadequate decisions, strategies and immediate responses.
- The resilience of buildings and infrastructure depends on strict control of the application of construction and design standards. Efficient institutions and the elimination of corrupt practises are a good step in this direction.
- Vulnerability evolves over time and requires constant attention to monitor changes in the population and ensure an appropriate response when it is necessary to provide assistance to the most vulnerable members of the community.

Local cultural specificities must be taken into account when developing strategies and plans for dealing with emergency situations. As an example, we point to the possible negative influence of religion on the safety of citizens when responding to disasters. Studies on this topic carried out in areas exposed to volcanic eruptions show that the reaction of the population depends on the cultural characteristics of the area as well as on the attitude towards *force majeure*. The example of the 19th century eruption of the Kraktoa (or Cracketouw) volcano is particularly illustrative, as there were two categories of populations exposed to the consequences of the eruption. For all the reservations expressed by David Harris about the sources used for the analysis, because the Dutch as colonisers had a dominant representation in the press of the time, which was the basic source of data and content for the analysis, the difference in behaviour between the indigenous population and the colonisers can be observed. In a situation where their lives were threatened, the colonisers took a proactive approach and evacuated the area affected by the outbreak, while the natives in these circumstances sought salvation in prayers and tried to appease the angry God. Here we should point out the cultural and all other differences that created a gap between the natives and the colonisers that prevented communication and the necessary level of trust in the system of institutions there. In contrast to the case of

the Krakatoa volcano, with the eruption of the Pinatubo volcano after more than a century, we have a situation where the institutions and the social system are closer to the people. Owing to the educational measures regarding the potential danger, the population was better prepared for the event, which reduced the number of victims (Harris, 2012).

Most of the problems related to the population's attitude towards risk arise from the presentation of this topic in the educational content and the quality of the education system. The ability to respond to threats in a timely manner requires that all citizens are sensitised to the risks they face as individuals, their families and the communities to which they belong. The most effective way to take preventive action is to incorporate the necessary content into the educational curricula and programmes of the school system. The use of modern IT technologies can introduce new content to adults who have completed the process of institutional education. Understanding the importance of disaster risk reduction helps to ensure that citizens are actively involved in the risk management process, limiting the scope for activities that may increase risk. In addition to new techniques and principles of risk management, materials aimed at the population should also include content based on local traditions and experiences from dealing with risks in previous generations.

CONCLUSION

Under modern conditions, researchers are required to work on new topics, with editors giving limited space to authors, which results in the fundamental assumptions on which a field is based being disregarded. The practise of tacit knowledge among novice researchers can lead to a deficit in the fundamental knowledge needed to understand the phenomenon. The situation is exacerbated by the practise in academic institutions of only recognising recent editions as relevant literature, in which the authors often imply some facts and processes that are close to them and with which young researchers have not had the opportunity to familiarise themselves. For example, in the article titled: *Disaster Studies: The Consequences of the Historical Use of a Sociological Approach in the Development of Research,* the author Quarantelli (1994) deals very correctly with the influence of sociologists on the field of Disaster Studies. However, a novice in this field may overlook the fact that the author deals with a sociological approach and remains as convinced as he is of the history of the development of the entire field. The global nature of the phenomenon at the centre of the topic means that disaster management is viewed through the prism of global challenges and threats and therefore global solutions are sought. However, it is necessary to adapt the solutions to local conditions by researching local specificities, so that environments where there is no tradition and deeper rootedness of scientific management of risks and disasters can also apply the general principles of disaster risk reduction. It is therefore necessary to emphasise the historical and sociological dimension of the process so that new researchers understand the importance of

contextualising methodological rules and standards that originated in developed countries. Indeed, there are fundamental differences in approach, conditions and culture that depend on the effectiveness of the application of models created by institutions and authors coming from a different social environment.

Given the different approaches to defining the content of the term, it is difficult to determine all the factors involved in the processes that lead to disasters and the intensity of their impact. In most cases, these are social constructions based on the perception of crisis situations and are the result of political and ideological frameworks that determine both the preparation for and the response to a disaster when it occurs. It is therefore necessary to consider disasters not only as a consequence of geophysical extremes (earthquakes, floods, droughts, etc.) and technological accidents, but also to include in the analysis the role of the existing cultural framework that determines man's relationship with his living environment and its historical dimension. This approach harbours a certain risk of losing sight of the essentials and, instead of identifying the true causes of disasters, succumbing to a socially imposed construct that depends on the subjective perception of disasters. From today's perspective, it can be said that the risks to which people are exposed in their natural environment are largely manageable, but the forms and structures of modern civilisation, especially in conjunction with the disadvantage characteristic of Third World societies, increase the risk and possible consequences of disasters (Oliver-Smith, 2020: 32-33).

If we focus only on one aspect, such as the physical causes of disasters (geophysical features of the terrain and technological accidents), we lose sight of the social aspect - the features of the social structures that contribute to the occurrence of disasters. On the other hand, if we focus only on the social aspects of disasters, we risk neglecting the contribution of individuals in creating the conditions that lead to disasters. Therefore, we should start from the fact that: "disasters are deeply embedded in the social structure and culture, just as they are part of the social environment". It can be said that disasters are a symptom of society's maladaptation to its environment (Oliver-Smith, 2020: 34).

It should be emphasised that, alongside nature, humans are the most important influencing factor in the field of disaster risk reduction. Through their actions, humans can change the degree of their vulnerability to natural phenomena and influence new types of risks that result from their actions. With the development of civilisation, organisational structures are becoming increasingly complex. It is therefore important to react to internal and ecological changes in good time in order to reduce the negative effects of human activities. Therefore, the challenges and threats that humans face in their daily activities require a systemic approach and do not tolerate ad hoc solutions.

By studying the nature of phenomena from past experiences, people can increase the resilience of their structures to numerous natural hazards. By applying standards

and procedures derived from examples of best practise, risks attributable to human activities can be minimised and, in some cases, even completely eliminated. Of course, the efficiency of the system depends on the results of the cost-benefit analysis, which is often burdened by the amount of profit that a particular process brings to the capital owner. It is therefore extremely important that the institutions do their work professionally and in the interests of all citizens and that the influence of big business on their work is minimised.

In addition to the aforementioned historical heritage related to the experience of disasters, we should also mention the cultural characteristics of the region, which are the result of frequent wars and instability and which give a special dimension to the relationship with property and human life. The character of the political system largely determines the attitude of citizens towards the institutions and the legal obligations they have in the field of disaster risk reduction. If citizens lack confidence in public officials, i.e., parliament does not reflect the will of the majority, then this has serious consequences for compliance with the institutions and laws that such a system seeks to implement. When creating a system to respond to natural and other disasters, one should take into account the great differences in wealth at the level of families and at the level of local governments. Poorer families build their houses in floodplains because the price of land is lower without taking into account the risk of flooding. Nor can one expect to achieve the highest standards of disaster risk reduction in areas where local budgets do not even allow for the ongoing maintenance of road infrastructure, let alone investment in the preventative management of torrential watercourses.

Religious affiliation and attitude towards life, i.e., the course of events, can be crucial in the disaster preparedness phase. A fatalistic attitude towards fate makes any resistance to what God has planned for us unnecessary. The institutional education system should confront the aforementioned fatalism and provide the necessary knowledge and skills to make individuals and communities more resilient to natural and other disasters. In this context, an approach that provides for continuous training in disaster preparedness is also very important, especially working with public servants (from members of parliament to members of the civil service).

Finally, it is important to emphasise the vital importance of staff selection in the field of disaster preparedness. An approach that sees this area as a good opportunity to accommodate party members and their friends is a sure way to collapse the system. Institutional training is often no guarantee that someone will do a good job, but if we have quality educational institutions that train profiles aimed at disaster preparedness, this is a potential that should be utilised. Of course, when recruiting new people, various selection methods should be applied that make it possible to obtain personnel who are motivated to do the job, have a certain level of empathy and are willing to undergo further training.

As a result of the scientific and technological progress, the conditions have been created to break out of the vicious circle of natural determinism and the fatalistic acceptance of the concept of destiny. Today, however, civilisation is faced with a fateful decision: will man abolish his natural environment by adapting nature to the needs of big capital and make himself dependent on the will of informal centres of power pulling the strings behind the curtain, or will he fight for compliance with democratic rules and principles that guarantee everyone the same right to life.

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WATER HAZARD - MANAGEMENT AND PRACTICE IN SWITZERLAND

Čekerevac Cane, PhD[1]
Head of Business Unit, Gruner Stucky Ltd

1 e-mail: cane.cekerevac@gruner.ch

WATER HAZARD - MANAGEMENT AND PRACTICE IN SWITZERLAND

Summary: Switzerland as an Alpine country, in Western Central Europe, is dominated by the Alps, which covers around 60% of the country's surface area. Its geographical and topographical features are associated with natural hazards, one of which is water- and flood-related hazard. Thanks to the federal political system, the competences are distributed among the three levels (federal, cantonal and communal) according to the principle of subsidiarity. Switzerland is currently aiming for an integrated approach to the management of risks related to natural phenomena. According to this approach, the following three questions shall be answered: what can happen, what is acceptable to happen and what must be done? Following the Swiss Federal legislation and recommendations, the cantons drew up the hazard maps for all affected areas by spatial planning in the years 2000-2014. A matrix of the probability of occurrence of the event and the intensity of the event, i.e., the height of the water and the speed of flooding is applied to the affected region. Depending on the affected area and potential damage, there are three ways to reduce the risks: through passive territorial, organisational and active measures. The case of the Rhône River was presented with the application of appropriate risk reduction solutions.

***Keywords**: Water natural hazard, flood protection, early warning system, hazard maps*

INTRODUCTION

Switzerland is an Alpine country in Western and Central Europe with a landscape characterised by numerous peaks, glaciers, lakes, and rivers. It consists of three main regions: Alps (about 60% of the country's area), Plateau (about 30%) and Jura (about 10%). Each of these regions has its own geological, climatic, geographical, and social characteristics. Within these main regions, these characteristics can also vary greatly, for example between the northern and southern slopes of the Alps (Cekerevac, et al., 2009).

This great diversity of geological, climatic, and ecological conditions gives Switzerland a rich and varied landscape, but also exposes it to many natural hazards, such as:

- Geologically related: rock and boulders falls, permanent or spontaneous landslides and collapses.
- Snow related: Avalanches.
- Water-related: Flooding of lakes and rivers, surface runoff, debris flows and erosion.

To the natural gravity hazards, we can add seismic and climatic phenomena (storms,

heat waves, hail, etc.) (Laloui, Cekerevac, & François, 2005).

The rest of this paper focuses on water-related natural hazards, which have significant impact on territorial organization of Switzerland. Indeed, almost 20% of the Swiss population currently lives in flood-prone areas. These areas are also home to around 30% of jobs and a quarter of material assets (840 billion Swiss francs, which corresponds to approximately 840 billion euros) (Federal Council, 2016).

Since the 19th century, this situation has led to the development of laws, strategies and tools for the management of natural hazards. These different elements evolve according to the political context and the evolution of society, scientific and technical knowledge as well as the different natural disasters that have characterised Switzerland, such as those of the 1980s, which led to the elaboration of the first protection objectives according to the use and the current federal legal bases (laws on the management of watercourses and forests).

The aim of this paper is to present the management of water hazard disasters in Switzerland, starting from the global and legal framework, followed by the presentation of integrated risk management and finally some practical applications.

GLOBAL FRAMEWORK AND LEGAL CONTEXT OF HAZARD DISASTERS IN SWITZERLAND

Switzerland is a federal state consisting of three political levels: the Confederation, the cantons and the communes. The different responsibilities are distributed among these three levels according to the principle of subsidiarity (Figure 1, Art. 5a, Federal Constitution of the Swiss Confederation of 18 April 1999). The tasks and powers of the Confederation are set out in the "Federal Constitution of the Swiss Confederation" (referred to as: "Cst."). Tasks that are not expressly assigned to the Confederation by the Federal Constitution are the responsibility of the cantons (Art. 3, Cst.).

The cantons have broad sovereignty and have their own constitutions and laws in their area of responsibility. In practise, they are responsible for implementing federal legislation.

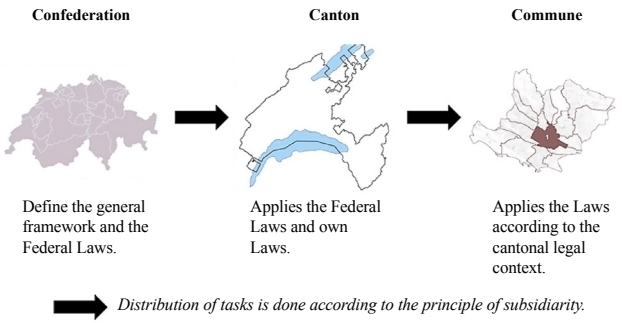

Figure 1: Summary of the legal context of water hazard disasters in Switzerland.

The municipalities exercise the powers delegated to them by the Confederation and the cantons, particularly in the area of spatial planning (Swiss Confederation, 2022).

At federal level, the Constitution stipulates that the Confederation *"within the scope of its powers [...] shall ensure protection against the harmful effects of water"* (Cst. Art. 76 para. 1). It also gives to the Confederation the power to legislate in the general area of water protection (Cst. Art. 76 para. 2) and to lay down the principles applicable to spatial planning, which is the responsibility of the cantons (Cst. Art. 75 para. 1).

The Federal Law on the Development of Watercourses (LACE, 1991), *"aims to protect population and important material assets from the harmful effects of water, in particular from flooding, erosion and alluviation (flood protection)"* (Art. 1). It indicates that flood protection is the responsibility of the cantons (Art. 2 LACE, 1991), but that the Confederation may contribute financially to the protection measures carried out by the cantons (Art. 6 LACE, 1991). The cantons must also designate the hazard zones and take them into account in the area of spatial planning (Art. 21 OACE, 1994). They must draw up the basic documents (e.g., hazard maps, emergency plans, event registers, etc.) for protection against natural hazards (Art. 27 OACE, 1994).

The Federal Law on the Development of Watercourses (LACE, 1991) is revised and renamed the Federal Law on Flood Protection (LPCr). Among other things, the revision introduces the term "risk" and the concept of an "integrated risk-based approach" (see next chapter) as well as the hazard of surface runoff.

The Federal Law on Spatial Planning (LAT, 1979) obliges the cantons to designate those parts of the territory that *"are seriously endangered by natural hazards"* (Art. 6 para. 2.c LAT, 1979). The cantons may also not designate new building zones in areas that are unsuitable for construction, particularly with regard to natural hazards (Art. 15 para. 4 LAT, 1979).

Other federal laws, which are not discussed in detail, also deal directly (e.g., the Forest Act for avalanches) or indirectly (e.g., legislation on the protection of the population or on climatology) with the problem of natural hazards.

The division of responsibilities between the cantons and municipalities and implementation of federal legislation are regulated at cantonal in the respective cantonal legislation.

In the canton of Vaud, the Vaud Law on Land Use and Construction (LATC, 1985) contains provisions on the prevention of natural hazards. The land-use plans prepared by the municipalities must incorporate the provisions "provided for in this Law, *the cantonal master plan, or in special legislation"* (Art. 24 al. 2 LATC, 1985). The LATC also requires that natural hazards be considered in the dimensioning of buildings (Art. 89 LATC, 1985). The construction, or the modification, of buildings in natural hazard zones is also subject to special authorisation (Art. 120 al. 1b LATC,

1985).

The Vaud Law on the Police of Waters in the Public Domain (LPDP, 1957) also contains provisions on the prevention of water-related natural hazards and the implementation of protective measures as well as the maintenance of watercourses. Art. 2h of the LPDP states that the municipalities are responsible for the creation and publication of water hazard maps, their consideration in spatial planning and the implementation of protective measures. They can receive practical and financial support from the canton to carry out these tasks. The municipalities of the canton of Vaud are responsible for managing their territory (land-use planning, issuing building permits) and are the project managers for the natural hazard maps. In carrying out these tasks, they rely in particular on the Cantonal Directive for the incorporation of data on natural hazards in land use planning and "cantonal protection standards & objectives" adopted by the State Council on 18 June 2014.

In addition to the municipalities and the canton, the official insurance institution against fire and natural hazards of the canton of Vaud (ECA) also advises on construction projects in natural hazard zones and issues the special authorisation required for their realisation in accordance with Art. 120 LATC. Moreover, the ECA issues guidelines on the safety levels that must be complied when applying for a building permit for new buildings and conversions, depending on the hazard situation and the type of the construction.

In the event flooding, the resources and organisation will vary depending on to the scale and nature of the event. The different emergency services at different levels (municipal, cantonal and federal) will be deployed as required. At communal level, the fire and rescue services (SDIS), the local police or the local technical services are usually called in first. They may be supported by the canton (e.g., cantonal police, civil protection), or even from the Confederation (Army). If necessary, the cantons can take over the overall management of the operations, for example within the framework of alarm and intervention plans for the organisation in the event of a disaster, which could be drawn up in advance.

In practise, the management of natural hazards is therefore mainly the responsibility of the municipalities and cantons within the framework of the federal government. The cantons and municipalities finance the tasks associated with the management of natural hazards. The federal government can also provide financial and/or practical support, particularly in the implementation of protection projects or in the event of a disaster. In addition, private owners and insurance companies may be required to contribute to the financing of protection measures, in particular measures taken directly to protect a specific building.

APPROACH TO DISASTER RISK MANAGEMENT

Switzerland is currently striving for an integrated approach to the management of risks related to natural phenomena.

In the past, the approach was to strive for standardised protection through constructive measures. These measures were carried out at the individual or local level, and then at the level of river sections. They did not systematically provide complete protection; the measures were not sustainable and the overall hazard analysis at catchment level failed.

Subsequently, risk concepts, differentiated protection goals and measures related to spatial planning were applied. This approach requires hazard maps at level of catchment areas and municipalities. The obligation to create these was therefore included in the LACE in 1991 (Federal Council, 2016).

Integrated risk management *"encompasses the full range of natural hazards. It applies comparable standards for quantification of risks and manages these risks in a comparable manner, involving all stakeholders and affected parties. All aspects of sustainability are considered in the weighing up possible measures"* (PLANAT, 2018).

This management approach must answer the following three questions (PLANAT, 2018):

What can happen?

The intensity, frequency and damage potential of an event are assessed using systematic and scientifically recognised tools and methods. The risk analysis requires the consideration of hazards and land use.

What is allowed to happen?

Based on the risk analysis, the risk assessment aims to define acceptable and unacceptable risks. This allows an objective assessment of the need for intervention and their prioritisation. In Switzerland, a criterion for the individual risk of death is generally applied for risks affecting humans. It is set at 10-5 per year, which, in practise means that natural hazards should not increase the probability of a young person dying by more than 10% per year. Protecting target matrices (intensity vs. probability) are used for assets. These are specific to the nature of asset and its protection needs. The definition of risk acceptance criteria has a social and an individual component.

What has to be done?

Once the risks have been identified, quantified and assessed, integrated protection planning aims to reduce unacceptable risks to an acceptable level. Current and future risks must also be kept at an acceptable level. The cost-effectiveness of the measures

and the principle of proportionality are taken into account during planning. The measures implemented must be sustainable over time (maintenance, renovation, etc.) to ensure long-term safety. Residual risks and damage are also taken into account.

The measures that can be implemented to minimise risks are various. They are grouped into three phases: prevention, event control and recovery. These phases are summarised in Figure 2 below and are explained in more detail in the next chapter.

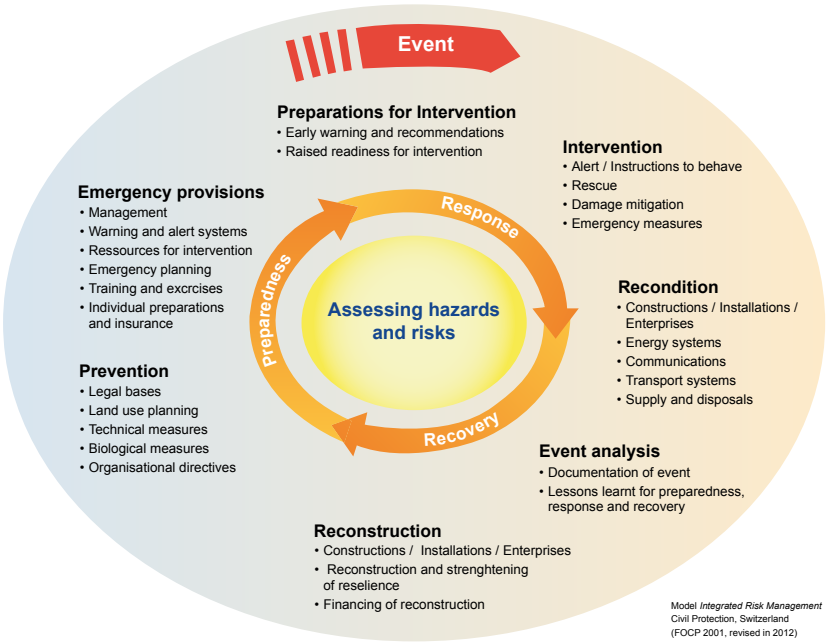

Figure 2: Model Integrated Risk Management (source: FOCOP 2001, revised in 2012).

APPROACH DISASTER RISK REDUCTION

Water Hazard maps

As mentioned above, the cantons drew up the hazard maps for all areas affected by development planning on the basis of federal legislation and recommendations in the years 2000-2014 The methodology used is summarised in Figure 3.

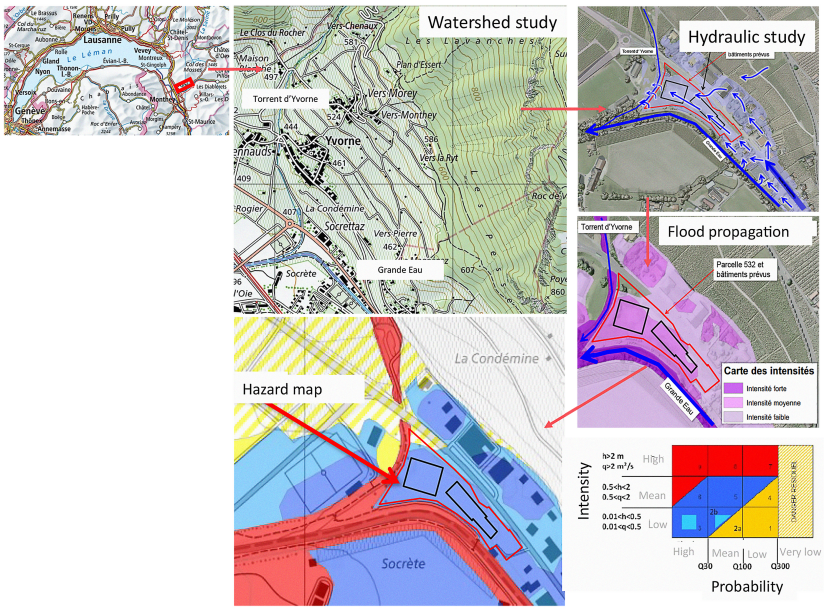

Figure 3: Hazard map methodology, example of Yvorne municipality.

For water hazard, flood and debris flow scenarios, including hydraulic capacity deficiency, aggravating factors such as sediment deposits, obstruction of bridges and arching, driftwoods, erosion are simulated at the catchment scale.

A matrix of the probability of occurrence of the event and the intensity of the event, i.e., the height of the water and the flood velocity is applied to the affected region, resulting in the water hazard maps shown in Figure 3 .

In recent years, Switzerland has increasingly suffered from risk of runoff hazard due to climate change. In particular, in June 2018, about 41 mm fell in 10 min in Lausanne (see image in Figure 4 of the railway station of Lausanne). The intensity of the storm was the highest ever measured. The probability occurrence was estimated at 80 years.

Figure 4: Picture of Lausanne railway station, made on June 11th, 2018 . – runoff hazard impact in the city.

Working group composed of representatives from the federal government, cantons, municipalities and insurance companies is nowadays working on defining a methodology and legal requirements to integrate runoff hazard into the legislation and practise for the water hazard management.

As a first step, the Swiss Federal Institute for the Environment has drawn up the general hazard map of runoff in Switzerland (see Figure 5). Even if this map is not detailed enough to work at the neighbourhood level, it's sufficient to inform cantons and municipalities about the danger and the need to prepare more detailed studies.

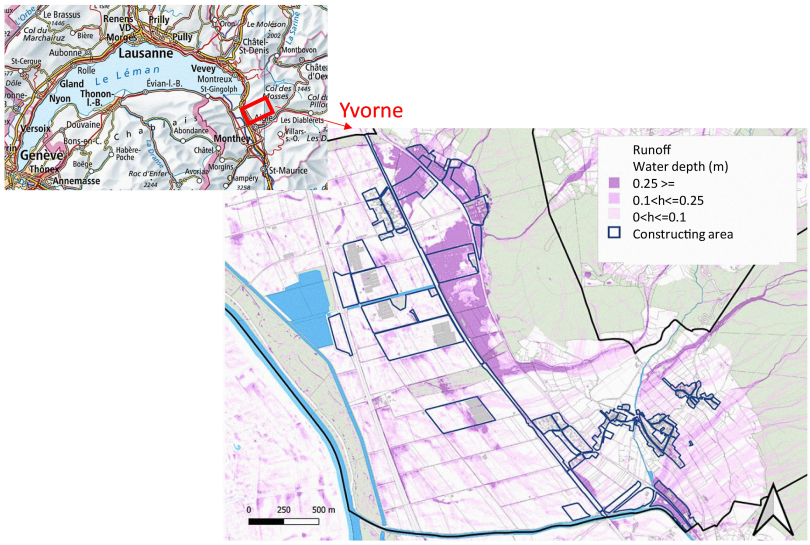

Figure 5: Global hazard map of runoff – an example for the Municipality of Yvorne, Switzerland.

Risk reductions solutions

As mentioned above, water-related hazard and risks of Switzerland are now well-known and documented. Then, how can the risk in Switzerland be reduced?

Depending on the area affected and the extent of potential damages, there are three ways to reduce the risks: through passive, organisational and active measures.

Passive territorial measures

Passive territorial measures are preventive measures implemented against the danger. They correspond to the solutions of the territorial regulations.

These measures do not reduce the risk at source or through constructive measures, but avoid damage through prevention.

As a part of the federal regulations, the cantons have issued building regulations depending on the land use and hazard conditions. An example is shown in Figure 6 for the Canton de Vaud.

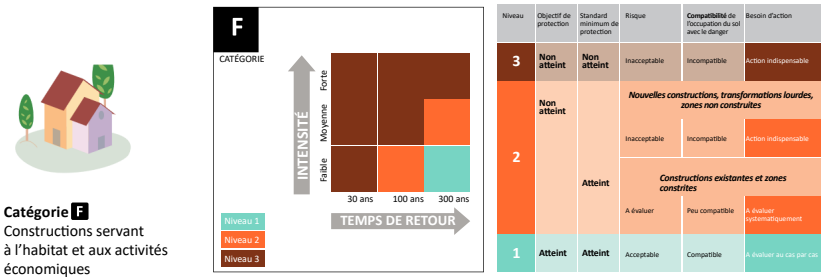

Figure 6: Territorial (spatial) regulations in Canton de Vaud.

Furthermore, the cantons called on the municipalities to transfer the hazards in their land use planning. When planning of the municipal territory, the hazards must therefore be taken into account to the territorial (spatial) regulations. An example is given in Figure 7 for the Municipality of Yvorne in Switzerland.

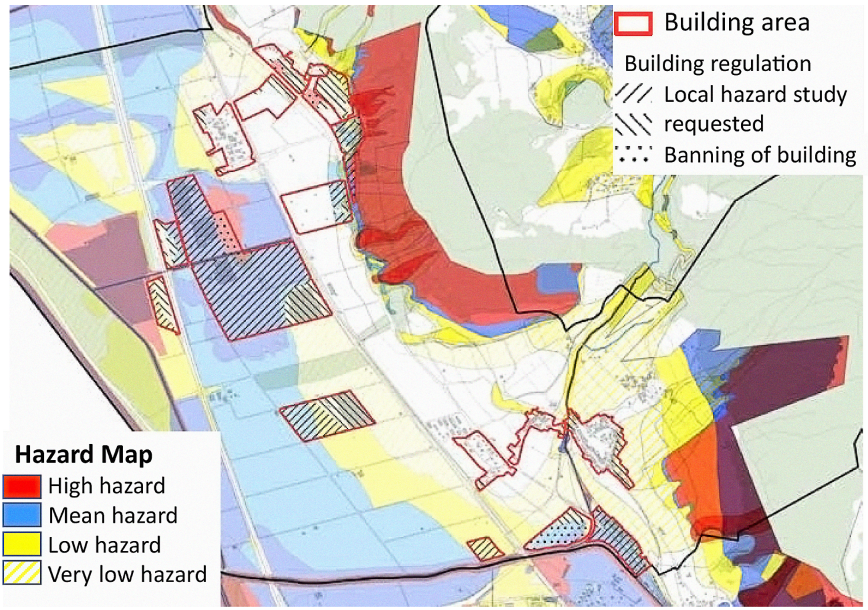

Figure 7: Transferring hazards into spatial planning – example of the Municipality of Yvorne Municipality, Switzerland.

This means new buildings located in a hazardous area can either be prohibited from being build or they can be built under some conditions. The conditions must result from a specific local study of the risks at the level of the construction project.
In order to control development in the hazardous areas, all projects planned in these zones must be authorised in advance by the cantonal departments responsible for hazards and by the cantonal insurance institutions.

Organisational passive measures

As far as passive measures are, these solutions will not reduce the source of danger. However, these measures consist of monitoring and organising preventive actions to minimise the consequences of an event. These measures consist of preparing of an Early Warning Systems (EWS).

The EWS is developed in collaboration between the canton and the municipal authorities.

The conditions required for an alarm plan are as follows:

- The rise of the flood must allow sufficient time to plan evacuation actions and/ or to put in place local protection measures such as cofferdams, sandbags, mobile equipment etc.
- The flood damage must be collective on the scale of a significant neighbourhood or municipal area.
- The development of the EWS implies the forecast of the flood about 24 to 12

hours in advance in coordination with the meteorological forecast, the knowledge the response time of the catchment and the time of the flooding. This means that the catchments and the rivers are monitored with measuring stations.

The EWS includes:

- The alert level thresholds correspond first to observations in critical areas, then to active actions as evacuation of population, local protection measures, such as installation of mobile equipment, etc.
- The communication chain among stakeholders such as cantonal and municipal authorities, the police and the fire brigade or army.

Active measures

If the previous study of water hazard has shown that several river sections affect significant area and lead to high damage costs, therefore the cantons could decide to reduce the risk at source. A study of collective active measures will then be launched. The study will be carried out at the water catchment area level to propose a catalogue of active measures to reduce the critical sections of the concerned rivers.

These measures may concern the modification of the hydraulic capacity of the river (enlargement of the section, deepening of the bed, raising of dike, combination of these measures, etc.), sediment transport, driftwood transports and watercourse diversion. In practise, one or more of these measures can be adopted and applied.

As required by the federal administrative procedure, an economic analysis is carried out, that includes comparison between the active measures and the cost of possible damage. In addition, the benefits and impacts on the environment are also evaluated. Measures that combine the best economic efficiency with the best environmental benefits will be maintained and further developed. The chosen measures are funded by the canton and the federal budget and to a smaller extent by the municipalities concerned.

These collective active measures aim to significantly reduce the hazard and then the new hazard maps are drawn up and integrated in the territorial planning.

If the hazard causes only minor damage in a particular local area, individual measures are selected that are less expensive and have less impact. These local active measures reduce the risk to the object to be protect and have no influence on the source of the hazard.

These local measures can concern local backfill, local bank protection, deflector, construction of cofferdam, walls, driftwood protection, etc. Figure 8 illustrates some examples of local active measures, which will be built locally on a limited stretch of the river.

Very often, a combination of collective and local active measures is giving good

results in reducing hazard risk, integrating floods, debris flow and runoff.

Case of the Rhône River

The Rhône River has its source in Gletsch (Rhône Glacier, in the canton of Valais) and flows 160 kilometres into Lac Léman (better known as Lake Geneva). The Rhône plain is the agricultural and economic development region which is why its flooding has dramatic consequences for the local economy.

The floods that have occurred since 2005 have caused serious damage to land and infrastructure, with a significant economic impact on the local population. Integrated flood management was applied, resulting in preparation of hazard studies and global planning to protect the entire flood-prone plain. These studies were carried out during the 1990s of the last century. That resulted in a flood protection plan for the Rhône River with the prioritisation of measures, according to the level of hazard and the cost of potential damage. The flood protection plan is based on the following measures:

- An Early Warning System (EWS) plans (organisational measures) of the plain with specific intervention measures at the level of the municipalities concerned.
- Homogeneous territorial regulation for the two cantons of Valais and Vaud for economic development of the plains (passive measures).
- Collective (active) measures, with an appropriate timetable for their implementation, depending on hazard level and the cost of the damage.
- Local (active) measures on a case-by-case basis. These measures are defined for the development of new project in hazardous areas, supported by the local risk analysis at the parcel level.
- The three pillars of the Rhône's development are based on:
- Permanent protection against water-related hazards.
- Improving the sustainable biodiversity of the Rhône River and the plain, and
- Sustainable economic and social development of the plain.

The bend of the Rhône in the canton Valais was defined as a high priority. The following figure summarises the risk approach for a section of the Rhône in the canton of Valais. The cost of risk reduction amounts to approximately CHF 300 million compared to CHF 777 million in damages. This project is funded by the canton on Valais and the Swiss Confederation. Completion of the protection measures is planned for 2028.

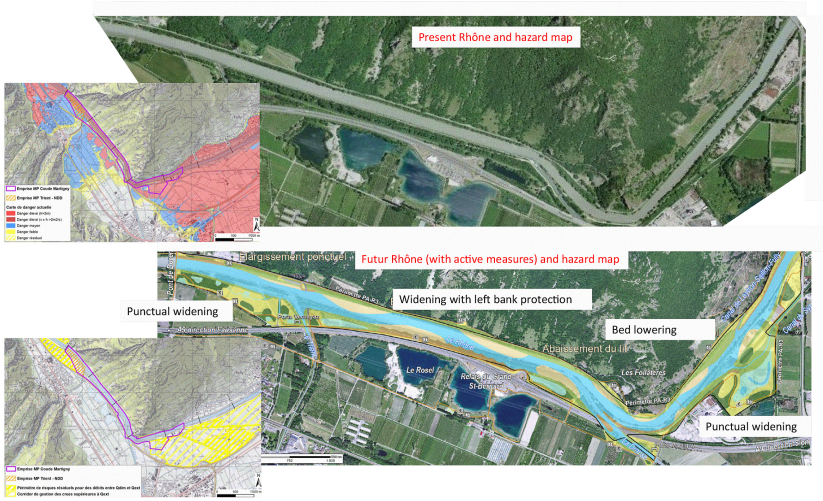

Figure 8: Risk management for the Rhône in the bend section of Martigny, in the canton Valais

CONCLUSIONS

The geographical and topographical composition of Switzerland is associated with high natural hazards, including floods, which induced a high awareness to it and forced the country to take special care of it. Thanks to the federal political system, the competencies are distributed among the three levels: federal, cantonal, and communal, according to the principle of subsidiarity. The Swiss Confederation defines the general framework and the federal laws, according to which the flood protection is a competence of cantons, but Confederation can participate financially in the protection measures. The cantons are responsible for application of federal laws and therefore they must draw up basic documents for protection against natural hazards. The Municipalities have duties to applies the laws according to the cantonal legal context.

Switzerland is currently aiming for an integrated approach to the management of risks related to natural phenomena. According to this approach, the three following questions shall be answered: what can happen, what is allowed to happen, and what has to be done? Following the Swiss Federal legislation and recommendations, the cantons prepared the hazard maps in the period 2000-2014. A matrix of the probability of occurrence of the event and the intensity of the event is applied to the concerned territory. Once the risks have been identified, quantified and assessed, integrated protection planning thus aims to reduce unacceptable risks to an acceptable level. Current and future risks must also be kept at an acceptable level. The cost effectiveness of the measures and the principle of proportionality are considered in the planning. The measures implemented must be sustainable over time (maintenance, renovation,

etc.) to guarantee safety in the long term. Residual risks and damages are also taken into account. The measures that can be implemented to reduce risks are various and they are grouped into three phases: prevention, event control and recovery.

It shall also be noted that some cantons have established an official Insurance institution against fire and natural elements, which is mandatory for all buildings on the cantonal territory. In the cantons where the official insurance does not exist, the private insurance companies are offering the insurance services against fire and natural elements.

In case of a flooding event, the different intervention forces at different levels (commune, canton and confederation) will be engaged according to the needs. At the communal level, it is generally the fire and rescue services (SDIS), the local police or the local technical services that will be engaged first. They may receive support from the canton (e.g. cantonal police, civil protection, etc.), or even from the Confederation (Army). If necessary, the cantons can take over the global management of the operations, for example within the framework of alarm and intervention plans related to the organization in case of disaster, which have been elaborated beforehand.

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CONCEPTUAL MODEL OF CIVIL PROTECTION IN THE REPUBLIC OF SRPSKA, MODELLED USING THE DELPHI METHOD

Željko Zorić, PhD[1]
Associate Professor, Independent University of Banja Luka - Faculty of Security and Protection

1 e-mail: zoriczeljko1@hotmail.com

CONCEPTUAL MODEL OF CIVIL PROTECTION IN THE REPUBLIC OF SRPSKA, MODELLED USING THE DELPHI METHOD

Summary: The existing system(s) of civil protection in Bosnia and Herzegovina have proven to be ineffective and dysfunctional when it comes to preparing for and responding to the numerous threats that have emerged with increasing frequency over the last two decades. Conducting scientific research on the Conceptual Model of Civil Protection in Republic of Srpska led to the adoption of the Zero Model of Civil Protection System, which proved to be the most acceptable for the Republic of Srpska entity. The model has been adopted by experts engaged in various systems, with different levels of education and professional orientations, as well as significant experience in their respective fields, all of which are related to civil protection. The paper describes the research methodology used and the main research findings based on the application of the Delphi method. The research is based on the research subject, research methods, the legal framework of the European Union and the legal framework of the Republic of Srpska. The adopted model will ensure the efficiency and effectiveness of civil protection intervention in emergency situations caused by natural disasters, as well as compatibility with the systems of neighbouring countries.

Keywords: *research, model, implementation, civil protection, Delphi method*

INTRODUCTION

With the end of hostilities in Bosnia and Herzegovina (B&H) in the mid-1990s of the last century, efforts began to establish a peacetime social order that recognised the need to organise and legally regulate the civil protection system.

This system is being developed in B&H at the entity level, while at the B&H level there is a Sector for Protection and Rescue within the Ministry of Security in the Council of Ministers of B&H. In accordance with the constitutional and legal solutions, the institutions and administrative bodies of Bosnia and Herzegovina coordinate protection and rescue activities rather than directing them. Operational functions are the responsibility of the entities and the Brčko District. In order to facilitate coordination at the level of Bosnia and Herzegovina, in accordance with the Framework Law on Protection and Rescue of People and Property from Natural and Other Disasters in Bosnia and Herzegovina, the Coordination Centre for Protection and Rescue was established. This body was formed, but does not act as a permanent body, but members meet as needed, (Zorić and Ćulibrk, 2017: 77).

Until 2012, the civil protection system in the Republic of Srpska (RS) evolved while searching for the most suitable organisational solution. The Civil Protection (CP) was part of the Ministry of Defence, the Ministry of the Interior and the Ministry of Local Government and Self-Government. The Republic of Srpska (RS) first formally

regulated the field of civil protection in 2012, in line with modern trends, by adopting the Law on Protection and Rescue in Emergency Situations (Official Gazette of the Republic of Srpska, no. 121/12). This law covered the areas of protection and rescue, as well as the organisation and activities of civil protection within the protection and rescue system. As an administrative authority, CP operated within the Ministry of Interior of the Republika of Srpska. This law remained in force until 2017, when it was amended. However, the amendments did not have a significant impact on the organisation of the CP system in the Republic of Srpska. The lengthy "trial and error" approach in the search for the optimal organisational solution for CP did not lead to the desired results. This was particularly evident in emergency situations caused by natural disasters, where the system's response was inadequate.

Driven by an implicit cultural framework, a system of social organisation emerged with the aim of protecting the population and society as a whole from natural and social challenges with potentially severe consequences. These include large-scale loss of human life, the destruction of infrastructure, the collapse of society, the erosion of culture and the destruction of the environment. Such systems can hardly be described as "systems" in the true sense of the word, as they were created and developed on the basis of this implicit culture. They are better described as substitute systems. Such term can also be used in situations where the positive experiences of others have been used to develop and improve certain social systems. The reason for this is the "copy paste" method of application, in which the culture in which the positive experience is to be applied has not been taken into account or at least neglected. This phenomenon is widespread in the so-called transition countries. In these contexts, the term transition is often misunderstood as mere "passage" rather than transformation (change or reformation). Passage means that the system goes through a process but remains essentially unchanged at the end, either because it has developed defence mechanisms against the transformation or because it has not grasped the end goal.

Several important methods were used in researching the zero model of the civil protection system: the dialectical method, the positivist method, the method of understanding, general scientific methods, the research method, the content analysis method and the modelling method. The proposed model of the civil defence system of the Republic of Srpska was validated through an expert assessment using a modified Delphi method.

FACTUAL ANALYSIS OF THE EXISTING CIVIL PROTECTION SYSTEM IN THE REPUBLIC OF SRPSKA

Legal framework of civil protection in the Republic of Srpska

The Civil Protection (CP) system in the Republka Srpska (RS) is centralised and organised through the Civil Protection Administration, regional departments and municipal departments. The law clearly defines an emergency situation, an emergency event, a disaster, a natural disaster, a technical accident, facilities and means of protection, aids, elimination of consequences, personal, mutual and collective protection, care, unexploded ordnance and hazardous substances. Civil protection in the RS is a relatively young protection and rescue system, established during the war in the 1990s and confirmed as such by the Dayton Peace Agreement, which is actually the Constitution of Bosnia and Herzegovina.

The basic document regulating the area of protection and rescue in the RS is the Law on Protection and Rescue in Emergency Situations (Official Gazette of the RS, no. 121/12), which was adopted at the end of 2012 and harmonises the entity Law of the CP with the Framework Law on Protection and Rescue. The RS protection and rescue system is organised at two levels - the entity level and the municipal level. The umbrella organisation of this system is the Republican Administration for Civil Protection, which is subordinate to the Government of the RS. The organisational units of the Republican Administration of Civil Defence in the RS are: Department for Organisation, Planning and Training, Department for Civil Protection Planning and Measures, Department for Training, International Cooperation and Information, Department for Monitoring, Reporting and Warning, Regional CP Departments (Zorić, 2016: 156).

Civil protection regulations

The basic regulations of civil protection are the following: Plan of activities in the preparation and implementation of earthquake protection and rescue measures in the RS for the period 2016-2019; Rulebook on training persons within primary and secondary education on hazards and protection against natural disasters and other disasters; Rulebook on determining the health capacity of citizens to participate in protection and rescue in the RS; Decree on the notification procedure and the method of data exchange with other countries that may be affected by an accident with cross-border effects; Curriculum and training program for the period 2016-2019; Rulebook on how to use the protection and rescue sign; Decrees on priority aid for rehabilitation of damage to residential buildings; Rulebook on the appearance, content and use of identification documents for members of civil protection units and teams in the protection and rescue system; Instructions on clothing and markings of members of civil protection units and teams in the protection and rescue system; Decree on the content and method of preparation of the Protection plan against natural disasters and

other disasters; Regulation on the organization and functioning of the monitoring, notification and warning system (Zorić, 2020).

The primary legal sources used in the drafting of the Law on Protection and Rescue in Emergency Situations are the following:

- Treaty on the Functioning of the EU, revised text, Part Three, Title XXIII, Civil Protection, Article 196, (Official Journal of the EU, 2010/C 83, 30/03/2010) - partially harmonised.

The secondary legal sources used in the drafting of the Law on Protection and Rescue in Emergency Situations are the following:

- Council Directive 96/83/EC of 9 December 1996 on the control of major-accident hazards involving dangerous substances - partially harmonised;
- Commission Decision of 8 November 2007 establishing a Community Civil Protection Mechanism (2007/779/EC, Euroatom) - partially harmonised.

At that time, the assessment of the fulfilment of the obligations was "partial fulfilment". Subsequent analyses were not carried out.

ANALYSIS OF THE EXISTING ORGANISATIONAL STRUCTURE OF CIVIL PROTECTION - REPUBLIC ADMINISTRATION FOR CIVIL PROTECTION OF THE REPUBLIC OF SRPSKA

The analysis of the existing organisational structure of the CPS RS was carried out on the basis of the documents available on the website of the Republic Administration of Civil Protection of the Republic of Srpska (RACP RS). In addition, the analysis was carried out from the point of view that the CP is a complex system, and not only the RACP of the Republic of Srpska. According to the theory of systemic-complex systems, the RACP RS should be treated as part of the CPS Republic of Srpska. According to the definition of systems theory, management represents only a small part of the entire system. Administration means management (governance) and control of the whole (system). It is true that the regional departments are integrated into the RACP RS, but a good part of the system is still missing. Several very important shortcomings can be observed here:

- There is no explicitly expressed structure and organisation of CPS RS (more precisely, there is only a very small part of the system - RACP RS), namely:
    - There is no explicitly expressed structure and organisation of the CPS RS at the RS level: Civil Defence System of Republic of Srpska as a whole; There is only RACP RS, which is only a small part of the whole, the so-called system;
    - There is no explicitly stated structure and organisation of the CPS RS

subsystem;

- There are no five regional subsystems of CPS RS; There are only regional departments and nothing more, with the important distinction between departments and subsystems;
    - There are no CPS RS municipal subsystems for 9 towns;
    - There are no CPS RS municipal subsystems for 55 municipalities;
- There is no explicit appointment (responsibility, competence) for the strategic management and control of the CPS RS; What is "understood" is that the Government of RS is responsible for this because all administrations, including the RACP RS, are managed by the Government of RS;
- There is no explicitly expressed hierarchical responsibility for the management and control of CPS RS in non-emergency and non-crisis conditions, and especially in ES and crisis situations, namely:
    - There is no explicitly expressed strategic management and control of CPS RS - at the RS level;
    - There is no explicitly expressed strategic-executive management and control of the CPS RS - at the RS level;
    - There is no explicitly expressed tactical management and control of the CPS RS - at the level of 5 areas in the RS (Banja Luka; Doboj; Bijeljina; Sokolac; Trebinje);
    - There is no explicitly expressed tactical-executive administration and control of the CPS RS at the level of 5 areas in the RS (Banja Luka; Doboj; Bijeljina; Sokolac; Trebinje);
    - There is no explicitly expressed operational management and control of the CPS RS - at the level of 9 towns in the RS (Banja Luka; Doboj; Bijeljina; Sokolac; Trebinje; Prijedor; Zvornik; East Sarajevo; Gradiška; Derventa);
    - There is no explicitly expressed operational-executive management and control of CPS RS - at the level of 9 towns in the RS (Banja Luka; Doboj; Bijeljina; Sokolac; Trebinje; Prijedor; Zvornik; East Sarajevo; Gradiška; Derventa);
    - There is no explicitly expressed executive administration and control of the CPS RS - at the level of the 55 towns in the RS;

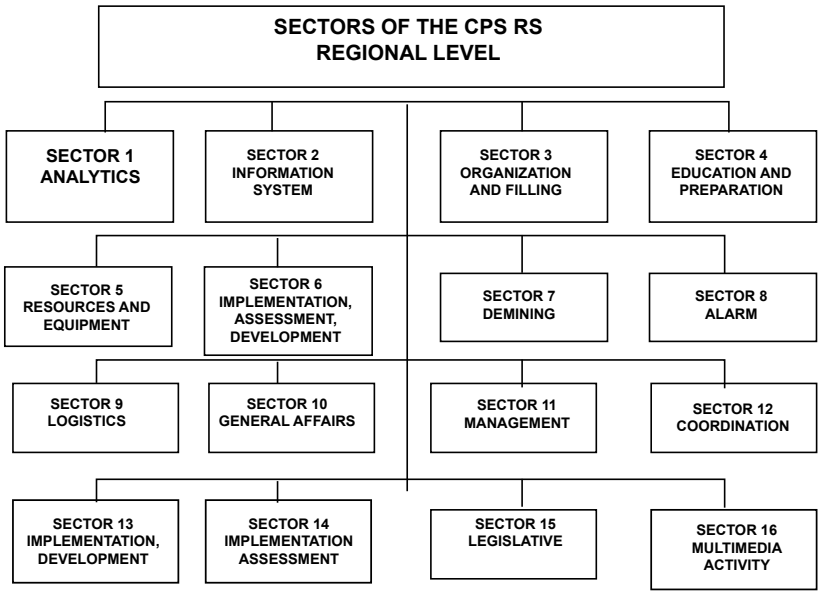
Such an approach to building a system can be called implicit. Here the adjective "implicit" is used to explain/justify the use (substitution) of the word system administration. This means that it is assumed that the administration represents the system. However, if one applies a complete definition of a system, with a set of global behavioural characteristics; functions and inter-functional relationships;

global characteristics of interest; goals, purpose, vision, mission; global design characteristics; the whole, behaviour, inputs/outputs, resources; including the structure, elements, functions, processes, activities, operators, interactions between system and environment, actions, hierarchical structure;... it is shown that the whole set of entities that explicitly represent a complex system does not exist. The situation (impression) is somewhat improved by the legal definition, but even within this framework there is a lot of "invisible", implicit, which means that there is still no CPS RS, but only a smaller part of the system defined by the RACP of the Republic of Srpska.

DEVELOPMENT OF THE CONCEPTUAL MODEL OF CIVIL PROTECTIONS IN THE REPUBLIC OF SRPSKA

The methodological framework for the design (design and development) of the conceptual model of CPS RS consists of several phases, namely:

1. Adoption of the systems theory as an infrastructural method and the systemic approach as a way of thinking in the design and development of the conceptual model of the CPS RS;
2. Design and development of the conceptual zero model of the CPS RS using the modelling method;
3. Conducting the expert evaluation of the conceptual zero model of the CPS RS using the modified Delphi method;
   3.1. Designing questionnaires and instructions for experts based on the zero conceptual model of the CPS RS;
   3.2. Carrying out the expert evaluation of the zero-model system of the conceptual model of the CPS RS;
   3.3. Processing and analysing the results of the expert evaluation of the zero conceptual model with conclusions;
4. In the following, we will describe each of these research phases and provide a theoretical basis for each of the methods used in the empirical research.



Picture 1. Sectors of the RS civil protection system - regional level (Source: Author)

Testing the conceptual model of civil protection in the Republic of Srpska

A total of 14 experts participated in the testing (verification) of the conceptual model of the Civil Protection System of the Republka Srpska. These experts came from various educational backgrounds, scientific fields, and professional areas. Their composition is as follows: (a) Education: 10 PhDs; 2 Master's degrees; 2 university degrees; b) Scientific fields: 8 in Security Sciences; 4 in Military Sciences; 2 in Technical Sciences: 1 in Mechanical Engineering; 1 Electronics; c) Narrow scientific fields: Civil Defence System; Civil Defence; Aetiology of Hazard; Fire and Explosion Prevention; Fundamentals of Environmental Security; Military Science; Electronics; Mechanical Engineering; Statistics (Data Science) Systems Theory; Management Theory; Decision Theory; Organisation Theory; g) Work Activity: Faculty of Security and Protection - BL; Faculty of Security - Belgrade; Faculty of Electrical Engineering - BL; Faculty of Medicine - BL; Faculty of Natural Sciences and Mathematics - BL; Armed Forces of Bosnia and Herzegovina; Security Research Centre - BL; Research Centre - BL; City Administration - BL; Republican Administration for Civil Protection of the Republic of Srpska.

Table 1. Presentation of the education and scientific field of the experts involved

No.	Education	Total	Scientific field	Total
1.	PhDs	10	Security Sciences	8
2.	Master of Science	2	Military Science	4
3.	Higher vocational training	2	Technical sciences	2
Other		14		14

Source: Author

Expert evaluation of the structure and elements of the conceptual model of the CPS RS

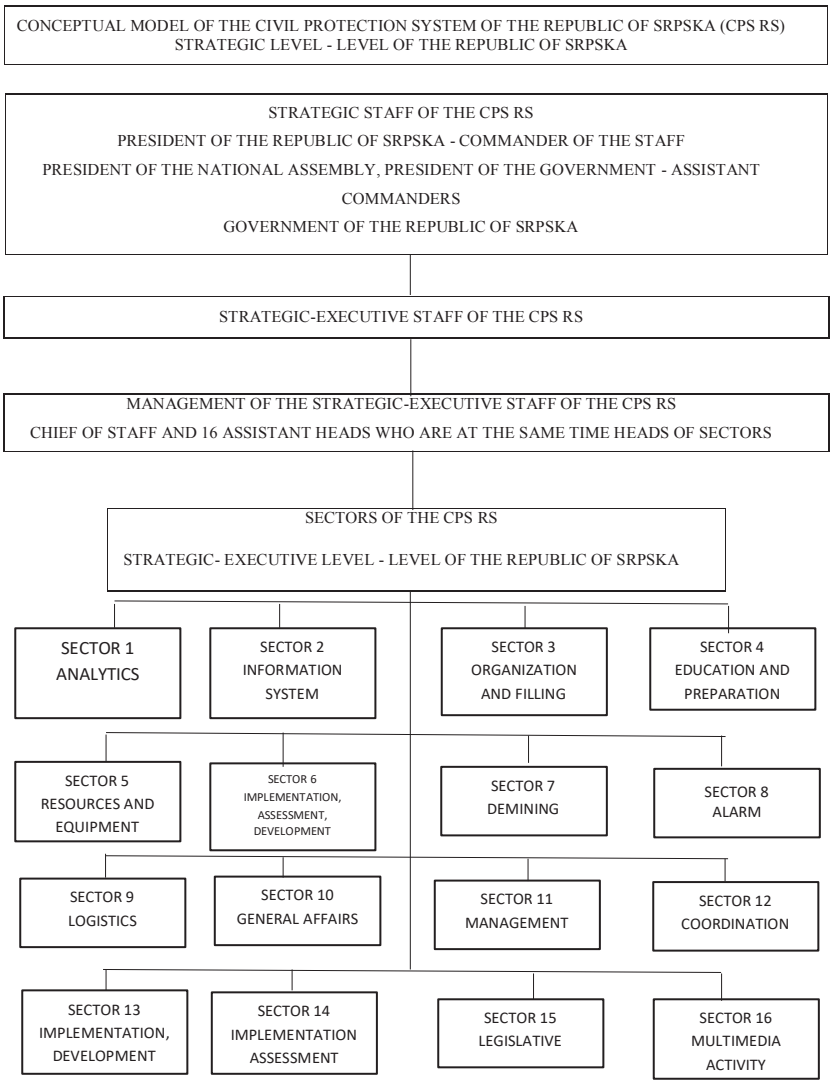
Based on the expert evaluation of the structure and elements of the conceptual model of the CPS RS, the modules of the conceptual model of the CPS of the Republka Srpska are accepted. The experts' opinions differ on the composition of the Strategic Staff, but this does not affect the essence of the model, so the proposed model is accepted. The proposed model of the Strategic Management Staff of the CPS RS with one chief and 16 assistants, who are also managers of individual sectors, is accepted. The focus here is not on the assistants, but on the tasks performed by the sectors, which means that the number of assistants can be reduced, but the tasks of the sectors cannot.

As a result, the majority of experts (85.14%) believe that the offered modules can form the basis for the CPS model of the Republic of Srpska. If we take into account the implicit culture regarding the application of systems theory, this result shows that there is a high level of agreement among the experts on the need to apply systems theory and conceptual modelling of the CPS RS. This means that it is necessary to conceptualise and implement the CPS RS as a system with all system attributes. Additional arguments in favour of a systemic approach to the design and implementation of the CPS RS are provided by the analysis of the expert comments. With their comments, the experts, apart from certain dilemmas and slight differences of opinion, support the design of the structure and elements of the conceptual model of the CPS RS (Zorić, 2021).

Implementation of the conceptual model of the CPS RS

After the evaluation of the initial (zero) conceptual model by experts, the design and adoption of the final model of the Civil Protection System of the Republic of Srpska (CPS RS), and after the adoption of the conceptual model by the authorities of the Republic of Srpska and the completion of all pre-implementation procedures, it is

necessary to proceed with the implementation of the final model of the CPS RS *(Picture 2).*



Picture 2. Conceptual model of the Civil Protection System of the Republic of Srpska – Strategic level – level of the Republic of Srpska (Source: Author)

Considering the state of the CPS RS, this task is very complex, demanding and time-consuming. In order for the complex task of implementing the projected conceptual model of the CPS RS to be realised, it must be segmented from two sides, namely: The first side is the sectoral structure of the CPS RS, regardless of the hierarchical level, namely: the CPS RS analytics; the CPS RS information System; the CPS RS organisation and staffing; the CPS RS training and preparation; the CPS RS

resources and equipment; the CPS RS implementation, evaluation and development; the CPS RS demining; the CPS RS monitoring, notification, warning; the CPS RS logistics; the CPS RS general affairs; the CPS RS management and control; the CPS RS coordination; implementation of the model and further development of the CPS RS; evaluation of model implementation and further development of the CPS RS; the CPS RS legislation; the CPS RS multimedia activity On the other hand, it is a hierarchical structure on levels: strategic level - Republic of Srpska level, tactical level - level of five Republic of Srpska regions, operational level - level of nine Republic of Srpska towns, executive level - level of fifty-five Republic of Srpska towns. The implementation of the conceptual model of the CPS RS takes place in the following phases: the preparatory phase; the first phase; the second phase; the third phase; the fourth phase; Integration of the conceptual model of CPS RS into the social system of the Republic of Srpska.

The preparatory phase

The preparatory phase consists of the following processes and activities:

- The first and most important part of the preparatory phase for the implementation of the CPS RS conceptual model is the formation and training of the team for the implementation of the CPS RS conceptual model... Taking into account the training of the team, the time required for the realisation of this task is estimated at 6 months.
- Second part: Elaboration of internal implementation documents (rules and work instructions) for the functioning of the CPS RS... All of the above-mentioned and other documents of this type are prepared by the implementation team in parallel with the initial state and determination of the desired state.
- Determination of the initial state (starting state) of the CPS RS. The current state of the RACP RS... After the analysis, the initial state of the CPS RS is determined as the basis for the inverse implementation.
- Determination of the desired (target) state and the time of implementation of the civil protection system model of the Republic of Srpska: Here it is necessary to design a detailed specification of the required elements for each organisational-hierarchical level and for each component based on general structural schemes, functions, processes, activities, operators, resources, management and control. Depending on the overall organisation, methods and working conditions, the structure of the CPS RS will differ considerably. In some cases, a particular function or management role needs to be placed within a structural element that is complex enough to be designated as a service. In other situations, the same function or management role could be assigned to a department, and in the simplest cases, it could be the responsibility of a single individual who already has other tasks. At the same time as this demanding design, the time needed for implementation must also be estimated.
- It is very important to point out the important fact that the CPS RS conceptual

model is not used for implementation, but for transforming the initial state into the desired state. Moreover, the implementation, which requires CPS RS to be constantly in active function, is particularly delicate. After all the above, the dilemma remains that the conceptual model CPS RS is implemented using bottom-up or top-down techniques. In our case, it is more acceptable not to build the CPS RS from scratch (bottom-up), but to build the system from top to bottom (top-down), because it is necessary to have a solid reference during the construction, which is able to assume the role of implementer for the implementation of all other components (16 sectors) and the CPS RS subsystems after the construction of the Strategic Centre and the CPS RS strategic-executive centre as a base.

- In order to estimate the time required to implement the individual parts of the CPS RS conceptual model, it is necessary to know the following:
  - Precise and clear goal and outcome of the desired (future) state;
  - The exact and clear initial state from which the transformation (new state) will take place;
  - The people required and their competences to implement the transition of the system from the initial state to the desired state;
  - All resources must be available to carry out the work of transitioning the system from the existing to the desired state;
  - Assessment of the permissible deviation from the desired state (as a rule, it is assumed that the permissible deviation is 5%);
  - Evaluation of the time constant (time of self-regulation of the system) τof the observed concrete element (function, process, activity, operator, management, control, department, service, sector, centre, etc.);
- Once all this is known, the time of the transition process can be calculated. It is estimated that determining the initial state and establishing the desired state with all its segments in each subsystem of the CPS RS will take at least 6 to 9 months. This task will be performed by the implementation team after its formation and training, while internal implementation documents will be prepared at the same time. Therefore, the total duration of the preparatory phase is 9 months.
- Training of the CPS RS implementation team: In order for all planned phases of the implementation of the CPS RS conceptual model to be solved efficiently and with minimum time, it is necessary to train the personnel to be deployed in each phase immediately before the implementation of the specific phase. In order for the training to be effective, the implementation team must prepare in advance all internal documents necessary for the functioning of the conceptual CPS RS (rules and instructions). Despite the fact that the conceptual model of the CPS RS is the same at all hierarchical levels in terms of organisation (philosophy), each of the hierarchical levels/subsystems of the CPS RS differs in its implementation. For this reason, the training is conducted in two parts. The first part: Common general training simultaneously for all subsystems of the CPS RS, covering general knowledge and skills on the functioning of each of the 16 sectors of the

CPS RS and the functioning of the hierarchical structure of the CPS RS. The second part: Specialised training that covers expertise and skills needed in the lower hierarchical subsystems of the CPS RS, with this training being conducted in parallel or after the first phase of implementation.

– It is estimated that one month will be needed for the general training and 15 days for the specialised training, which will be conducted separately for each of the five regional subsystems of the CPS RS. The total time for the implementation of the preparatory phase is 6 months.

The first phase of the implementation of the conceptual model of the PS-RS

The first phase - defining the elements - structure, measures - functions - management of the CPS RS at the structural level - level of the Republic of Srpska:

- Introduction and verification of the implementation of the CPS RS conceptual model; duration: 3 months;
- Testing of the conceptual model of the CPS RS; duration of one year in total at each hierarchical level;
- Evaluation and review of the test work and granting of a licence to work with the CPS RS conceptual model; duration: one month for each hierarchical level;
- Total time for the strategic level of the CPS RS 16 months;

The second phase of the implementation of the conceptual model of the CP-RS

The second phase - defining the elements - structure, measures - functions - management of the SPS RS at the tactical level - level of the five urban subsystems of the CPS-RS:

- Introduction and verification of the implementation of the CPS RS conceptual model; duration: 3 months;
- Testing of the conceptual model of the CPS-RS; duration of one year in total;
- Evaluation and review of the test work and granting of a licence to work with the CPS-RS conceptual model; duration: one month;
- Total time for the tactical level of the CPS-RS 16 months;

The third phase of the implementation of the conceptual model of the PS-RS

The third phase - defining the elements - structure, measures - functions - management of the SPS RS at the operational level - level of the nine urban subsystems of the SPS RS:

- Introduction and verification of the implementation of the SPS RS conceptual model; duration: 3 months;
- Testing of the conceptual model of the CPS RS; duration of one year in total;
- Evaluation and review of the test work and granting of a licence to work with the CPS RS conceptual model; duration: one month;

- Total time for the tactical level of the CPS RS 16 months;

The fourth phase of the implementation of the conceptual model of the CPS-RS

The fourth phase - definition of the elements - structure, measures - functions - management of the CPS RS at the executive level - level of the fifty-five municipal subsystems of the CPS RS:

- Introduction and verification of the implementation of the CPS RS conceptual model; duration: 3 months;
- Testing of the conceptual model of the CPS RS; duration of one year in total;
- Evaluation and review of the test work and granting of a licence to work with the CPS RS conceptual model; duration: one month;
- Total time for the tactical level of the CPS RS 16 months;
- Total time for the operational and executive level of the CPS RS 16 months;
- Integration of the conceptual model of the CPS RS into the social system of the Republic of Srpska; duration six months for each hierarchical level; As easy as it may seem to integrate the conceptual model of the CPS RS, once the conceptual model of CPS RS has been created, evaluated, verified and licenced at all hierarchical levels, this work is demanding because the CPS RS must be accepted by all institutions of the Republic of Srpska at all hierarchical levels, especially from the point of view of management and control. Total duration of integration 6 months;
- The total time for the implementation of the CPS RS, taking into account the preparatory phase and the four implementation phases as well as all serial and parallel activities, is 5 years and 3 months (Zorić, 2021).

CONCLUSION

It can be concluded from the present work that the Civil Protection System of the Republic of Srpska can only be adopted by applying scientific methods rooted in the rational thinking of experts and oriented towards the actual needs of the Republic of Srpska. It is also evident that the civil protection system can only function successfully if it is structured both horizontally and vertically hierarchically. The key to success lies in the connections between the different levels, which are maintained by people. The study clearly points to a significant shortcoming of the existing "implicit" civil protection system, which ultimately plays a crucial role in the acceptance or rejection of the system, especially in the broader context. This deficiency arises from the misalignment of existing laws with European Union directives and recommendations. Expert opinions have proven to be crucial for the adoption of the civil protection system at all levels, which fully justifies the use of the Delphi method in this research.

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EARTHQUAKE RISK IN CROATIA - HISTORICAL OVERVIEW AND CURRENT STATUS

Nika Pavić, Mag.ing.aedif[1]
University of Zagreb, Faculty of Civil Engineering

1 e-mail: nika.rakas@grad.unizg.hr

EARTHQUAKE RISK IN CROATIA - HISTORICAL OVERVIEW AND CURRENT STATUS

Summary: Disasters pose complex, multidimensional challenges that require careful consideration and effective management at both international and national level. Earthquakes, in particular, were the major natural disaster in Croatia, with the last major impact of which was felt in 2020. Earthquakes are caused by the sudden release of accumulated elastic potential energy within the Earth's crust, resulting in ground shaking and the propagation of seismic waves. Although it is impossible to prevent or predict earthquakes, understanding and assessing earthquake risks is crucial for mitigating potential damage. Croatia is one of the most earthquake-prone countries in Europe, as the European Seismic Hazard Map shows. The most vulnerable regions include Zagreb, Rijeka, Split, and Dubrovnik, which are densely populated and economically important. The seismic risk assessment includes determining the identifying seismic hazards, the exposure of the built environment and population, as well as the physical vulnerability of different building types. By understanding these factors, communities can better prepare for and respond to future seismic events, thereby minimising losses and enhancing resilience. Historical data and recent research emphasise the need for continuous risk assessment and disaster management strategies to protect lives and infrastructure.

Keywords: *disasters, earthquake, risk assessment, building database, damage*

INTRODUCTION

Disasters present a complex and multidimensional challenge that requires careful consideration and effective management at both international and national levels. One of the disasters Croatia has faced throughout history, the devastating effects which were most recently felt in 2020, is the earthquake. Earthquakes are caused due to the sudden release of accumulated elastic potential energy within a specific area of the Earth's crust, causing ground shaking and the propagation of seismic waves, combined with the generation of heat (Dasović et al., 2021). They are impossible to prevent and predict. In the context of global seismic activity Croatia is one of the most earthquake-prone countries in Europe according to the European Seismic Hazard Map (Figure 1) (Atalić & Hak, 2014).

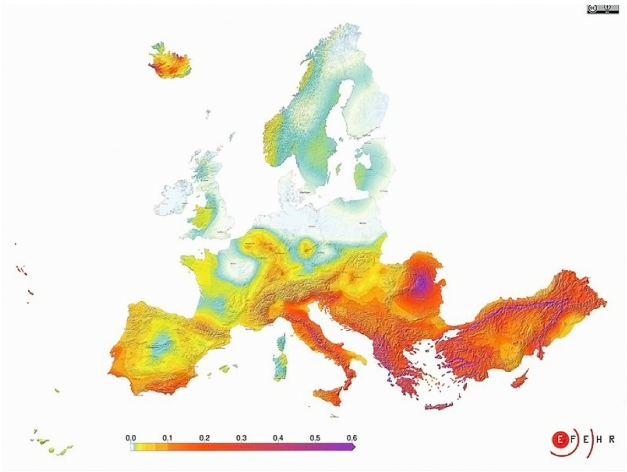

Figure 1 Reference peak ground acceleration (PGA) on bedrock with a 10% probability of exceedance in 50 years (return period of 475 years) for Europe (Danciu et al., 2021)

The most vulnerable parts of Croatia include the most densely populated and economically and socially important areas such as the cities of Zagreb, Rijeka, Split, and Dubrovnik. These regions, the coastal area and north-western part of Croatia, are characterised on the ”Seismic Hazard Map of the Republic of Croatia“ by a reference peak ground acceleration (PGA) or more than 0.25g with a 10% probability of exceedance in a 50-year period (return period of 475 years) (Figure 2) (Herak et al., 2011).

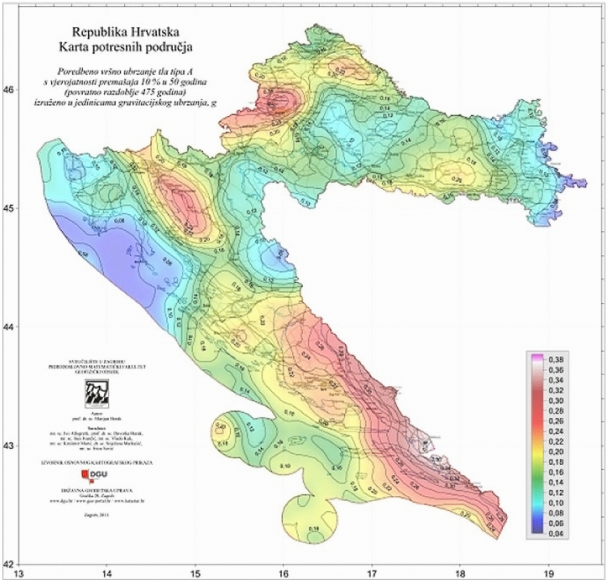

Figure 2 Reference peak ground acceleration (PGA) on bedrock with an exceedance probability of 10 in 50 years (return period of 475 years) for Croatia (Herak et al., 2011)

Given the extent of vulnerability in Croatia and the inevitability of the consequences of such sudden and unexpected threats, it is very important to minimise them as much as possible. In order to achieve this, the risk must be addressed, taking into account all the factors that constitute it, i.e., seismic hazard, exposure, and vulnerability (Erdik, 2017).

EARTHQUAKE RISK

Earthquake risk involves the identification and quantification of three interrelated input components: the seismic hazard, the exposure of the built environment and population and the extent of physical vulnerability of different types of buildings (Figure 3) (Erdik, 2017). Seismic hazard cannot be influenced, but by understanding and influencing the exposure and vulnerability, the consequences of earthquakes can be mitigated.

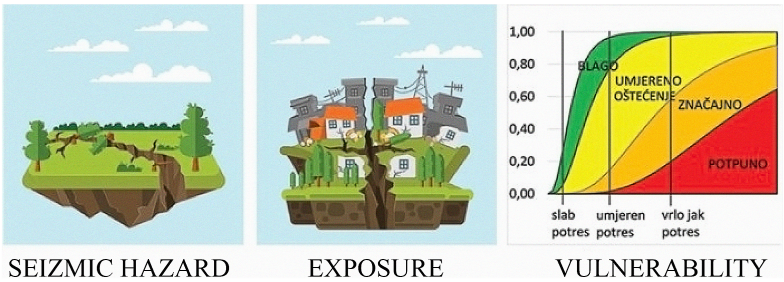

Figure 3 Factors constituting earthquake risk

Seismic hazard is expressed by the statistical probability that a selected parameter, such as peak ground acceleration or spectral acceleration, within a specific period of time, and encompasses various negative effects such as ground shaking, liquefaction, and landslides. In Croatia, the hazard is defined by the seismic hazard map (Herak et al., 2011).

Exposure can be described as the extent of human activity, i.e., the presence of buildings (stock) in areas prone to seismic hazard. Key exposure data usually includes a list of existing buildings, as the damage or destruction of buildings has a significant social and economic impact, and includes information on the number of inhabitants, usage, etc.

The interaction of seismic hazard and exposure defines the physical vulnerability, i.e., the susceptibility of exposed buildings to the effects of earthquakes (damage). The objective of the physical vulnerability assessment is to determine the probability that a specific type of building will exceed a specific level of damage caused by an earthquake of a certain intensity. The ability to quantify vulnerability is extremely important for modelling economic and social losses, which is of great importance in the case of future earthquakes.

Potential economic losses can be categorised into two types: direct and indirect. Direct losses relate to the repair, removal, and replacement of damaged buildings, while indirect losses include costs such as business interruption, expenses related to housing the displaced population, disruption of industrial processes, impact on the economy and similar costs. Earthquake risk assessment is a crucial phase in taking measures that can reduce potential damage and losses. Focusing on the assessment of potential losses is closely linked to the analysis of damage incurred to buildings exposed to earthquakes (so-called vulnerability curves), because in most cases, damage or complete collapse of buildings is the main cause of human losses in devastating earthquakes. Such damage is often the result of deviations from modern seismically resistant design principles (horizontal and vertical irregularities, unfavourable interventions in structures, etc.) (Atalić et al., 2019).

Risk assessment enables the prediction of losses and the proper establishment of disaster response systems while raising public awareness of the risk. Since we cannot influence the threats, our goal should be to mitigate the consequences as much as possible. This requires action in advance through the identification and targeted strengthening of critical or weak links in the system and preparedness for post-disaster response, which includes not only experts but also the community engagement, developed evacuation plans, rescue operations and damage assessments.

HISTORICAL OVERVIEW

Risk assessment and disaster management are key elements for any country, especially for a country like Croatia, which is located in an area prone to various disasters. A major problem with risk assessment in Croatia, in contrast to other countries at risk, has been the sporadic and unsystematic approach to this issue.

The history of risk assessment in Croatia spans several phases of development and came to the fore especially with the country's accession to the European Union and the adoption of international frameworks such as the Sendai Framework for Disaster Risk Reduction (Nations Office for Disaster Risk Reduction, n.d.).

With Croatia's accession the European Union, one of the obligations related to disaster risk management was taken on. In accordance with Article 6 of Decision 1313/2013/EU of the European Parliament and the Council of 17 December 2013, Member States were invited to submit a summary of disaster risk assessments to the European Commission by 22 December 2015. Based on a decision of the Croatian government in 2014 and the initiation of the process to achieve the set goals, a first Disaster Risk Assessment for the Republic of Croatia – Earthquake Risk was prepared in 2015 by the Faculty of Civil Engineering of the University of Zagreb, as the main executor. The risk was categorised as unacceptable (Atalić & Hak, 2014). Subsequently, in 2018, a Risk Management Capability Assessment for the Republic of Croatia was conducted, together with updates and supplements to the Disaster Risk Assessment for the Republic of Croatia – Earthquake (Atalić et al., 2018).

Various projects and institutions have dealt with the risk of earthquakes, only a few which are mentioned in this paper, while the project "Earthquake Risk of the City of Zagreb" is described in more detail below. Researchers at the University of Osijek have been actively working on earthquake risk assessment for many years. They conducted a rapid earthquake risk assessment of urban areas in Croatia, which can be a first step in identifying vulnerable areas (Kalman Šipoš & Hadzima-Nyarko, 2017). They developed a building database for the city of Osijek (Hadzima-Nyarko, 2019), which they upgrade regularly, and published numerous papers on exposure modelling, building vulnerability (Hadzima-Nyarko et al., 2016; Pavić et al., 2019), and risk assessments for the city of Osijek and rural areas in Slavonia (Pavić et al., 2020). Additionally, they have prepared a textbook in Croatian that deals with earthquake risk and building vulnerability assessment (Hadzima-Nyarko et al., 2018).

The Faculty of Civil Engineering, Architecture, and Geodesy at the University of Split participated in the project "Prevention, Management, and Overcoming Risks of Natural Disasters to Mitigate Their Impact on the Economy and Society," which began in 2019. The objectives of the project included developing innovative methodologies for preventing, managing, and coping with the risks of natural disasters in the regions of Italy and Croatia involved in the project. The project also aimed to improve the level of protection and resilience to specific natural disasters in these areas, including floods, meteorological tsunamis, and earthquakes.

Historical data on earthquakes have shown that the risk for Croatia is unacceptable, including human casualties and material losses. The following figure shows the epicentres of approximately 60,000 earthquakes on the territory of Croatia, with an average of about 45 earthquakes per year (Figure 4) (PMF, n.d.).

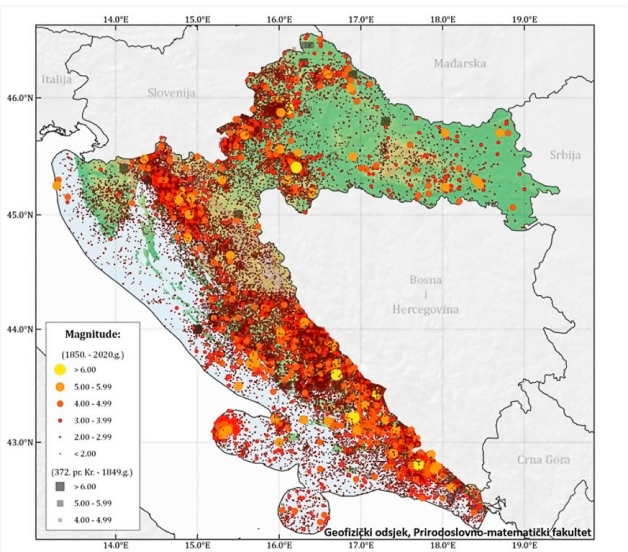

Figure 4 Map of Epicentres of Earthquake in Croatia from Before Christ to 2020 (PMF, n.d.)

Catastrophic earthquakes were recorded on the island of Pag in 361, when an entire town collapsed into the sea, and in Dubrovnik in 1667, when 3,000 people died. They were categorised as intensity X° on the Mercalli-Cancani-Sieberg scale, with 21 earthquakes of intensity IX° on the MCS scale. A devastating earthquake of intensity VIII° on the MCS scale hit Zagreb in 1880, damaging numerous buildings and causing many inhabitants to evacuate.

In 1996, an earthquake with a magnitude of ML = 6.0 on the Richter scale, intensity VIII° on the MCS scale, shock Ston and its surroundings, which had already suffered from the consequences of war. Reconstruction efforts were focussed on both disasters, but awareness of the potential earthquake risk went largely unnoticed due to intensive post-war activities.

All of the above was preceded by warnings and risk assessments that raised questions about the readiness and capacity of the system, as well as the economic, social, and political stability of the country in the event of a future disaster (Atalić, Šavor Novak, Uroš, et al., 2018). Unfortunately, it is human nature to ignore potential threats until they occur.

EARTHQUAKES IN 2020

On Sunday, 22 March 2020, Zagreb and its surroundings were shaken by two earthquakes in the early hours of morning, the main shock with a magnitude of 5.5 on the Richter scale and an estimated intensity VII° on the EMS scale at the epicentre, and an aftershock with a magnitude of 4.9 about 40 minutes later. Although, these earthquakes were of moderate magnitude, from a seismological point of view, they claimed on life and caused considerable damage. The city centre, which is a protected historic-urban area, and the area around the epicentre were the worst affected. By the end of 2021, around 3,500 earthquakes had been recorded, with around 3,200 earthquakes recorded in the first year after the main earthquake. This series of earthquakes had a significant impact on the Zagreb region and its surroundings (PMF, 2023). The intensity map of the Zagreb earthquake below shows the intensities, marked with different colours (legend), and assessed according to the European Macroseismic Scale (EMS) (Figure 5).

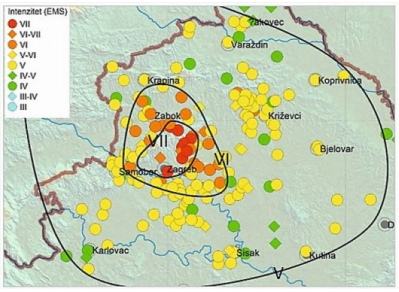

Figure 5 Map of the intensity of the Zagreb earthquake (PMF, 2023)

The magnitudes and epicentres of the main and aftershocks of the Zagreb earthquake series are shown in different sizes and colours (Figure 6).

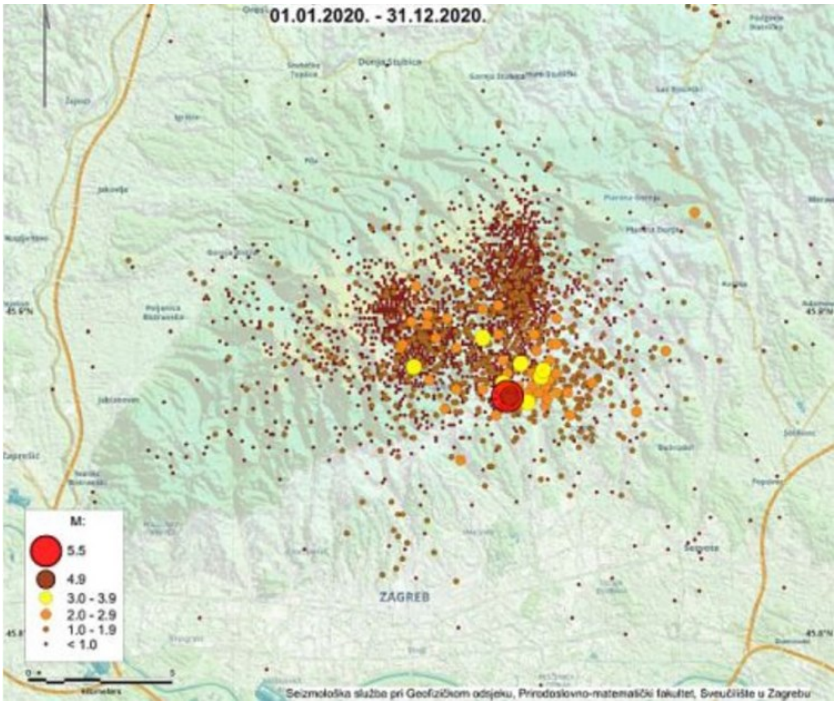

Figure 6 The epicentres of the Zagreb earthquakes from 1 January 2020 to 31 December 2020 (PMF, 2023)

The earthquakes severely damaged to the rich cultural and historical heritage of the City of Zagreb, including the south tower of Zagreb Cathedral. The damage to the old city centre, critical infrastructure, especially hospitals and schools, as well as buildings that are crucial for the functioning of the city and the state, posed the greatest problem, as Zagreb is the administrative centre of Croatia. The assessment revealed that around a one-fifth of the residential buildings were damaged, highlighting the need for urgent intervention and reconstruction. A mitigating factor was the COVID-19 pandemic, which prohibited gatherings and prevented further loss of life. Damage to structural systems ranged from minor to moderate, with numerous chimneys, parapets, gables, and other unsecured parts of buildings collapsing. Fear and panic prevailed and a large number of citizens temporarily relocating, highlighting the significant vulnerability of the capital of the Republic of Croatia (Atalić et al., 2021, 2022; Novak et al., 2020).

Figure 7 Consequences of the 2020 earthquake in Zagreb (Croatian Centre for Earthquake Engineering, 2024)

Experts quickly gathered and began conducting rapid assessments of damage and the usability of building to determine the extent of damage and the safety of buildings, infrastructure, and other structures. Rapid assessments are crucial to ensure the safety of people after an earthquake and to establish basic infrastructure. The rapid assessment is usually followed by a more detailed technical damage assessment and long-term reconstruction planning.

The assessment was carried out using a methodology developed on the basis of experience from Italy, with the participation and education of experts from Croatia as part of the EU MATILDA project. The methodology and assessment forms were adapted to Croatian conditions, and a GIS (Geographic Information System) database was created in collaboration with the company GDi. d.o.o., to facilitate data tracking and analysis (Atalić et al., 2019).

A map of Zagreb with the associated damage categories, colour-coded according to EMS98, is shown (Figure 8).

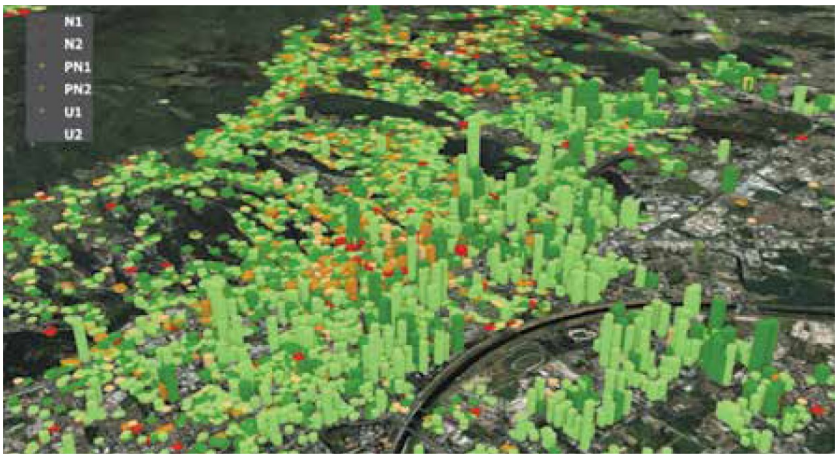

Figure 8 Illustration of damage to residential and mixed-use buildings by usability markers (colours) and gross developed area (column height) on a perspective view of the map (Novak et al., 2020)

Only nine months after the so-called ”Zagreb earthquake“, Croatia was struck by an even more devastating event, a series of earthquakes that began on 28 December 2020 with the epicentre near Petrinja. The first earthquake with a magnitude of ML = 5.1 (moment magnitude MW = 4.9) was felt in large parts of central Croatia, followed by earthquakes of local magnitude 4.6, 3.8 and a series of weaker quakes that turned out to be foreshocks. The next day, 29 December, an even stronger earthquake occurred with a magnitude of ML = 6.2 (moment magnitude MW = 6.4), which was rated at intensity VIII° on the EMS scale at the epicentre, and was also felt outside Croatia (Atalić et al., 2022).

Numerous buildings collapsed or were damaged, and seven people lost their lives. This earthquake caused additional damage in the still unreconstructed city of Zagreb. In addition, many secondary effects of the earthquake were observed in the wider area around the epicentre, such as liquefaction, cracks, landslides and sinkholes. A large number of people had to leave their homes. Reconstruction is still underway today, four years after the earthquake, and there is no end in sight. Another major challenge related to the earthquake is that the Sisak-Moslavina County, the area affected by this earthquake, is facing long-term economic challenges and poverty.

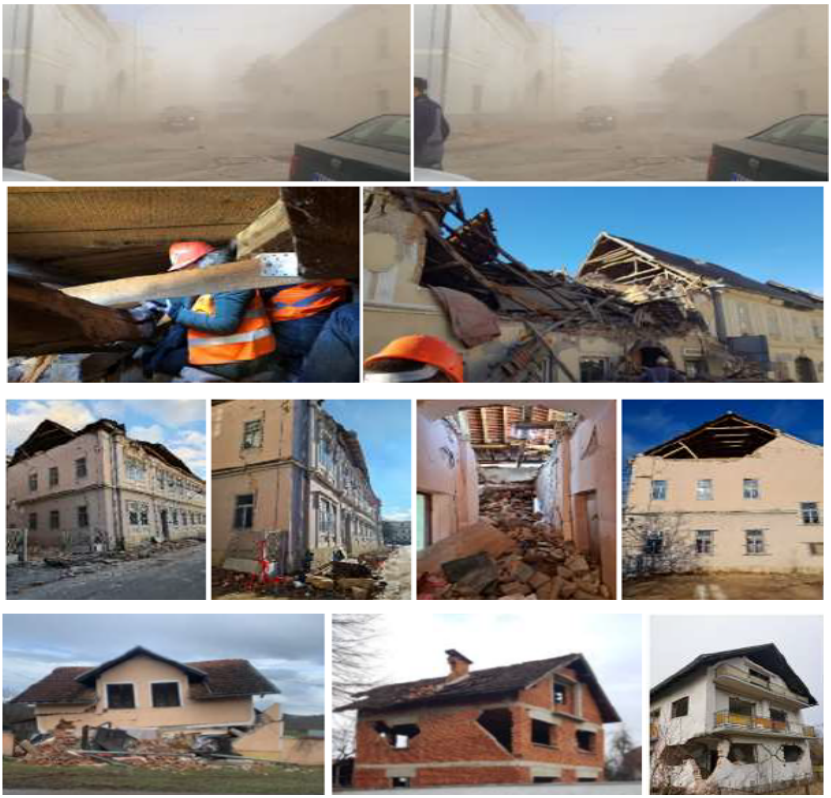

Figure 9 Consequences of the 2020 earthquake in Petrinja (Croatian Centre for Earthquake Engineering, 2024)

As mentioned earlier, people tend to ignore potential problems and the solutions and ways to mitigate damage until it happens. We all know that an earthquake is unpredictable and cannot be prevented, but by raising awareness and preparedness of the population in Croatia for earthquake risks, and promoting a culture of prevention and preparedness for potential disasters, at least a system could be developed to minimise the consequences as much as possible.

The earthquake has highlighted the need for systematic earthquake risk assessment and appropriate protection and preparedness measures. Before the earthquake, and after the 1909 earthquake, the area around Petrinja had not been actively exposed to strong seismic activity, which led to a lower awareness of potential hazards. However, when the earthquake struck the region, it became clear how important it is to plan and prepare for such events in advance.

It is important to emphasise that earthquake risk assessment is not limited to seismological aspects, but also includes the analyses of the vulnerability of infrastructure, buildings and population. In addition, it is necessary to develop systematic education and awareness -raising programmes to educate citizens about

what to do in case of an earthquake and to improve community preparedness.

The Petrinja earthquake has shown how important it is to continuously invest in the development of earthquake protection systems and the implementation of preventive measures. This includes strengthening building standards, improving urban planning, ensuring adequate resources for emergency interventions, and promoting a culture of safety and preparedness among the population.

If communities like Petrinja understand and adequately assess earthquake risks, along with appropriate preparedness and take appropriate protection measures, they can minimise potential damage and protect the well-being of their inhabitants in the event of future earthquakes.

Another important aspect is to have a developed network of experts and sufficient capacity to respond quickly in the event of such a disaster.

EARTHQUAKE RISK ASSESSMENT – CITY OF ZAGREB

After Zagreb was hit by a series of earthquakes in March 2020, including an earthquake measuring 5.5 on the Richter scale, it became clear that the existing risk assessment and preparedness systems were inadequate. These earthquakes highlighted the need for a detailed analysis of the seismic risk in the city and the development of strategies to mitigate these risks. The earthquakes in Petrinja further confirmed the need for such measures, which should be implemented nationwide.

The recently completed project ”Earthquake Risk of the City of Zagreb“ was designed in response to the need for a comprehensive approach to assessing earthquake risk in the Croatian capital. A key factor that initiated this project was the increased awareness of potential earthquake threats, especially after the recent earthquakes that affected Zagreb and its surroundings. The aim was to gain a deeper understanding of the potential impact of earthquakes on Zagreb and to identify the most important measures that should be taken to enhance the city’s resilience to future earthquakes.

The project ”Earthquake Risk of the City of Zagreb“ was conceived as a pilot project to serve as an example for other areas in the Republic of Croatia. It was implemented as part of the project ”Multisensor Aerial Imaging of the Republic of Croatia,” funded by the Operational Programme ”Competitiveness and Cohesion 2014 - 2020“; Priority Axis 5 - ”Climate Change and Risk Management“; 5b - ”Encouraging investments related to specific risks, ensuring disaster resilience, and developing disaster management systems“; Specific Objective 5b1 - ”Strengthening the disaster management system.” The planned duration of the project was 36 months (from April 2021 to April 2024), but due to various circumstances, the project had to be completed by the end of 2023.

The project activities included the following:

1. Development of a risk assessment methodology (applicable to the entire territory of Croatia)
2. Definition of hazards in the City of Zagreb
3. Collection and processing of building data and establishment of a database
4. Seismic risk assessment

As part of Activity 1, existing risk assessment methodologies, scientific projects in this field, practises of different countries, software packages and tools for risk assessment, and legal regulations were studied and analysed. A risk assessment methodology with three levels of complexity was proposed, depending on the available input data and the capacity of the team conducting the assessment. A sample assessment was provided for each level.

Eight reports were produced as part of Activity 2, covering the areas of seismology, geology, geotechnics, tall buildings, civil engineering structures, cultural heritage, and cartography. These reports further define the components of seismic risk and are available on the project website. Scientists and experts from various institutions were involved in their preparation.

Activity 3 was dedicated to the collection of building data using the building-by-building method, which was the most extensive activity of the project.

Activity 4 assessed the seismic risk for buildings and the population, emphasising results for cultural heritage buildings. The state-of-the-art methodology and the software package Openquake (Silva et al., 2014) from the GEM Foundation (Global Earthquake Model) (GEM, n.d.) were used. The seismic risk was also assessed for bridges on evacuation routes and hydraulic engineering structures.

The initiation of this project has greatly contributed to improving the understanding and management of seismic risks in Zagreb and developing preventive strategies and measures to protect citizens and property in the event of future earthquakes.

It is important to mention that we encountered numerous problems during the project. The first and at the same time the most important and biggest problem, was the lack of building data, i.e., the lack of a basic database. Experience has shown that that this is the fundamental basis and the most important and first step in any risk assessment, which includes a number of characteristics such as the structural system and material, number of storeys, area, irregularities, year of construction, location, and the like. One of the important characteristics is also the purpose because it determines the number of residents or users. In order to produce a high-quality risk assessment, it is very important to define the methodology and establish uniform criteria for the assessment. Since there is there is no Building Registry yet, and for in order to define the project task and the number of buildings in the area of the City of Zagreb, an overlap of three official/available databases was made – the Digital Cadastral Plan

(DKP, source: City Office for Cadastre and Geodetic Affairs), the Register of Spatial Units (RPJ, source: City Office for Cadastre and Geodetic Affairs), and Existing Land Use 2020 (source: City Office for Strategic Planning and City Development). The overlap covered more than 300,000 structures, of which around 230,000 being related to buildings.

The project included 35 attributes (characteristics) such as year of construction, structural type, number of storeys, regularity, and the like, but additional attributes required for earthquake risk assessment were also collected in accordance with the methodology used by the Global Earthquake Model (GEM) Foundation. The assessment was conducted on a ”building-by-building“ basis. The attributes were collected through field work (building surveys) and remote work (via computer), and certain data from a LIDAR survey, which was conducted as part of the project “Multisensor Aerial Imaging of the Republic of Croatia”, was used.

One of the ideas was to involve citizens in collecting data on the buildings they live in. An online questionnaire was created for this purpose, but the response rate was negligible compared to the total number of buildings.

An exposure model was created on the basis of the data collected on the buildings. Here too problems arose because some buildings were demolished, and new ones were constantly being built in almost every part of the city.

In the end, the estimated total replacement value of the building stock was around EUR 86 billion, with reinforced concrete buildings accounting for around 37% and masonry buildings 62%. The following map shows the total number of buildings by city districts where CR stands for reinforced concrete, MCF for confined masonry, MUR for unreinforced masonry, S for steel, W for wood, as well as the map of replacement cost (Figure 10).

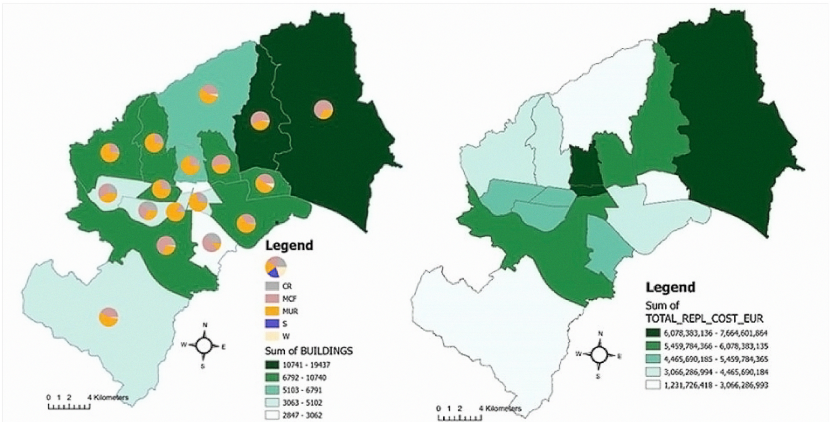

Figure 10 Maps of the total number of buildings (left) and the replacement cost of building stock (right) in the individual city districts (Earthquake Risk of the City of Zagreb, 2023)

Vulnerability, as one of the three factors that make up earthquake risk, was defined by

fragility and vulnerability curves. Since no curves are available for our area, which was also a major drawback, the curves were taken from the GEM database (Figure 11)(Martins & Silva, 2021). It is important to mention that some currently ongoing projects funded by the Croatian Science Foundation are specifically focussed on this topic (2BESAFE and ARES) (2BESAFE, n.d.; ARES, n.d.)

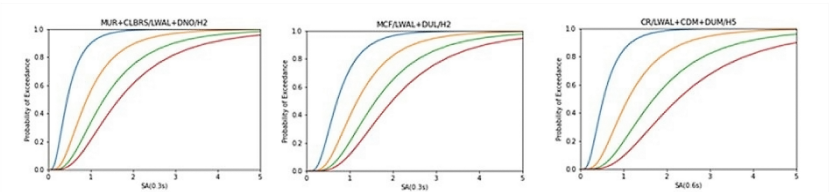

Figure 11 Example of fragility curves from the database of the Openquake programme (Martins & Silva, 2021)

Below are some of the results of a risk assessment scenario (return period of 500 years) conducted in Openquake (Silva et al., 2014). The results are presented at the level of city districts (Figure 12).

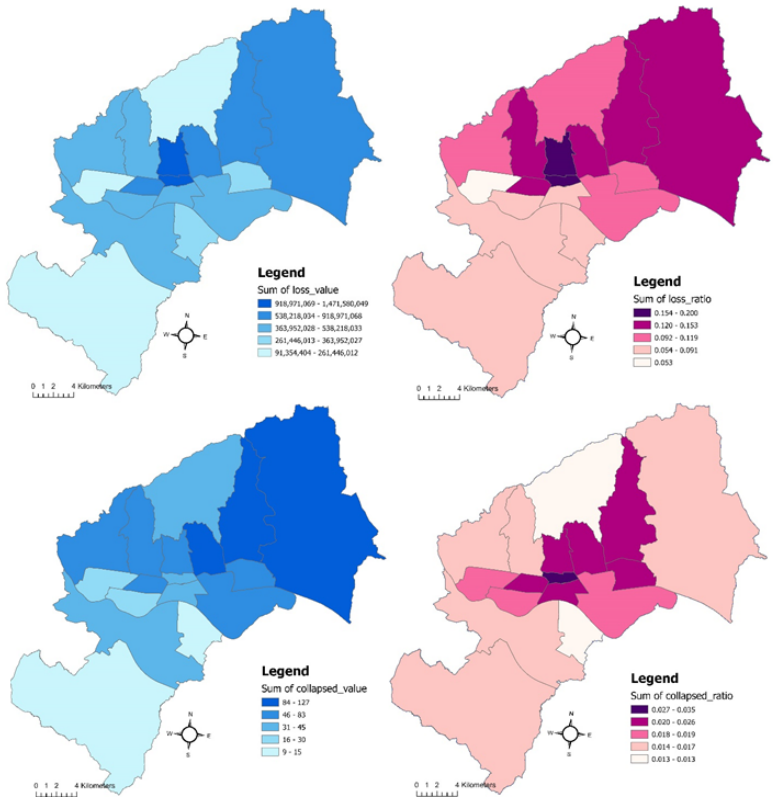

Figure 12 Earthquake risk for events with a return period of 500 years in the individual city districts (total and relative values): monetary losses [EUR] and number of collapsed buildings (Earthquake Risk of the City of Zagreb, 2023)

Maps with blue colour show the total values of risk indicators for individual city districts, while maps with pink colour show relative values (example.g., for monetary losses, the relative value is the total value divided by the replacement cost of the building stock; for the number of collapsed buildings, it is the number of collapsed buildings divided by the total number of buildings).

For the scenario mentioned above, which is usually used for the design of new buildings, around 900 collapsed buildings and monetary losses of around EUR 9.6 billion can be expected.

To check the model, a comparison was made with a deterministic earthquake scenario corresponding to the Zagreb earthquake in 2020, the consequences of which are well-known. The results showed a very good match.

The project carried out confirmed earlier assessments and warnings about the city's high earthquake risk and potential consequences. The comparison of the project results with the actual damage and losses is a further confirmation and a sign of the initiation of risk mitigation measures, which are crucial for the safety, development and the preservation of cultural heritage.

CONCLUSION

The aim of this paper was to provide an overview of the situation and the various challenges in Croatia related to earthquakes - the disaster that this country has been confronted with most in the recent times. Given the country's geographical position and seismic activity, earthquakes pose a constant threat to Croatia. The analysis of the earthquake risk and historical risk assessments in the country, clearly shows a need for continuous monitoring, assessment and management of this natural hazard. The risk assessment process consists of risk identification (description of threat, exposure, vulnerability, capacity, historical events, damage and losses, development of scenarios), risk analysis (use of identified threats, exposures, and vulnerabilities in risk in the preparation of analysis, consequences, probability and frequency), and risk evaluation. Part of the assessment should also include an analysis of key response systems to define the need for additional or new operational forces. Through detailed risk assessment and scenario development, information can be gathered that is crucial for strategic action to improve the seismic resilience of specific building types (typology) or for the preparedness of emergency services The project "Earthquake Risk of the City of Zagreb" represents a step in the right direction and provides a basis for a better understanding of the potential impact of earthquakes on the capital city of Croatia. Its implementation not only enables f the city of Zagreb to better prepare for earthquake events but can also serve as a model for other cities in the country. However, it is important to continuously invest in research, educate the population, and implement preventive measures to reduce the risks and improve the safety of citizens and infrastructure in the event of an earthquake. It is crucial to draw lessons

and learn from the experiences of countries that have already faced disasters, rather than relying solely on our own experiences, as the consequences can be devastating. Furthermore, it is important to act in accordance with the guidelines and enhance existing processes and strategies. Efforts to improve seismic safety, both in Croatia and in all other countries, should include continuous research, systematic analyses, and comprehensive activities aimed at understanding the various aspects of the earthquake risk reduction process.

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PROTECTING VULNERABLE GROUPS IN EMERGENCY SITUATIONS

Nataša Todorović[1]
Expert associate for protection, inclusion and gender equality, Red Cross of Serbia, Belgrade

1 e-mail: natasa@redcross.org.rs

PROTECTING VULNERABLE GROUPS IN EMERGENCY SITUATIONS

Summary: The resilience of a community affected by a disaster depends on its readiness to recognize the vulnerability of certain groups, to respond to their needs, but also to recognize the potential and capacities possessed by individual members of vulnerable groups. Vulnerability is a complex concept. It is affected by factors at different levels, from local to global, moreover, the complex factors that make people vulnerable are not always obvious. Various factors determine vulnerability: class, age, gender, disability, migration status and the nature and extent of community connections. It has also been shown that vulnerability is fluid and changes over time and depends on different circumstances. It can happen that people who functioned normally in everyday circumstances become vulnerable during emergency situations. In responding to emergency situations, we must adhere to a rights-based approach, we must bear in mind the heterogeneous nature of vulnerable groups, we must be aware of the various factors that make up one's vulnerability and which, on the other hand, can create additional barriers to exercising rights. But it is also necessary to continuously fight against various stereotypes, prejudices and discrimination based on age, gender, ethnicity, economic status, etc.

Keywords: *vulnerability. vulnerable groups, emergency situations, disasters, resilience*

CURRENT SITUATION

Successfully protecting and building the resilience of the community, vulnerable groups and individuals in emergency situations depends primarily on understanding two fundamental concepts: disaster and vulnerability. Disasters are complex in nature and represent a mixture of natural hazards and human activities. The natural and social aspects of disasters should not be separated. If we do, we will not be able to understand the natural hazards on the one hand, but on the other hand we will not be able to respond appropriately and understand the measures to mitigate the consequences.

When we talk about disasters, we usually mean those caused by natural hazards such as floods, earthquakes, epidemics, armed conflicts and famines as a result of drought, floods, etc. However, in these situations we must also be aware of the other side, i.e., other circumstances that affect the consequences, namely that people live in unfavourable economic conditions that force them to inhabit regions and places that can be affected by natural hazards, be they flood prone plains, volcanic slopes or earthquake zones. In addition, there are many other, less obvious political and economic factors: the way in which assets, income and access to other resources such as knowledge and information are distributed among different social groups, and there

are various forms of discrimination that occur in the distribution of humanitarian aid that are based on pre-existing discriminatory practises in the community. (Blaikie et al., 2003)

Another important concept in this area is vulnerability. Vulnerability is also a complex concept and there is a tendency for different people to often describe vulnerability using different terms such as "predisposition", "fragility", "weakness", "deficiency" or "lack of capacity" (Vulnerability. Understanding the risk of disaster, 2017).

Vulnerability is defined as "the extent to which people may be disproportionately affected by the disruption of their physical environment and social support mechanisms following a disaster or conflict, resulting in an increased risk of exploitation, illness or death". (Sphere, 2019). Some authors define vulnerability as the human dimension of disasters, which is also the result of a range of other factors: economic, social, cultural, institutional, political and psychological factors. These factors shape people's lives and the environments in which they live (UNDRR, 2017).

Although vulnerability is individualised, it is also true that some groups are more likely to experience greater harm or suffering in relation to different risks. In any case, vulnerability should be considered as an intersection between the resilience of an individual, the resilience of different vulnerable groups, the resilience of society and the nature of the disaster itself. Discussions of vulnerability are complemented by the concept of "capacity" - the ability of a group, household or individual to withstand and easily recover from harmful impacts caused by a change in the environment (Anderson and Woodrow 1998; Eade 1998; Blaikie et al., 2003).

Various factors determine vulnerability: class, i.e., economic status and minority group membership, age, gender, disability (note here that different types of disability may have a greater or lesser impact on a person's vulnerability in a given situation), migration status, and the nature and extent of connections in the community (Blaikie et al., 2003), (Todorović et al., 2018). In any case, one should be careful when defining vulnerability, because not all members of the same group are equally vulnerable, and their vulnerability can change in complex ways over time.

When considering vulnerability, it is important to recognise that in some situations not all individuals belonging to vulnerable groups are equally at risk, but also that in emergency situations individuals who were previously functional and did not belong to a vulnerable group may become at risk due to changing circumstances. As vulnerability lies at the interface between the resilience of the person and his/her environment and the nature of the disaster, the vulnerability itself changes with the changes in the environment and the disaster.

It is important to always remember that vulnerable groups are not homogeneous. The vulnerability of individual members depends on many factors and also changes with time and circumstances. Furthermore, the complex factors that make people vulnerable are not always obvious.

For example, a person living with diabetes who regularly receives treatment and monitors their health is fully functional and leads a normal family and working life. However, if there is an accident and various changing circumstances that may result in a person not having access to the necessary therapy, that person becomes vulnerable and his/her health deteriorates and his/her life is threatened at that moment if an appropriate response is not made and access to regular therapy and health monitoring is prevented.

Another example is older people aged 65 and over, who are usually immediately categorised as a vulnerable group in emergency situations. With such an attitude, we do not respect the heterogeneity of this age group and the circumstances in which they have lived and continue to live. By including vulnerability in our understanding of disaster risk and responses thereon, we are simply recognising the fact that disaster risk does not only depend on the severity of the hazard of the situation or the number of people and assets affected by the disaster, but also reflects the vulnerability of people and assets to loss and damage. This level of vulnerability (and exposure) explains why some less extreme hazards can lead to extreme disaster impacts and consequences, while conversely some extreme events may not have major consequences. Especially in the context of extensive risk, people's vulnerability is the biggest factor in determining risk (UNDRR, 2017).

Throughout its history, the Red Cross has worked by mobilising solidarity in difficult times, including during natural and other disasters, and has paid particular attention to vulnerable populations who may be at higher risk of disasters due to a number of factors. Over time, this has been integrated into the ethos of all responses to disasters and accidents, so that continuous attention is paid to all groups and attention is paid to strengthening their resilience, because it is precisely the reduction of the vulnerability of these groups under normal circumstances that contributes most effectively to reducing the risk of these groups in emergency situations. The Red Cross of Serbia regularly carries out activities with various vulnerable groups. Through these activities, the Red Cross reduces the risk of disasters by strengthening the resilience of these groups. On the other hand, the Red Cross of Serbia pays special attention to these groups, especially in times of disasters, precisely because the threat is fluid.

The chain of causes of community vulnerability, starting from the underlying drivers of vulnerability, such as socio-economic processes, to the immediate conditions, such as poor-quality housing, can be long and complex, but by following this chain, we can more easily recognise the progression of vulnerability that puts pressure on communities. Vulnerability can be reduced by taking action to reduce vulnerability at different points along the causal chain (UNDRR, 2017).

At the community level, there are two main factors that influence the definition and recognition of vulnerability: the environment and the perception of the vulnerable

group. The environment includes the political, economic and social environment, all of which can contribute to a greater or lesser risk of vulnerability. On the other hand, the perception of a vulnerable group in society can also contribute more or less to the risk through prejudices and widespread stereotypes, which also influence policy and the implementation of crisis responses. If we perceive all older people as vulnerable and passive recipients of help without taking into account their abilities and contributions, this reduces the effectiveness of the community's response, because age alone does not make a person more vulnerable. The relationship between age and certain health characteristics and the circumstances in which a person lives increases risk (Fernandez et al., 2002).

Simply recognising the specific characteristics of a particular vulnerable group can be a lengthy process that requires data collection, research, experience and practical activities. For example, the Humanitarian Inclusion Standards for Older Persons and Persons with Disabilities were only adopted by the Sphere Executive Board in 2018. It is therefore important to point out that recognising intersectional factors and how they change over time for a particular group is an important step in crisis response planning and, taking into account context and perceptions, is a pillar of protection for vulnerable groups at all stages of the response to an emergency.

When we talk about an individual, we should realise that the structure of a person's vulnerability is also a product of several factors. A person's vulnerability depends on their personal status. This includes, for example, health status - which can increase vulnerability - as well as economic status, which can include people living in extreme poverty, but also people with low incomes or people who have little access to basic services. These are factors that often lead to people being marginalised in their communities, which further increases the risk of vulnerability in emergency situations (Todorović et al., 2018).

Another important factor that affects a person's vulnerability is their integration into a community, which affects whether and to what extent a person receives support during disasters. Lonely people can be exposed to increased risk in disasters due to their isolation. The increased risk for such individuals may mean that they do not recognise evacuation warnings in time, do not find out the safest evacuation routes in time, do not know the recommendations for the use of shelters, do not know enough about access to services they are entitled to or access to available humanitarian aid (Todorović et al., 2018). One factor that also affects a person's vulnerability is their immediate environment, which can influence mobility, access to services and access to humanitarian aid.

When talking about vulnerability, we must always avoid the risk of paternalistic attitudes towards individuals and groups and stereotyping. Indeed, it is important to bear in mind that people, regardless of their membership of a group that may be considered vulnerable, also have significant capacities and that when talking about

vulnerable groups or "groups with special needs", a conscious effort must be made not to reduce their members to passive recipients or even "victims", but to keep in mind their capacities both to help themselves and to contribute to the community's response to the situation that arises (Hewitt, 1997).

There are certain constraints in society that affect the response to disasters. One of these is social vulnerability, which affects groups in society rather than individuals and is not directly related to their life choices or personal characteristics. A successful response to disasters also depends on social cohesion, as it provides practical and emotional help to people in emergency situations, on one hand, and influences a person's health and well-being by providing and receiving emotional support, practical support, information support, humanitarian aid, etc., on the other hand, Access to material, practical and informational resources available to different groups in emergency situations is influenced by social inequality and socio-economic status. This concerns not only access to humanitarian aid, but also the availability of transport, communication technologies, shelter outside the disaster-affected area, etc. There is also a social inequality related to geographical location – for example, those living in flood prone areas are likely to increase their risk of vulnerability (Blaikie et al., 2003).

When talking about vulnerability, an important factor is the timely receipt of vital information, which may relate to evacuation, health care, distribution of relief supplies, or other important issues that are critical to affected families and individuals. The channels and media used to deliver information exclude a significant portion of the population - and this includes many older people - for a variety of reasons, often due to the need to know or own a particular technology. According to 2017 data from Internet World Stats, of the total 3.6 billion people worldwide covered by the survey, 48.3% of the population are digitally excluded. The rapid development of technologies is leading to a growing gap between those who have access and the necessary knowledge to use modern communication and information technologies and those who do not, which may influence the further deepening of inequality in society (Todorović et al., 2019).

In addition, the development of digital technologies, for example, can reinforce the marginalisation of age and gender: in many parts of the world, older people, especially older women, are more likely to be illiterate, so the reliance on text media to transmit vital information increases the risk of their marginalisation. It is therefore necessary to take into account the heterogeneity of the population in terms of data access and to find appropriate communication channels that include the largest possible percentage of the population. On the other hand, at the level of planning and preparedness for emergency response, the lack of statistical data regarding gender and age within the population limits planning and significantly affects the emergency response, reducing its effectiveness.

It is important to remember this: communication technologies do not give people a "voice" but allow their voices to be heard.

Older people can serve as an example of the various specific limitations that contribute to the vulnerability of this age group. In order to respond appropriately in emergency situations, existing age-related restrictions on data collection must first be abandoned - for example, the frequent practise of collecting statistics on women only up to the end of their reproductive years (a good example is the collection of data on violence against women, which in 2013 is up to 49 years old) (UN, 2013). But even when data is collected on older people, it is not broken down into five-year cohorts. This practise assumes that the older population is homogenous – when in fact it is primarily heterogeneous – and this makes any subsequent interventions less effective. It also contributes to a very large group of older people appearing to be invisible, lost in statistics that do not have sufficiently sophisticated criteria to describe them properly. The effects are very specific: in emergency situations, general humanitarian aid often does not cover the basic needs of older people and older women.

Previous experience in crisis situations indicates that older people are the most vulnerable category and that they are at greater risk of neglect, injury, illness and death in such situations (Klynman et al., 2007). In "slow" crises, such as heatwaves or droughts, older people are often particularly vulnerable, which is not recognised: during the 2003 heatwave in Europe, of the 34,800 people who died, most were over 70 years old - almost half in France, a country with high-quality healthcare. (Kosastsky, 2005). But even in typical, urgent emergency situations, older people make up the majority of victims, despite the fact that society in general and the specific structures responsible for providing assistance in particular recognise older people as a particularly vulnerable group. Examples show, for example, that 71% of the victims of Hurricane Katrina in Mississippi in 2005 were over 60 years old (Tokesky & Weston, 2006). There is also data showing that regardless of whether they were able to evacuate or not, older people are at a higher risk than the general population of falling victim to a variety of scams following crises, particularly when it comes to home renovation scams (Kilianek & Drabek, 1979). Older people make up between 36% and 65% of internally displaced people worldwide (Wells et al., 2012). The World Bank predicts 216 million internally displaced persons due to climate change by 2050 (Voegele, 2021).

In the current conflict in Ukraine, one third of all people in need of assistance are over 60 years old and only 43% have access to all necessary prescribed medication (Karimova, 2023).

For the response to be effective in emergency situations, it is necessary to recognise not only the specific limitations of the vulnerable group, but also the specific contributions of that same group, and in this case, the contribution of older people.

Older people can contribute throughout the cycle from planning to design to implementation of emergency responses, and this can be crucial.

With some support, older people are not only able to be independent in an emergency situation, but also to help other older people, for example their partners, family members, children and neighbours. The knowledge and experience that older people have, especially in previous emergency situations, is a valuable contribution to the community. It is also worth noting that older people often want to contribute to helping and can become frustrated if they are perceived as not helping.

Furthermore, the mental health of vulnerable groups in emergency situations should certainly not be ignored or seen as less important, as it is likely that mental health has a major impact on a person's overall health and their access to support. It was the COVID-19 pandemic that highlighted the particular importance of mental health in emergency situations. In addition, one of the most important factors in the vulnerability of older people during the period of isolation and strict movement restrictions was the mental health of their informal carers, which is often not taken into account, despite being an essential part of the long-term care system, without which older people could not receive adequate support. Researches during the COVID-19 pandemic clearly show that the burden of caring is a significant factor in the development of depressive symptoms in informal carers. This needs to be taken into account when planning responses to similar crisis situations in the future (Rajović et al., 2021).

CONCLUSIONS AND RECOMMENDATIONS

Emergency response planning should always be guided by a rights-based approach. A human rights-based approach refers to empowering people to know and access their rights, as well as enhancing the capacities and responsibilities of individuals and institutions responsible for the respect, protection and realisation of rights. A human rights-based approach enables the integration of human rights standards and principles in the development of policies, in the daily work of institutions, but also in the development of responses to emergency situations.

We must also take into account the heterogeneity of vulnerable groups and the multitude of other different factors that can make up a person's vulnerability and create additional barriers to the exercise of rights in emergencies, continuously over time in disaster preparedness, response and recovery.

An important element of the rights-based approach is the fight against various stereotypes, prejudices and discrimination based on them (based on age, gender, ethnicity, economic status, etc.) at all levels: individual and structural.

At the individual level, we mean a situation in which humanitarian workers themselves may act under the influence of prejudices and stereotypes about a

particular vulnerable group, which may result in members of some vulnerable groups receiving inappropriate, unequal or otherwise sub-optimal services and treatment.

At a structural level, it is important to include representatives of vulnerable groups in changes and additions to public policy. This involvement is the minimum requirement to ensure the influence of vulnerable groups on data collection policy and contingency planning as well as operational management and reporting. In this situation, the needs and capacities of vulnerable groups are fully recognised.

To protect vulnerable groups, it is also necessary to bridge the gap between the level of public policy and the level of implementation. While the concept of inclusion is recognised, planning, budgeting and operational management do not yet meet established standards to achieve the inclusion of all vulnerable groups.

Key to planning a targeted response is the systematic collection, disaggregation and analysis of data. This should be an element of any emergency planning, response and recovery effort and an integral part of planning at all levels, as data consistently shows that this leads to a more equitable and efficient use of resources and better respect for the rights of all populations.

In modern society, it is important to recognise the power, but also the limitations, of modern information and communication technologies. Vulnerable groups will be even more at risk if information and communication move completely online. Therefore, it is necessary to provide more communication channels through different media to reach the most vulnerable groups and provide them with information in a form that is understandable to them and meets their needs.

Disasters and crises increase the risk of abuse and violence against members of vulnerable groups. In this sense, it is necessary that this risk be recognized and it should be highlighted during emergency response planning.

It is very important that the distribution of emergency aid takes into account the specific needs of vulnerable populations as early as the planning and preparation phase, so that the aid distributed in the response phase contains items that meet their specific needs and not generic items that may not be usable in a particular situation.

COVID-19 also helped us gain an insight into how effective money is as a form of humanitarian aid in emergency situations and especially in prolonged crises. It has been shown that in crises like COVID-19, when the infrastructure in society is not compromised, humanitarian aid in the form of money actually helps different vulnerable groups meet their needs far better than it would be achieved by distributing packages. Also, people who receive money and not a package can buy what they need most themselves, and this makes the money a kind of best-suited humanitarian aid. Adjusting packages to meet the needs of very different groups would be prohibitively expensive and, in most practical situations, largely impossible. Therefore, distributing cash is significantly more economical and provides recipients with the opportunity

to use it in ways that address their most urgent needs—needs that typically cannot be met through the distribution of aid in goods. For example, this includes paying electricity bills or accessing otherwise unattainable healthcare services, as was the case for many older individuals during the COVID-19 pandemic.

Cash distribution implies savings related to packaging, transport, warehouse, distribution - all of that is not present in cash distribution, and the intact infrastructure of banks is used during the crisis. To conclude, although the distribution of cash cannot be the only and universal response to humanitarian crises, this is a type of aid that is cheap and relevant in a large number of scenarios, and since it is adapted to the individual needs of individuals, it is also adequate.

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CRIMINAL ASPECTS OF DIGITAL DEFENCE IN DISASTER RISK REDUCTION: A NEW PARADIGM OF GLOBAL SECURITY

Andreja Mihailović, PhD[1]
Teaching Associate, Faculty of Law, University of Montenegro

1 e-mail: deamihailovic@gmail.com

CRIMINAL ASPECTS OF DIGITAL DEFENCE IN DISASTER RISK REDUCTION: NEW PARADIGM OF THE GLOBAL SAFETY

Summary: This paper highlights a complex synergy between digital defence and disaster risk optimisation through a multidimensional analysis of the increasing prevalence of cyber risks, shaping the need for advanced risk management strategies in organisations and posing new criminal and geopolitical challenges. Taking into account the dynamics and complexity of cyber risks, manifested through sophisticated methods and techniques, the paper discusses in detail the implications of the European Union's regulatory and institutional framework, particularly in the context of critical infrastructure protection and the implementation of effective, adaptive and inclusive strategies at national and organisational level.

The paper examines in detail how compliance with international standards (ISO 27001), in particular the provisions of the NIS2 Directive on the security of networks and information systems, forces organisations to be proactive in the area of cyber security. It highlights the importance of preventative measures such as detailed risk analysis and regular updates to security protocols to minimise potential exposure to cyber threats, thus achieving resilience in the digital space. Particular attention will be paid to the role and contribution of the European Union Agency for Cyber Security (ENISA) in the development, coordination and implementation of cybersecurity policies, standards, practises and criminal liability in the cyber domain. It discusses how the EU, through ENISA and similar institutions, effectively coordinates cyber defence at the international level, promotes cross-sectoral cooperation between the public and private sectors and sets criminal law standards for cyber security. Particular attention is paid to the way in which optimising the risk of cyber disasters in the EU context goes beyond the traditional technical aspects and also encompasses legal, economic, social and cultural dimensions. In this context, it emphasises the need for a holistic, integrated approach involving different sectors and disciplines, focusing on the predominant risks emanating from the human factor and considering their criminal law implications.

The paper formulates recommendations for regulatory and other measures aimed at developing a cybersecurity culture, improving international cooperation and a holistic approach to cyber risk reduction, as well as the need for harmonisation with current EU legislation, policies and international standards.

***Keywords**: Digital defence, criminal law aspects, risk mitigation, cybersecurity*

INTRODUCTION

In the modern age of digital convergence and global hyperconnectivity, cyber defence has become not only a technical discipline but also a strategic imperative that is increasingly embedded in the discourse of risk management and disaster resilience concepts. Given that cyberspace is a vital component of the critical infrastructure that supports all aspects of modern society - from the economy to national security - cyber security has become a key component of national and international security, where complex hybrid forms of attack and defence take place.

Cyberattacks such as DDoS attacks, ransomware and spear phishing, attacks on control systems (ICS) in industrial facilities and energy grids are frequently the target of attacks and can often have irreversible consequences for a range of critical processes, including the compromise of critical infrastructure, economic loss and socio-political instability. These cyber risks are inherently linked to disaster risk management concepts such as risk identification, analysis, assessment and mitigation. For this reason, cyber risks pose a serious threat to modern society and have the potential to cause devastating consequences that can be measured similarly to disasters of natural or anthropogenic origin (Cassotta et al., 2019).

Cyberattacks on vital components of critical infrastructure such as energy grids, transport systems or water supplies have the potential to have serious and devastating consequences. These attacks can be carried out using various techniques, including distributed denial of service (DDoS) attacks or attacks on management and control system. The result can be power outages, traffic congestion or even water supply disruptions, which has the potential to cause massive disorganisation of society. An attack on the information systems of healthcare facilities can prevent access to vital medical data, which has serious and often irreparable consequences for patients and affects the quality and continuity of healthcare in the long term (Mahmood, 2017, Wasserman, 2021). This is underpinned by an attack on Düsseldorf University Hospital in 2020, which resulted in the death of a patient during transfer to another hospital. This is officially the first known case in which the death of a patient was directly linked to a cyberattack (Wired, 2020).

Given the complexity and interdependence of modern ICT systems, cyber risks regularly have unpredictable consequences, as an attack on one component of critical infrastructure can trigger a chain reaction that affects other sectors and systems and has similar effects to natural disasters, the actual extent of which cannot be accurately predicted (Palletti et al., 2021). This interdependence is particularly pronounced in modern energy systems, in which physical and cybernetic elements are closely linked. Attacks on software components can have a direct impact on physical processes, such as the distribution and generation of electricity. When a malware attack is carried out on a cyber-physical energy system, the consequences are not limited to the original point of attack. For example, a compromise of the control

system in a power plant can lead to overloads and outages in other parts of the grid, which can result in widespread power outages. In addition, the heterogeneity of grid structures further complicates the situation, as different parts of the energy grid may have different levels of security and resilience to attack, meaning that vulnerabilities in one segment can threaten the entire system (Shen et al., 2020). Consequently, cyber risks in the form of damage to the integrity and failure of information and communication technology systems can have profound and complex cascading effects, causing a whole spectrum of far-reaching negative impacts (Smith, 2020). Considering that telecommunication networks have become not only infrastructural pillars but also critical factors in the management and coordination of emergency situations, the disruption of these networks can have far-reaching consequences, including compromising the operational efficiency of emergency services, slowing down the response to crisis situations and disrupting access to critical information. In the context of emergency services, SMS and Cell Broadcast (CB) technologies often serve as primary channels for the dissemination of critical information. These channels are characterised by a high degree of vulnerability to cyber incidents targeting the integrity and confidentiality of the transmitted data. For example, SMS messages are vulnerable to network congestion, while CBs are more resilient to congestion but can be compromised by localised jamming attacks (Williams, 2021). In this context, the cascading effects of cyberattacks on telecommunications networks manifest as complex, interdependent phenomena that require multidisciplinary analysis and strategic remediation.

In a broader context, the cascading effects of cyber risks can affect international relations and economic stability. For example, a cyberattack on one country's power grid can have consequences for neighbouring countries and their resources that may depend on the same energy source. Cyberattacks on telecommunications networks can lead to international tensions and economic instability, especially if the attacks target critical infrastructure that is vital to regional or global stability. In addition, cyber risks have become one of the most important risks to global monetary stability, as they can spread quickly through the financial system due to the complex connections between different organisations. The compromise of a financial institution's data can lead to customer withdrawals, which in turn may cause liquidity crises and potential solvency issues, further impacting international currency and interest rates, and ultimately contributing to global economic instability. For this reason, cyber risks often have a serious economic impact, ranging from the blocking of business processes, loss of consumer confidence, theft of intellectual property or theft of sensitive financial data. The consequence is balance sheet losses and far-reaching costs to restore and protect the system, which can lead to economic disruption at a national level and even a recession. It is predicted that cybercrime will cost the global economy around $10.5 trillion annually by 2025, up from $3 trillion in 2015 (Embroker, 2023). In addition, cyberattacks compromise sensitive information, such as citizens' personal data, sensitive business information or military documents.

This can have far-reaching consequences, such as the violation of individual privacy, identity theft, destabilisation of public opinion through the spread of fake news and disinformation, which is why more and more are being brought into the context of hybrid threats and cyber warfare.

MULTIDIMENSIONALITY OF CYBER RISKS

Cyber risk is a multifaceted and complex concept that spans various disciplines and sectors, including computer science, engineering, business, law, economics and the natural sciences. Although the concept of cyber risk is widely used, there is still no universally accepted definition due to various factors, including the rapid evolution of cyber threats and technologies and the interdisciplinary nature that is constantly evolving. The multidimensional nature of this risk is illustrated by a number of key components that play a central role in understanding its profound impact through a multidisciplinary and holistic understanding of three distinct but interconnected dimensions: technical, organisational and economic (Mihailović et al. 2021). Based on such an approach, organisation can implement more efficient strategies that enable them to anticipate, detect and thereby respond effectively to cyber threats, minimise potential damage and ensure the sustainability of business operations.

The definition of cyber risks in critical infrastructures means vulnerabilities and potential threats emanating from the interconnectivity of devices, systems and networks (Genge et al., 2016). These risks are underpinned by factors such as the organisation's heavy reliance on information and communication technologies, the exposure of critical infrastructure systems to cyber threats, the need to update cyber defences by implementing cyber defence technologies in line with frameworks such as ISO 21001 and investing in human resources with the aim of a coordinated and organised response. (Maglaras et al., 2020).

The prevailing discourse is about addressing the risks to critical infrastructure, particularly with regard to the proliferation of vulnerable external devices. These devices greatly expand the potential space for cyberattacks and create fertile ground for the development of sophisticated cyber threats. Therefore, a comprehensive cyber threat assessment is an essential aspect of critical infrastructure management. Consequently, it is suggested that one of the most efficient approaches to address these challenges is to implement a strategic management model that includes defined protocols for preparedness, effective and efficient incident response, and detailed information about cyberattacks. (Bélanger, et al. 2019). It is also important to constantly monitor and update security measures in order to adapt them to the latest trends and threats in cyberspace. The implementation of such a model would significantly contribute to increasing the resilience of critical infrastructure to cyber risks, which is crucial for the integrity and functionality of these vital systems. In addition, the wider use of cloud services is associated with lower operating costs,

especially for smaller cyberattacks. This is due to the weakness and flexibility of the cloud infrastructure, which enables more efficient resource management. However, it is worth noting that with the increasing use of cloud services, the risks of "tail-end" risks increase as cloud service providers become systemically relevant and this reliance on multiple key providers can lead to a concentration of risks.

In this context, it is important to see how the Sendai Framework for Disaster Risk Reduction, adopted at the Third United Nations World Conference on Disaster Risk Reduction in Sendai, Japan, in 2015 as a global approach to risk reduction and disaster management, can be applied to cyber risks, particularly in the context of critical infrastructure protection (United Nations Office for Disaster Risk Reduction, 2015). Although the principles of the Sendai Framework are primarily focused on natural disasters, they emphasise the need for a comprehensive understanding of risks in order to develop effective strategies for their reduction and prevention. The application in cyberspace is about identifying, analysing and assessing potential cyber threats, the vulnerability of the system and the possible consequences of a cyberattack on the critical infrastructure. The Sendai Framework also promotes the involvement of all relevant actors in risk reduction processes, which is an indispensable prerequisite for systemic resilience building, and refers to the involvement of four key actors at national level - public, private and civil sectors, academia and citizens, emphasising the importance of public-private partnership. (Guitton and Fréchette, 2023).

The multidimensional and multidisciplinary characteristics of cyber risks require a highly differentiated approach when considering this concept in order to efficiently observe its deeper implications and respond to the complex challenges it presents. Strengthening the resilience of critical infrastructure through advanced cyber safety measures includes regular system updates and maintenance, security audits and capacity building for effective cyber incident response. (Mihailović, 2023). It is therefore crucial that organisations regularly identify and analyse potential cyber risks to which they are exposed in order to develop more effective strategies to reduce and manage them.

Technical dimension

Analysing the subtle technical aspects of threats, vulnerabilities and potential weaknesses of the systems is the central point of the technical dimension. In this context, the detection and neutralisation of malware is not only critical, but absolutely necessary for comprehensive analysis and efficient cyber risk management. Certain types of malware, such as ransomware, have the potential to damage the integrity, authenticity and confidentiality of sensitive data (Smith, 2020). Similarly, distributed denial of service (DDoS) is a sophisticated technical threat that aims to overload the network, often with the aim of disguising other, more subtle threat (Jones & Patel, 2019). In the face of these challenges, there is not only a need but also a compulsion for radical innovation in the field of cyber security, which primarily relates to the

implementation of advanced detection techniques and the architecture of adaptive networks.

Organisational dimension

The organisational dimension of cyber risks goes beyond the mechanism of risk management and focuses on the creation and maintenance of a security culture within organisational structures. Organizations are called upon not only to set up systems for proactive detection and rapid response to cyber threats, but also to continuously improve them. Therefore, formulating and implementing corporate cyber security policies, clearly defining employee responsibilities and promoting an inclusive security culture are not only desirable but also essential (Brown & Green, 2018).

Economic dimension

The economic dimension of cyber risk not only highlights but also analyses the profound financial impact of cyberattacks. Financial losses arising from digital risks are extremely complex, as they include indirect costs such as loss of business, reduction in market value and potential legal sanctions, in addition to the direct costs of restoring and rebuilding the system, all of which require rigorous and detailed economic analysis (Taylor & Brooks, 2021).

A HOLISTIC APPROACH

A holistic approach refers to the integration of different perspectives and the creation of a complete framework for analysing, preventing and managing cyber risks in the form of interconnected components. In a technical context, a holistic approach implies a deep understanding of technical vulnerabilities and advanced attack techniques. Attacks such as DDoS, ransomware and phishing are serious threats that can incapacitate systems, and software vulnerabilities, especially outdated operating systems, are easy prey for attackers (Forbes Technology Council, 2023). In addition, hardware failures can lead to service interruptions and data loss. Lack of redundancy and inadequate network segmentation are also key technology risks that are particularly serious as they allow attackers to spread across multiple systems within an organisation or even across multiple companies within the same industry. This requires a continuous improvement of capacities and research in the field of information systems security, as well as the development of innovative technical solutions to identify, detect and protect against threats. The organisational aspects of cyber security include analysing the organisational structure, managing risk, defining security policies and promoting a security culture among employees. This requires a partnership between management, the IT department and all employees to ensure continuous and comprehensive monitoring of data security.

The economic perspective of holism is reflected in the analysis of costs and benefits

related to cyber risks, which primarily refers to the assessment of losses and the consideration of strategies to manage cyber risks, including the use of insurance and alternatives to reduce the financial consequences. Furthermore, it is important to emphasise that uncertainties in various parameters influence cybersecurity investments (Fielder et al., 2017), indicating the need for sophisticated risk quantification models that can integrate variables such as human error and the rapidly evolving landscape of cyber risks. In this sense, social aspects in cyber security represent a critical risk factor in cyber security that has implications for risk identification and quantification of responsibility, considering that the human element has been identified as a contributing factor in over 95% of all cyber incidents. In the study by Widdowson and Goodliff (2015), the authors outline how the "Cyber Human Error Assessment Tool" (CHEAT) and Human Reliability Analysis (HRA) enable the identification of appropriate risk management and mitigation strategies based on applied knowledge of human limitations and cognitive biases to structure typical human errors in cyber security scenarios (Widdowson and Goodliff, 2015). This is highly relevant in the context of the current challenges related to social engineering, which is increasingly used in the context of cybersecurity through sophisticated manipulation tactics to obtain confidential information, often leading to unauthorised access to sensitive systems. What is special about this method is that it relies on the human tendency to trust and social interaction, rather than traditional hacking methods that require technical knowledge. In this context, the attackers use various social engineering tactics, including phishing, pretexting, baiting and tailgating, to exploit human weaknesses. This involves regularly sending fake emails that appear to come from legitimate sources with the aim of tricking users into revealing their passwords or other sensitive information. These methods are particularly dangerous due to their highly customisable nature, as they can be easily adapted to target groups - specific individuals or organisations, making them highly effective in compromising cyber security.

Dealing with complex challenges such as social engineering requires a comprehensive approach that includes both technical security measures and user education and awareness. Organizations should implement strict policies and procedures for identity and access management and organise ongoing training for their employees to familiarise them with the advanced tactics of cyber attackers and how to protect themselves. It is also important to establish a culture of cyber security within the organisation where employees feel responsible for reporting suspicious activity. Technological solutions, such as advanced email filtering systems and constantly updated security protocols, also play an important role in protecting against these sophisticated attacks. Through a combination of education, campaigns to raise awareness of potential risks and technological solutions, it is possible to significantly reduce the risk of cyberattacks through social engineering.

Properly integrated protection measures, monitoring, training and response will

be necessary to reduce cyber risks and ensure the integrity of information and communication technology systems. Multidisciplinary and cross-sector integration and polyvalent analysis of all these aspects of cyber risk are crucial to ensure a comprehensive and effective cyber risk management strategy. By taking a holistic approach, organisations are better prepared to address cyber risks, mitigate their impact and maintain security and stability in an ever-evolving digital world.

EU CHALLENGES AND PERSPECTIVES

In an era of accelerated digital convergence, key national infrastructures such as energy grids, transport corridors and telecommunication systems are becoming epicentres of potential cyber risks (Johnson & Turner, 2022). These infrastructural points, once characterised by their autonomy and primarily protected by physical barriers, are now often networked into globalised information ecosystems, exponentially increasing their vulnerability to the advanced tactics of cyber attackers (Williams, 2021). The European Union faces numerous challenges in the area of cyber security. These include rapid technological change, sophisticated cyberattacks and the need for coordination between different actors and sectors. In addition, the challenge is to achieve a balance between security and the protection of privacy and fundamental rights of citizens, which require constant attention and adaptation to ensure effective cyber defence and protection in a dynamic digital environment. Given these interdisciplinary and cross-sectoral challenges, the protection of critical national infrastructures has become not only a national priority but a global strategic imperative. Recognising this critical need, the EU has launched a series of proactive measures and strategies aimed at comprehensively protecting its citizens, businesses and vital operating systems from incidents in cyberspace (EU Cyber Security Strategy, 2019).

First and foremost, the EU has formulated the need to create strict cyber security standards and protocols that apply universally to all members of the Union (Thompson & Ivanov, 2021). These standards should ensure homogeneity and synergy in protection methods and enable effective identification, intervention and resolution of cyber incidents.

The Electronic Identification, Authentication and Services Directive (eIDAS), adopted in 2014, is a key instrument of the European Union to regulate electronic identifications and transactions, which are crucial for the digital economy and e-commerce in the EU (European Commission, 2023). eIDAS establishes uniform standards for electronic signatures, electronic seals, time stamps, electronic documents, electronic delivery services and electronic authentication services, thus contributing to the integrity and reliability of digital transactions. This Directive is essential for the management of digital identities and transactions, which is crucial for security and efficiency in the digital space.

The General Data Protection Regulation (GDPR), which came into force in 2018, plays a key role in protecting personal data within the EU by imposing precise data protection requirements and obliging organisations to implement appropriate technical and organisational measures to protect data from unauthorised access and cyberattacks. This Regulation also introduces significant penalties for non-compliance, encouraging organisations to take their obligations seriously and take proactive steps to protect personal data (European Commission, 2018). This includes risk assessment by identifying potential cyber threats and vulnerabilities in their information systems, evaluating technical efficiency and the obligation to regularly update databases. One of the most important aspects in this part is the obligation to report cyber incidents, as in the event of a data breach, organisations are obliged to inform the relevant regulatory authorities and, in certain circumstances, the data subjects themselves. This transparency in dealing with incidents helps to increase consumer confidence and ensures that cyber incidents are dealt with quickly and efficiently. With the introduction of the GDPR, the EU has set high standards for the protection of individuals' right to privacy. At the same time, it has a major impact on the protection of critical infrastructure, especially in sectors where large amounts of personal data are processed, such as healthcare, financial services and public administration.

The Directive on the security of network and information systems (NIS), adopted in 2016, was the first important step towards creating a harmonised legal framework for cyber security at European Union level (ENISA, 2023). As the first horizontal instrument of the EU internal market, the NIS Directive aimed to improve the resilience of the Union's network and information systems to cyber risks while ensuring the smooth exchange of information and best practises between Member States. It requires Member States to develop and implement national cyber security strategies, set up specialised computer security incident response teams (CSIRTs) and ensure a high level of protection for networks and information systems that are important to the public and private sectors.

However, despite considerable results in the field of information security, the NIS Directive quickly showed certain limitations, especially in the face of rapid digital change, exacerbated by the crisis triggered by the COVID-19 pandemic, which broadened the range of threats and challenges to critical infrastructure protection and required adapted and innovative responses. For this reason, a revision was made in the form of the NIS2 Directive, which expands the scope of the previous directive, sets minimum standards for cyber risk management and introduces stricter mandatory measures that organisations must implement to strengthen the protection mechanisms for critical information and communication technologies. The application of NIS2 is scheduled to begin in October 2024. It includes new sectors such as telecommunications, postal services, social media platforms and public administration. It also introduces the categorisation of topics into "important"

and "significant", with particular attention to their size and importance within their respective sectors. Organisations that fall within these sectors must conduct regular security risk assessments and report serious incidents to the relevant authorities. Key issues include sectors such as energy, transport, banking, financial market infrastructure, healthcare, drinking water and wastewater, digital infrastructure, public administration and space. Important facilities also include sectors such as postal and courier services, waste management, chemical production and distribution, and food production, processing and distribution. In addition, the NIS2 also covers providers of critical digital services that have access to vital infrastructure, such as the internet and cloud services, which must also fulfil security and reporting requirements. The Directive itself does not provide for criminal liability, but focuses on administrative sanctions and fines. For example, the NIS2 provides for significant penalties for organisations that do not comply with its requirements, including fines that can amount to up to €10 million or 2% of the organisation's total annual global turnover. (European Commission, 2023). However, in some cases, particularly in situations where non-compliance with the NIS2 Directive leads to serious cyber incidents or significant damage, national laws may provide for criminal liability. This could include situations where non-compliance with the Directive has led to serious privacy violations, financial losses or other significant consequences.

With the introduction of the NIS2 Directive, the EU continues to demonstrate its commitment to strengthening cyber security and adapting to the new challenges of the digital age. This directive not only broadens the scope of the previous one and strengthens security standards, but also encourages organisations to be more proactive in managing risk and aligning with modern standards, thus contributing to strengthening the overall security and stability of the digital space within the EU. In terms of standardisation, ISO/IEC 27001 is an internationally recognised standard that provides a framework for Information Security Management Systems (ISMS) in organisations of all sizes and industries. Developed by the International Organisation for Standardisation, this standard provides a framework for organisations to establish, implement, maintain and continuously protect their information assets through a systematic approach to managing sensitive data to ensure its confidentiality, integrity and availability. The standard is an important tool for organisations to ensure and demonstrate compliance with new requirements. It helps them to identify, assess and manage cyber risks. With its implementation, organisations can achieve significant benefits in terms of maintaining business continuity, which is crucial for maintaining a high level of cyber resilience and protecting critical infrastructure, and credibly communicate to customers and partners that the company is committed to maintaining information security.

In addition, the EU has emphasised the importance of cross-border cooperation and partnership in the defence against cyber risks (Lopez & Fernandez, 2020). Through a series of bilateral and multilateral initiatives, the EU seeks to strengthen cyber

security capabilities and transparent information sharing with global partners and relevant international organisations. The EU's institutional framework for cyber security is a complex and dynamic system that is constantly evolving to meet the growing challenges of the digital world. While ENISA, ISACs, ECSO and CSIRT/CERT play a key role in this framework, the continuous development, coordination and cooperation between these entities is essential for effective EU cyber defence given the rapid changes in the technological landscape.

The European Union Agency for Cyber Security (ENISA), established in 2004, is an important pillar of the European Union's institutional framework for cyber security. As the central entity in this area, ENISA provides Member States, companies and EU institutions with the necessary support in developing and implementing measures to reduce cyber risks and for prevention. It also plays a key role in creating a cyber security certification framework, promoting best practises and coordinating responses to cross-border cyberattacks. Its role is particularly emphasised by the EU Cyber Security Act, which has expanded its mandate with the aim of strengthening trust in digital products, services and processes and thus contributing to greater security in the EU's digital single market in cyberspace.

Cyber security incident response team (CSIRTs/CERTs) are indispensable components of the operational response to cyber incidents within the EU (CSIRTs Network, 2023). They provide key services such as monitoring, early warning, incident response and cyber risk analyses, thus contributing to a fast and effective response to cyber incidents. Information Sharing and Analysis Centres (ISACs) are also key elements in the EU's cyber security ecosystem, enabling the exchange of threat intelligence and best practises between the public and private sectors. They play an important role in strengthening cyber resilience, especially in critical infrastructure sectors such as energy. Similarly, the European Cyber Security Organisation (ECSO) acts as a public-private partnership that brings together key players from the cyber security industry. ESCO plays an important role in the development of strategic initiatives and programmes such as Horizon Europe, which funds research and innovation in the field of cybersecurity.

However, despite these advanced mechanisms, the EU continues to face a number of cyber security challenges, including rapid technological change, sophisticated cyberattacks and the need for coordination between different actors and sectors (Reynolds & Smith, 2021). Future prospects include strengthening cooperation and coordination between different institutions and sectors and developing common standards and protocols for cyber security. In addition, continuous investment in research and development and capacity building is required, particularly in the area of shortage occupations. In view of the rapid development of technology and cyber threats, legislation needs to be continuously updated and adapted. This applies in particular to criminal law aspects, where it is necessary to establish clear standards and sanctions for cybercrimes and international legal cooperation in their prosecution.

The development of effective legal instruments to combat cybercrime, including international agreements and conventions, are key to creating a global environment in which cyber threats are adequately addressed and perpetrators are legally penalised. In this context, the harmonisation and implementation of the Council of Europe Convention on Cyber Crime (known as the Budapest Convention), the first international agreement to combat cybercrime, including offences committed via the Internet, is essential (Council of Europe, 2001). This Convention provides a framework for legal co-operation between member states, including extradition, mutual legal assistance and other forms of international police co-operation. Finally, education and awareness-raising on the criminal law aspects of cyber security are essential. This includes continuously informing the public about the risks and consequences of cybercrime and the legal measures available to protect them, which not only has an impact on the prevention of cybercrime, but also strengthens public confidence in the institutional capacity of the state to ensure security in the digital world.

NATO CAPACITY BUILDING FOR CYBER DEFENCE

Against the backdrop of the accelerated spread of cyber risks, cyber defence has become a key component of military and security strategies in recent decades. The international community understood relatively early on the importance of treating cyber space as an operational domain in its own right, and the cyber incidents in Estonia in April and May 2007 were a major contributing factor. This influence encouraged NATO to intensify its efforts in the area of cyber security, with a particular focus on protecting communications and information systems from unauthorised access and attacks. In addition, the Alliance increased its support for individual member states' initiatives to improve their information infrastructure. At the Lisbon Summit in 2010, cyber defence was identified as a key challenge, with a focus on protecting NATO's information and communication systems. This commitment was further reaffirmed at the 2016 Warsaw Summit when cyber space was defined as a fourth operational domain, enabling the activation of Article 5 of NATO's founding treaty in the event of "aggressive behaviour in cyber space", allowing for effective defence analogous to operations in the air, on land and at sea. (NATO, 2023). This implies the right of states to take "countermeasures", including physical actions to block or deny access, to de-escalate illegal situations.

In the context of cyber defence, this military-political alliance is continuously developing guidelines and rules aimed at protecting digital resources and infrastructures, which is crucial for maintaining international stability and security. NATO's Cyber Defence Policy defines as a fundamental policy the Alliance's approach to protecting its cyber systems and supporting members in strengthening their cyber capabilities. In addition, the Cyber Defence Pledge adopted in 2016 commits members to improving their national cyber defence capabilities. (US

Department of State, 2022). These initiatives were later complemented by the Enhanced Cyber Defence Policy, which further emphasises the importance of cooperation, information sharing and alignment with international norms. The implementation of these policies includes the development and implementation of specific action plans such as the NATO Cyber Defence Action Plan, which defines the objectives and measures necessary to improve cyber defence within the Alliance. A Cyber Resilience Action Plan (CRP) has also been developed to strengthen the ability to respond to cyberattacks, including setting common cyber standards and improving cooperation between members.

In addition to internal efforts, NATO is actively working to build partnerships with non-NATO countries and international organisations to improve global cyber security. This cooperation is crucial for sharing knowledge and experience and strengthening the international cyber defence network. In this context, the NATO Cooperative Cyber Defence Centre of Excellence, based in Tallinn, Estonia, serves as a leading resource for cyber defence research, training and exercises (CCDCOE, 2023).

However, despite numerous efforts, asymmetric threats such as hacker attacks and cyber espionage pose a constant challenge that requires constant adaptation and innovation of cyber defence strategies. Rapid technological developments, including artificial intelligence (AI) and quantum computing, also pose new challenges for the protection of cyber space. In addition, strengthening international cyber diplomacy through the development of international norms is crucial for an effective defence against cyber threats.

Therefore, Alliance members rely on complex and sustainable cyber defence mechanisms to achieve strategic objectives in the areas of collective defence, crisis management and security cooperation. NATO is continuously enhancing its capabilities for the defence of its information systems and operations in the face of increasingly sophisticated cyber threats. It is endeavouring to protect networks in order to achieve the primary goal of strengthening the cyber resilience of all member states. A key aspect of this approach is to strengthen cyber defence capabilities through education and training. This is in line with EU strategies that promote cyber security education as a key element of capacity building.

CONCLUSION

Considering that cyber space has become a key area for economic, political and military activities in the modern world, it is obvious that cyber risks can lead to geopolitical tensions, as countries may take unilateral measures to protect their national interests, which may include military interventions or economic sanctions. Given these geopolitical implications, it is necessary to take comprehensive measures to mitigate the risks of these risks. They are multidimensional and therefore require a coordinated approach on several levels - from the technological to the legal to the geopolitical level - in order to minimise the potential damage. This includes not only the technical aspects of cyber security, but also the development of international standards and protocols that will govern behaviour in cyber space as a new paradigm of global security in optimising disaster risk.

It is also crucial to develop mechanisms for international co-operation on cyber security, including information sharing and coordination of responses to cyberattacks. The EU has recognised and articulated the need to protect its critical national infrastructures as cyber risks change and adapt in their sophisticated character. Through holistic strategies, interdisciplinary initiatives and international cooperation, the EU is actively committed to creating a resilient and protected digital space for all its stakeholders. Consequently, the EU cyber security regulatory framework is a key element in protecting the digital space and infrastructure in the Union. While the GDPR, the NIS2 Directive, the EU Cyber Security Act and the EU Cyber Security Strategy form the foundation of this framework, continuous development and adaptation is necessary to effectively address the dynamic cyber environment. It is also necessary to strengthen cooperation between the public and private sectors and to develop common standards and protocols for cybersecurity at international level.

At an internal level, it is essential to develop a strategic approach to developing a security culture in relation to cyber risks, raising awareness among all stakeholders in the organisation and continuously conducting training to build organisational resilience to cyber threats.

Future prospects include continuously updating and adapting the legal framework to respond to new cyber threats and technological innovations. This also includes criminal law aspects, where it is necessary to establish clear standards and sanctions for cybercrimes and international legal cooperation in their prosecution. The development of effective legal instruments to combat cybercrime, including international agreements and conventions, are key to creating a global environment in which cyber threats are adequately addressed and perpetrators are legally penalised. In this sense, multidisciplinary and cross-sectoral integration and a polyvalent analysis of all these aspects of cyber risk are crucial to develop a comprehensive, sustainable and effective strategy to optimise them and maintain security in a constantly evolving digital world.

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THE ECONOMY RESILIENT TO DISASTERS

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RESILIENCE IN THE CONTEXT OF A DISASTER: FINANCIAL STRATEGIES FOR COPING WITH DISASTERS

Elona Pojani PhD[1]
Associate Professor, University of Tirana

1 e-mail: elonapojani@feut.edu.al

RESILIENCE IN THE CONTEXT OF A DISASTERS: FINANCIAL STRATEGIES FOR COPING WITH DISASTERS

Summary: This paper emphasises the profound impact of disasters on the economic performance of developing countries and the well-being of underprivileged people worldwide. With economic development and increasing investment, the frequency of extreme weather events is rising, leading to an increase in the costs of disaster. An accurate assessment of these costs is vital for the development of effective financial resilience strategies. The paper provides an analysis of the impacts of disasters and their relationship to development, looking at both the macro and micro levels, including the role of government and individual experiences. It also addresses the important issue of financial resilience and its relationship to disaster risk. In the context of Albania, a country vulnerable to natural disasters and climate change, findings are highly relevant. The paper contributes to a comprehensive understanding of disaster management and resilience strategies at national and individual level in Albania, supporting preparedness and informed decision-making.

Keywords: *disasters, resilience, financial strategies, Albania*

INTRODUCTION

Disasters have a significant impact on life, economic prosperity, and the state of the environment and its services in the affected areas or nations. The impact is primarily due to the growing population and assets that are vulnerable to harmful natural occurrences. This pattern is expected to worsen with urbanisation, environmental degradation, and the expected increase in the quantity and severity of hydrometeorological events due to climate change. (Ghesquiere and Mahul, 2010). I It is recognised that disasters can have far-reaching consequences, not only damaging and destroying people, structures, and infrastructure, but also disrupting economic operations, potentially leading to global impact. These effects can be long-lasting, and, in some cases, permanently change economic and social conditions, as well as the environment.

As countries grapple with increasingly frequent and severe disasters while facing financial constraints, the development of disaster risk management strategies has become a critical imperative. These strategies are crucial to strengthening society's resilience to disasters and mitigating their lasting social and economic consequences. For the effective implementation of an efficient disaster risk management strategy, a comprehensive understanding of the impact of disasters in all their facets is crucial. Furthermore, the success of a strategy depends on how society understands and accepts the strategy. This in turn is closely link to the interrelated issues of risk communication and risk perspective.

This paper will give an overview of disaster impacts. The first part of the paper will

focus on the relationship between disasters risk and economic development. This will be followed by a short overview of financial resilience, which is used to manage such risk. Finally, financial resilience is discussed in the Albanian context, focusing on the response to climate change at three levels: the international, the national and the individual level.

DISASTER AND DEVELOPMENT

Around the world, there are recognisable differences in the patterns of natural and man-made disasters: Natural and technological disasters occur more frequently compared to financial crises and violence-related disasters, as measured by average annual frequency per country. (Sawada and Takasaki, 2017). The discussion about disasters and their global impact emphasises the crucial role of climate change. Climate change affects disaster risk in two ways: short-term climate fluctuations and extremes influence the frequency and intensity of shocks experienced by societies, while long-term climate change can alter the basis of the economy, particularly in regions dependent on natural resources. Human activities, especially in developed countries, have exacerbated climate variability and imposed environmental costs on developing and poorer countries. Scientists emphasise the urgent need for climate action to prevent irreversible environmental damage for future generations.

Researchers have long observed the relationship between disasters and economic development. Disasters impact macroeconomic indicators in each country where they occur, and no obvious link has been found between economic development and exposure to natural hazards (Stromberg, 2007). Many studies have shown that while the absolute economic losses are concentrated in high-income countries, the human costs of disasters are predominantly incurred in low- and middle-income countries. This burden is expected to increase, especially under the conditions of a changing climate, which, as already shown, increases the frequency and severity of extreme weather events (see for example Sawada and Takasaki, 2017; Winsemius et al 2018; Hallegatte et al 2020; Gurenko and Lester, 2004). This is due to many factors, including infrastructure conditions, lower building standards, lack of or inadequate mitigation incentives, and underdevelopment of private markets that do not provide disaster insurance for homeowners and small businesses and the greater restriction of government resources available to deal with disasters. Although capital losses may be smaller in absolute terms compared to those in developed countries, their relative weight and overall impact is usually very large and even affects sustainability (Ghesquiere and Mahul, 2010.).

Of the 40 worst disasters in terms of the number of victims in the period 1970-2001, 39 occurred in developing countries (Gurenko and Lester, 2004). According to a 2013 study, disaster losses in developing countries totalled $862 billion, which is considered an underestimate (Kellett and Caravani, 2013). The United Nations

Development Programme (UNDP) has calculated that although e only 11% of people exposed to droughts, earthquakes, floods and windstorms live in countries with a low level of development, these countries account for 53% of the people who lose their lives (UNDP, 2004). These devastating events affect millions of people around the world, killing and injuring and destroying homes and livelihoods. Moreover, inequality is even greater than the available loss data suggests with low-income countries underreporting (CRED and UNISDR, 2018). While high-income countries reported losses from 53% of disasters between 1998 and 2017, low-income countries reported losses from only 13% of disasters. Loss data is therefore not available for almost 87% of disasters in low-income countries.

Developing countries face further limitations when trying to develop disaster risk management strategies that would change the impact of disasters. This is because of the mentality that prevails in these countries. These include the mentality of governments, which often develop short-term strategies to suit the election cycle, the mentality of the private sector, which focuses its activity on short-term profit considering the damage to the environment and infrastructure, and the mentality of the population, which does not consider insurance as a risk protection technique (Lester, 2000; Gurenko and Lester, 2004; ECLAC, 2003).

RESILIENCE IN CASE OF DISASTERS

Disaster resilience encompasses three key dimensions that are interconnected and critical to withstanding and recovering from various challenges, shocks or disasters (Zobel and Baghersad, 2020). Physical resilience can reduce the severity of damage and, thus the financial burden of recovery. Social resilience can strengthen community cohesion, which is essential for collective recovery efforts and can indirectly contribute to financial resilience (Cinner and Barnes, 2019). Economic resilience, in turn, provides the necessary resources to enhance physical and social resilience (Cardona et al, 2008). These three dimensions are interrelated. Together, these dimensions create a comprehensive framework for building resilience at different levels, be it at the individual, community, organisational, or national level. Developing and strengthening all three dimensions is essential to effectively cope with and recover from a wide range of challenges and adversities.

Basically, it is the public sector that is most affected by disasters (Aakre et al, 2010). This is partly due to the increase in public expenditure, as resources are allocated to dealing with the consequences of these hazards, and partly due to the decrease in revenue, as economic disruption and damage to infrastructure can reduce tax revenues. Demographic change, influenced by these risks may affect public sector responsibilities and resource allocation. Interrelated risks may also arise, further complicating the management of these hazards. Finally, contingent liabilities may arise if the public sector assumes responsibility for managing the consequences of

these hazards, which may result in long-term financial commitments (Cebotari, 2008; Hochrainer, 2006).

The economic impact of a disaster is usually divided into three categories: direct, indirect, and macroeconomic impact (often also called secondary impact). Direct economic damages damage is usually the immediate damage or destruction of assets or "stocks" that can attribute to to the event *per se*. A smaller proportion of this damage results from the loss of already produced goods. The direct damage to stocks has an indirect impact on the "flow" of goods and services, i.e., indirect economic losses occur as a result of the physical destruction affecting households and businesses (Menchler, 2005; Hochrainer 2006; ECLAC 2003).

Dealing with the impacts of disasters require the development of a risk management strategy that involves not only the public sector, but also all other stakeholders affected by a disaster event. Any population exposed to natural hazard must be optimally informed about the risk characteristics, preventive measures and appropriate behaviour in emergencies. Authorities have a duty to prepare adequate planning, prepare coping strategies, and effectively communicate information to residents, people at workplace, and communities as a whole. A better response to natural disasters requires the active participation of residents, who should be informed and educated about the hazards they are exposed to (Miceli et al, 2008). In other cases, public discussion, stakeholder participation and perhaps joint conflict resolution are required (Renn, 2008). All these situations involve social processes that are commonly summarised under the term "risk communication" (Rohrmann, 2000). Risk communication is seen as a necessary link between risk perception and risk management. Communication programmes should be based on a sound understanding of the social psychology and risk perception of the individual (Morgan et al, 2001). The process is particularly important in developing countries (Pojani & Hudhra, 2018; Grabova & Pojani, 2021; Fakaj & Pojani, 2022).

The development of a risk management strategy depends largely on conditioned by the (internal and external) resources available to deal with the event. Financial strategies for disaster risk management are designed to ensure that individuals, businesses and governments have the necessary resources to deal with adverse financial and economic consequences of disasters, enabling critical funding for disaster relief, recovery and reconstruction. After a disaster, countries generally have access to various sources of funding. These sources can be divided into ex-post and ex-ante financing instruments. Ex-post instruments are sources that do not require advance planning. These include budget reallocations, domestic credits, external loans, tax increases, and donor assistance. The public sector often relies on such ex post funding, where international assistance has been particularly important. This is particularly true for developing countries (Linnerooth-Bayer and Hochrainer-Stigler, 2015). Although donors and international development bank funding can be an important component of government disaster risk management strategy, over-reliance on this

approach has often resulted in countries lacking economic incentives to proactively manage disaster risk (Gurenko and Lester 2004). In addition, international ex post assistance can be inadequate in some cases as it is often provided in kind, which has several disadvantages (Keipi and Tyson 2002).

The predominant instrument for financing market risks is risk transfer by insurance and reinsurance (Mechler, 2005). According to Linnerooth-Bayer and Mechler (2008), insurance and other risk-transfer instruments are justified by the concept of risk aversion. In addition to reducing direct and indirect losses, insurance provides economic security. For businesses, insurance means that risks are removed from balance sheets, which means that higher-profit and higher-risk activities can be undertaken. For governments, insurance ensures timely assistance and recovery, which can attract more investment to the country (Mechler, 2003). However, according to Hochrainer (2006), there are several problems on the supply and demand side of the insurance market. The low insurance density in developing countries is not surprising.

On the demand side, commercial insurance is not affordable for low-income households and is associated with high opportunity costs. Many low-income countries are highly exposed to the risk of natural disasters, so even fair premiums would be quite high. As a consequence, residents of such countries are unable to pay the price for such risk transfers and are therefore dependent on support from the risk-free communities or international support.

On the supply side, insurers are reluctant to promote coverage due to, among other things, inherent problems of insurability of disaster risks, the lack of formal property titles of businesses and individuals in developing countries without which no formal proof of ownership can be provided and therefore no premium calculations can be made, high transaction costs, unstable business environments and inadequate risk assessment and mitigation. As a result, households in developing countries generally do not rely on insurance, but on family and public support. In addition, they use traditional coping mechanisms to protect themselves from the economic impact of natural disasters: diversification of crops and livelihoods, different sources of income, remittances from family members living abroad or spatial distribution of family members (Hochrainer, 2006; Linnerooth-Bayer and Hochrainer-Stigler, 2015).

Given the limited scope of formal insurance coverage for natural disaster loss, particularly in developing countries, informal insurance mechanisms naturally play an important role as safety net for the impoverished, alongside public disaster risk management initiatives (Sawada and Takasaki, 2017). Various disaster insurance schemes are in place in different countries to address the challenges of adverse selection and moral hazard. For example, Turkey's mandatory earthquake insurance scheme, the Turkish Catastrophe Insurance Pool (TCIP), help to mitigate adverse selection. In Thailand, following a devastating flood in 2011, the National Disaster

Insurance Fund was introduced to provide indemnity-based policies to cover damage from floods, earthquakes, and windstorms, even though viability has yet to be assessed. In addition to traditional insurance methods, there is growing interest in index insurance schemes, which are designed to cover specific events such as droughts or floods and are organised at a regional basis. These index insurance contracts have potential advantages, as they are immune to adverse selection and moral hazard issues, making them a cost-effective alternative.

In addition to traditional insurance and reinsurance, there is growing interest in other alternative risk transfer instruments, e.g., catastrophe bonds and weather derivatives. Weather derivatives are index-based, e.g., physical indicators such as rainfall measured at a specific location are used to define triggering events. Weather derivatives and index-based insurance are now seen as promising risk transfer instruments for the developing and emerging economy countries, especially in the agriculture sector (World Bank, 2005). Disaster bonds have emerged as instruments primarily for reinsurers; however, in some countries (e.g., Mexico) there are government efforts to transfer their risk with this instrument (Hochrainer, 2006).

Intertemporal risk spreading is another approach for risk management. At the household level, risk can be spread over time through form of savings. At national level, governments can set up disaster reserve funds, which are usually financed by taxes and are only emptied in the event of a disaster. Contingent loan makes it possible to borrow money after an event, whereby the annuity payments after the event are lower compared to a regular loan. Borrowing is also a form of inter-temporal risk spreading of losses, as the payment will only be made in the future. As one can see, a contingent loan is a mixture of saving and borrowing (Hochrainer, 2006).

As the frequency of disaster events is expected to increase with the growing risk of climate change, businesses, infrastructure, assets and economies will be exposed to even greater disaster risks. The inexorable increase in disaster losses over the past 50 years underscores the fact that *ad hoc measures* may no longer be enough. The rising frequency of natural disasters and the costs they cause require more action to reduce disaster risk. A more proactive approach is urgently needed starting with a better understanding of the sources of risk, the systematic consideration of risks in development planning, and the development of financial protection mechanisms. Understanding how to involve the private sector in responding to these risks – or encouraging the sector to take advantage of the new business opportunities that may arise from changing climatic conditions – is crucial to encourage greater investment in activities that increase the resilience of countries, businesses, and communities. Interestingly, public policies for disaster risk management often do not include climate action (Schipper and Pelling, 2006). This separation is due to the different focus and timeframe of each agenda. Climate change policy primarily addresses climate-related hazards, while disaster risk reduction emphasises immediate, localised impacts. In addition, climate change adaptation takes a longer-term perspective, often at a global

level, whereas disaster risk reduction focuses on local and national level.

Finally, when considering disaster risk financing instruments, it is important to consider the cost of capital, timeliness, discipline in the use of funds, ownership of risk and the ability to provide accurate risk information. Together, these factors determine the effectiveness and suitability of a particular instrument for managing and mitigating the financial impact of disasters, and play a critical role in strengthening the resilience of communities and governments in the face of various disaster scenarios (Ghesquiere, 2012).

ALBANIA AND DISASTER RISK

Albania is affected by a number of natural disasters. The greatest risks in Albania are earthquakes and severe widespread river flooding. In addition to these risks, the typical risk throughout Albania is that of smaller disasters related to floods, landslides and extreme weather events. The vulnerability of the Albanian population to disasters is associated with poverty, poor infrastructure and communication, a construction boom and a variety of man-made environmental factors, from rapid deforestation to poor watershed management and environmental pollution (GoA, 2023). Other challenges include both man-made and natural soil erosion, inadequately regulated coastal development, tenure insecurity and water pollution, which is exacerbated by low public awareness of climate change. The vulnerability of Albania's energy supply and agricultural sector to climate change, combined with a series of recent severe floods and landslides, make climate change preparedness a priority in Albania's development planning (Resource Environmental Centre, 2022). Indeed, Albania has experienced many floods in the last century. Especially, the western lowlands seem to be more affected. According to the registered and published data of the Disaster Information Management System (DesInventar), there were 504 registered cases of flooding in the five regions of the western lowland during the period 1900-2018, whit 65 cases of flooding in the Tirana region, 77 cases of flooding in the Durres region, 133 cases of flooding in the Lezha region, 183 cases of flooding in the Shkodër region and 46 cases of flooding in the Vlora region. The floods from November 1962 to January 1963 were the most severe in terms of the area flooded, the duration and the damage caused (Bogdani, 2009). It is assumed that the sea level rise and weather scenarios increase the risk of flooding, especially for those living in coastal areas.

Focusing on more recent disaster related events, in 2019, Albania was hit by a severe earthquake with a magnitude of 6.4, affecting more than 200,000 people in 11 municipalities, including major cities such as Tirana and Durrës. The earthquake had a significant economic impact. The Post-Disaster Needs Assessment (PDNA) conducted in the aftermath of the disaster found that the earthquake caused damage amounting to 6.4 per cent of the country's gross domestic product (GDP) in 2018, in addition to losses of a further1.1 per cent (GoA et al., 2020). The housing sector

suffered the most damage, while the production sector suffered the highest losses.

In response to this crisis, the Government of Albania (GoA) has taken considerable financial burdens. This earthquake, combined with the subsequent challenges posed by the COVID-19 pandemic, posed a severe threat to the country's economic stability. It is estimated that the cumulative effect of these disasters could, at best, set poverty back by eight years.

In light of these challenges, the Albanian government has taken several initiatives to improve its financial preparedness for future disasters:

- Development of a comprehensive Disaster Risk Financing Strategy and Contingency Plan: The Government is working on formulating a comprehensive strategy and plan that will addresses the financial aspects of disaster risk management. This plan should ensure that the country has adequate financial resources to respond effectively to natural disasters.
- Improved Understanding of Risk: Understanding the nature and extent of disaster risk is a prerequisite for preparedness. Albania is working to improve its capacity to assess and understand these risks, which will enable better planning and decision-making.
- Optimising the Use of Public Funds: The introduction of new risk financing instruments aims to optimise the allocation and use of public funds for disaster response and recovery. These instruments can help to ensure that financial resources are available when they are most urgently needed.
- Strengthening Infrastructure and Social Protection Systems: To reduce the impact of disaster, it is essential to make infrastructure and social protection systems more resilient and able to respond to shocks. Albania is focussing on strengthening these systems to improve their ability to respond to shocks.
- Introducing Risk Transfer Instruments: Risk transfer mechanisms such as insurance and reinsurance can be valuable tools to share the financial burden of disasters. The introduction of such instruments can help the government to mitigate the direct financial impact of future disasters.

In summary, Albania's experience with the 2019 earthquake and the subsequent challenges posed by the COVID-19 pandemic have underlined the importance of financial preparedness for disaster management. The Government's proactive steps, including developing a comprehensive strategy, improving risk understanding, optimising budget allocation, strengthening infrastructure and social protection and introducing risk transfer instruments, aim to improve the country's resilience and its ability to respond effectively to future natural disasters.

CONCLUSIONS

This paper offered a discussion on disaster risk and development. Firstly, a general overview of the impact of disasters on both developed and developing countries was presented. This part emphasised that while disaster can occur in any country, their impact on economic development is much more severe in developing countries. Several reasons for this were discussed. A theoretical overview of the macroeconomic risk of natural disasters and some approaches and instruments to finance the risk of these disasters were presented. It then discussed resilience and the options for achieving this resilience at both government, municipal and household level. These options have been categorised based on their approach, timeframe and nature.

In conclusion, this study provided a theoretical argument for building resilience to disasters. Several key points need to be taken considered:

Integrating Disaster Risk into Financial Planning: To build resilience, it is imperative that disaster risk considerations are incorporated into medium to long-term financial planning. This means factoring in the potential financial impact of disasters and allocating resources accordingly. In this way, governments and organisations can be better prepared to deal with the economic consequences of disasters.

Implementing Disaster Financing Strategies: Developing and implementing a disaster financing strategy is essential. This includes the provision of funds or the establishing of mechanisms to quickly access financial resources in the event of a disaster. These funds can be used for emergency response, recovery, and reconstruction to ensure that financial constraints do not hinder the response to disasters.

Managing Uncertainty: Disaster-related expenditure is often associated with uncertainty in terms of timing and scale. Strategies to build resilience should include mechanisms to manage effectively this uncertainty. This may include the establishment of contingency funds, insurance mechanisms or risk-sharing arrangements to mitigate the financial risks associated with unforeseen disasters.

In summary, building resilience to disasters requires a comprehensive approach that incorporates disaster risk into financial planning, establishes financing strategies, minimises opportunity costs, and effectively manages the uncertainties associated with disaster-related expenditure. These measures contribute to better preparedness and a more effective response when a disaster strikes.

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EFFICIENT RECOVERY AFTER NATURAL OR OTHER DISASTERS: THE USE OF DISASTER RISK FINANCING INSTRUMENTS - CASE STUDY OF SERBIA

MSc Sandra Nedeljković, PhD candidate[1]
Faculty of Technical Sciences, University of Novi Sad, Disaster Risk Management Specialist, Ministry of Construction, Transport and Infrastructure of the Republic of Serbia, Local Infrastructure and Institutional Development Project

1 e-mail: sandra.nedeljkovic@mgsi.gov.rs

EFFICIENT RECOVERY AFTER NATURAL OR OTHER DISASTERS: THE USE OF DISASTER RISK FINANCING INSTRUMENTS - CASE STUDY OF SERBIA

Summary: High intensity natural disasters and climate change pose a severe risk to sustainable development. Disasters have a significant impact on the public budget and the ability to recovery in a short period of time. To recover from natural or other hazard it is important that governments or individuals have sufficient financial resources to quickly return to normal operations. In order to adequately prepare for disasters, in addition to the preventive measures that are applied before the event, it is also necessary to prepare liquidity and preparedness to financially respond to the challenges of disasters. The use of various financial instruments can ensure that countries exposed to a high risk of certain hazards are also financially resilient to disasters. This paper outlines the options for governments to prepare financially for the impending disasters. It also reflects on how the Republic of Serbia recovered in a short time with various financial instruments in 2014, when the large floods, defined as hundred-year floods, affected it.

Keywords: *disaster risk financing, recovery after natural or other disaster, floods, damage and loss assessment, resilience*

INTRODUCTION

Natural disasters of high intensity have a significant impact on national budget and the ability to recover in a short period of time and return to normal flows. In the United Nations documents, we find explanations of basic terms such as sensitivity/vulnerability, hazard/dangers, risks. Sensitivity/vulnerability is defined as "conditions determined by physical, social, economic and environmental factors and processes, which increase the susceptibility of a community to hazards", while hazard is defined as "a potentially harmful physical event, phenomenon or human activity that may lead to human casualties or injury, damage to property, social and economic disturbances or environmental pollution" (UNISDR, 2009). "Risk is a combination of hazard, exposure and vulnerability. Exposure and sensitivity turn danger into disaster " (Nedeljkovic, Laban, 2020:300). Natural hazards are characterised by growing uncertainty in terms of their occurrence or severity. The manifestation of risks of different origins, combined with the overall health, social, material, economic, and other consequences, brings a community to a state of disaster. A disaster is defined as a severe disruption in the functioning of a community or society caused by hazardous events interacting with conditions of vulnerability and exposure, resulting in widespread human, material, economic, and environmental losses and impacts (UNDRR, 2015). Disaster risk is the consequence of the interaction between a hazard and the characteristics that make people and places vulnerable and exposed (UNDRR, 2017).

In the view of the severe and widespread consequences that risks bring and the disasters they cause, numerous activities have been undertaken at all levels to mitigate these impacts. As Milosavljević explains: "International disaster risk reduction activities at local, national, regional, and global levels, which intensified in the last quarter of the 20th century, were driven by the increasingly evident threats posed by natural and other disasters worldwide. These disasters had a significant impact human lives and health, quality of life, material assets, the environment, society, and the economy. According to data covering a 20-year period (1985–2005), on average over 200 million people worldwide were affected by disasters annually. Based on the national and regional reports on the implementation of the Hyogo Framework for Action (2005–2015), disasters continued to have severe consequences globally during this decade: over 700,000 people lost their lives, more than 1.4 million people were injured, and around 23 million people were displaced from their homes. In addition, between 2008 and 2012, around 144 million people were displaced due to disasters" (Milosavljević, 2015:53). Data from the Brussels-based Centre for Research on the Epidemiology of Disasters (CRED) reveal that, over 10 years (2003–2012), the world experienced an average of 388 disasters annually, with over 100,000 fatalities and more than 210 million people affected in other ways—health impacts, homelessness, and hunger—resulting in economic damages exceeding 150 billion US dollars (USD) per year (Guha-Sapir et al., 2014). Over the past decade, there has been a noticeable rise in disasters driven by climate change. Storms, extreme temperatures, floods, droughts, landslides, and wildfires have resulted in 10% more fatalities compared to the 1996–2005 period (CRED & UNISDR, 2016).

As Doganjić and Paunović note, there has been a growing trend in economic losses caused by natural disasters in recent decades. The consecutive years with the highest economic damages from natural disasters globally were 2017 and 2018, during which, insured damages from natural disasters amounted to 219 billion US dollars, with more than half attributable to secondary risks. However, there remains a considerable gap between the total damages and the insured portions. For example, it is estimated that damages caused by natural disasters in 2017 and 2018 totalling 280 billion US dollars, this amount remained uninsured (Doganjić and Paunović, 2021:38). In 2021, the international database (EM-DAT) recorded 432 catastrophic events related to natural hazards worldwide. These events resulted in 10,492 fatalities, affected 101.8 million people, and caused economic losses totalling approximately $252.1 billion in economic losses. Globally, 2021 was characterised by an increase in the number of disasters and extensive economic losses. Five of the ten most expensive disasters of 2021 occurred in the United States, causing a total economic cost of $112.5 billion (Disasters in Numbers. Brussels: CRED, 2022). According to AON's report, *"Weather, Climate, and Catastrophes Insight: 2023,"* economic losses from natural disasters were estimated at $313 billion in 2022. Although this is a decrease compared to 2021 ($343 billion), it is an increase compared to 2020 ($297 billion) (AON, 2023).

The economic costs of major disasters are on the rise due to the increasing concentration of populations in risk areas and the lack of adequate investment in resilience and early warning systems. They can destroy capital, trigger investment in post-disaster response and recovery and negatively impact economic growth. Vulnerability to natural disasters is determined by the country's economic structure and level of development. Natural disasters are a development issue, because development policies can really influence a country's overall resilience and make the difference when it comes to mitigating the disaster impact on poverty, growth, and wellbeing. Natural disasters affect the economy and the way societies adapt to or ignore these threats. Although in absolute terms losses from disaster events are greater in economically developed countries (due to the high concentration of property values), in relative terms, i.e., compared to the GDP levels, the consequences of the realisation of disaster risks are greater in small and underdeveloped economies.

Under conditions of increasing intensity and frequency of disaster events, the ability of developing countries to limit their fiscal burden from the consequences of such events becomes a priority for their sustainable development. In economically developed countries, the harmful effects of disaster events are usually compensated through a combination of advanced private financial arrangements and efficient schemes of public revenues, based on strong tax systems. In underdeveloped and developing countries, on the other hand, there are fiscal constraints and market mechanisms for disaster risk management are not developed (Kočović, Jovanović Gavrilović & Đukić, 2015:5). It is estimated that in developed countries more than 40% of disaster losses are insured, while in developing countries 10% and in underdeveloped countries only 5% of disaster losses are insured (Cummins J.D., Mahul, O. 2009:5).

As Bauman observes, modern civilisation seems to lack both the time and the intrinsic need to contemplate the darkness at the end of the tunnel. It is prone to disasters that routinely surprise current problem-solvers and potential solution-makers. The way it addresses these disasters is guided by the rule of not acting until something bad has already happened and is probably out of control. In the meantime, the restless spirit of modernisation ensures a constant increase in such adverse events, which tend to multiply of their own accord (Bauman, 2010: 92).

To adequately prepare for disasters, countries/governments need to prepare their liquidity and financial preparedness to respond to the challenges of disasters, in addition to the preventive measures implemented before the event. Effective financial risk management is the greatest challenge for any government, especially those that are exposed to a high risk of certain hazards and have limited capacity to adequately manage the financial impact of disasters (OECD, 2017:2). The "Concept of Resilience to Natural Disasters" has been developed as a guide for protection, crisis management, and limiting the extent of potential damage. This concept includes synchronised preparation for disaster events (by analysing the types and intensities of potential

events and preparing for these events), prevention (through proactive measures to mitigate the consequences of natural disasters as far as possible), protection (activities to protect life, health, and property), response to natural disasters (actions to limit the extent of damage after the disaster has occurred) and finally financial protection measures and recovery (rehabilitation) following disaster events to restore normal levels of activity (Munich Re, 2017:12).

DISASTER RISK FINANCING INSTRUMENTS

The government can use two types of disaster risk financing: *ex-ante* and *ex-post* financing. Pojani explains that ex-ante risk financing instruments require proactive planning in advance and include accident reserves or funds, contingency budgets, potential debt mechanisms and risk transfer mechanisms. These practises are considered an essential part of disaster financial planning. Risk transfer instruments are of great importance and are frequently mentioned a lot in academic literature, financial strategies and the recommendations of international institutions, especially as means of risk management that should be considered and applied in developing countries (Pojani, 2020:12). The literature and current practises suggest several ex-ante mechanisms that can be used by the government, to finance natural disaster losses (Kočović, Jovanović Gavrilović & Đukić, 2015:14):

a) Government reserves – In some countries, government reserves are allocated annually in the national budgets, with a new amount allocated each year, while in other countries, reserves are allocated annually in the budget, and unspent amount is accumulated and carried forward, thus forming a sort of self-insurance against future disaster losses.

b) Contingent credit arrangements – these are credit lines that are usually agreed with international financial institutions and can be withdrawn by the government at relatively low interest rates at relatively short notice in the event of a natural disaster.

c) Catastrophe-linked bonds – allow issuance companies to issue bonds that are sold to investors (the government can also play a role of investor and sponsor) at fixed interest rate. The principal and interest are payable at the maturity rate if no disaster occurs. In the event of disasters, however, the principal is written off, so that the sponsor only pays the interest. The principal is used by the sponsor to finance damages.

There are several options available to governments for the subsequent provision of funds for emergency intervention, recovery, and reconstruction (Kočović, Jovanović Gavrilović & Đukić, 2015:16):

a) Reallocation of funds within the current budget – reallocation of funds from ongoing projects to recovery activities,

b) Introduction/increase of taxes,

c) Borrowing/deficit financing and

d) International aid, search for international partners.

The number and type of financial instruments to help governments manage their fiscal liability for disaster risk has grown exponentially in recent years. The World Bank and others are supporting countries develop risk financing strategies that combine complementary instruments as a part of risk-layering approach. Risk retention instruments such as budget allocations, reserves and contingent lines of credit are used to finance recurrent events, while risk transfer instruments such as reinsurance and catastrophe bonds are used to provide additional financing for more extreme events (Miskic, Coric & Beslac, 2017:88).

Risk mitigation and adaptation actions are essential to reduce losses from events that occur in the short term, but certain residual risks and losses will still materialise. The financial and insurance markets can potentially cover these costs along with the creation of specialised financing and risk transfer facilities in collaboration with the private and public sectors and international institutions (Tse-Ling Teh, 2015:241). The promotion of private disaster risk financing instruments should include a range of activities that would raise the awareness of disaster risks among the individuals and businesses and improve the affordability of private insurance policies (Kočović, Jovanović Gavrilović & Đukić, 2015:15).

FLOODS IN MAY 2014 IN SERBIA

In May 2014, floods occurred in the Republic of Serbia due to heavy rainfall comparable to rainfall that occurs once in a hundred years. Record amounts of precipitation led to a rapid and shar rise in river levels: Sava, Tamnava, Kolubara, Jadar, West Morava, Great Morava, Mlava and Pek. There were floods and landslides due to the overflowing of rivers from their beds, the breaking of embankments, torrential watercourses, and the effects of groundwater. The natural disaster endangered the lives, health and property of more than 1.6 million people, or 22% of the total population in 38 municipalities in central and western Serbia. The floods killed 51 people and more than 31,000 people were temporarily evacuated. On 15 May, the Government of the Republic of Serbia declared a state of emergency for the entire country, and due to the loss of life, the Government declared three days of national mourning on 20 May 2014. The floods mostly endangered and destroyed property of major value, which prevented the operation of businesses, schools and other educational institutions, health care institutions, social welfare institutions and other entities in the flooded areas, and in particular jeopardised the smooth functioning of the energy production system of the Republic of Serbia. Agricultural production (arable farming, livestock farming) was also severely affected, so that agricultural products planted were destroyed to a great extent, and the livestock was largely jeopardised, and in some cases destroyed. In September 2014, just four

months after the May floods, three local self-government units of the Bor district the eastern part of Serbia, Negotin, Majdanpek and Kladovo, were affected by the same natural disaster, and a state of emergency was also declared in these local self-government units. (Government of the Republic of Serbia, December 2014)

When disaster occurs, however, it is necessary to properly assess the damage and all losses incurred during and after the event. The assessment is important both for the financial factors needed to restore and rebuild the destroyed and lost resources, and to analysis the needs for continuation of an orderly life after the disaster. The Methodology in force in the Republic of Serbia was adopted in 1987, at the time of the Socialist Federal Republic of Yugoslavia. A it is a good and comprehensive document, it was created at a when there was a different social and political system and cannot fulfil today's requirements. Parallel to the urgent measures to protect the population, the Government, with the support of the European Union, the United Nations and the World Bank, initiated a procedure to assess the damage and losses incurred in accordance with internationally recognised methodology *Post Disaster Need Assessment (PDNA)* (Nedeljković, Radonjanin & Laban, 2022: 234).

Immediately after the rain stopped, the Serbian Government, with the support of experts from the EU, UN and WB, assessed the needs for post-disaster reconstruction. The assessment lasted five weeks, from 9 June to 10 July 2014. The assessment team consisted of representatives/officials from line ministries, government services, agencies and local self-government units, as well as international experts. The damage assessment was performed in accordance with the international methodology - Post Disaster Need Assessment, under the leadership of a team of international experts, as there were no trained experts for this task in our country. In Serbia, the Instruction on a Standardised Methodology for Assessing Damage caused by Natural Disasters is still in force in Serbia, which does not meet today's requirements for post-disaster reconstruction of the country after the disaster. As more than thirty years have passed since then and significant economic, political, and social changes have taken place in the meantime, it was necessary to apply an internationally recognised methodology in order for the report to be credible when applying for international financial assistance. According to the assessment, the flood damage in the 24 flood-affected municipalities selected for the assessment totalled to 1,525 million euros, of which 885 million euros (57% of the total damage) was the value of destroyed fixed assets, while 640 million euros (43% of the total damage) was to production losses. If the remaining municipalities are taken into account, which means that all 38 municipalities were affected by the floods, the total flood damage is € 1.7 billion or more than 4 percent of GDP. The most affected sector was the mining and energy sector (32% of the total damage), followed by the housing, agriculture and trade sectors, each with around 15% of the total damage. The immediate consequence of the floods is the temporary loss of employment for around 51,800 people, due to the interruption in production activities, resulting in a significant drop in household

income for these people. It is estimated that 125,000 citizens fell below the poverty line after the floods, which led to an increase in poverty of almost 7 percent compared to previous year (Government of the Republic of Serbia, European Union, United Nations, and World Bank 2014).

Table – 1: Damage and losses in production after floods in May 2014

POST-DISASTER NEEDS, MILLION EUR			
SECTOR	RECOVERY	RECONSTRUCTION	TOTAL
Agriculture	40.6	111.4	**151.9**
Manufacturing	18.5	51.7	**70.2**
Commerce	12.8	144.5	**157.3**
Tourism	0.5	0.7	**1.2**
Mining and Energy	210.0	202.0	**412.0**
Housing	58.8	204.5	**263.3**
Education	2.0	4.3	**6.3**
Health	2.7	4.4	**7.1**
Culture	0.1	1.2	**1.3**
Transport	/	128.2	**128.2**
Communications	/	12.6	**12.6**
Water and Sanitation	3.5	24.0	**27.5**
Environment	2.8	38.7	**41.5**
Governance	2.3	14.1	**16.4**
Employment	46.4	/	**46.4**
Gender	2.0	/	**2.0**
TOTALS	402.7	942.3	1,345.0

Source: Floods in Serbia, 2014.

According to the sectoral approach of the assessment, the greatest damage was recorded in the manufacturing industry with 1,070 million euros, which corresponds to 70% of the total damage, in the social sector, which includes housing, education and health with 242 million euros and 16% of total damage, and infrastructure with 192 million, i.e., 12%. In terms of individual sectors, the energy sector was the most affected with 494 million euros and 32% of total damage and losses, followed by housing with 231 million euros and 15%, agriculture with 228 million euros and 15%, trade with 225 million euros and 15% and transport with 167 million euros and 11% (Government of the Republic of Serbia, European Union, United Nations, and World Bank 2014).

The Republic of Serbia had not expected a natural disaster of such intensity. On 15 May, the Government of the Republic of Serbia adopted a Decision on declaring a state of emergency due to a natural disaster - flooding (pursuant to Article 32, paragraph 3 of the Law on Emergency Situations, Official Gazette of the RS, No. 111/2009, 92/2011 and 93/2012), which was in force throughout the Republic until 23 May. The announcements of the Republic Hydrometeorological Institute (RHMI) did not predict precipitation of up to 240 ml of rain per 1 square metre. According to

the RHMI warning, the precipitation should have been 80ml/ m2. In Obrenovac, the majority of the population was not adequately informed and did not evacuate their homes in time [5]. The evacuation continued for several days after the event. Around 25,000 people were evacuated from Obrenovac alone. The population was neither prepared for an emergency, nor did they have any information about the right course of action in such an event. The information that the citizens received exclusively informally did not contain any instructions in the event of a flood or any rules of behaviour during and immediately before the evacuation. The citizens of the flood-affected areas were surprised by the speed with which they had to leave their homes. They had no time to prepare and did not know what to take with them (Government of the Republic of Serbia, December 2014). The unpreparedness of the population when hand in hand with the fiscal unpreparedness of the government to rebuild the country after a disaster of such magnitude. There was no legal or institutional mechanism to adequately rebuild the country.

In order to be able to react quickly and efficiently, the Serbian Government established the Office for Assistance and Reconstruction of Flood-Affected Areas, by its Decree adopted on 22 May 2014 (Government of the Republic of Serbia, May 2014). On 18 July 2014, the National Assembly passed the Law on Eliminating Consequences of Floods in the Republic of Serbia (National Assembly of the Republic of Serbia, July 2014) with a validity period of one year from the date of entry into force. The Law stipulates that the removal of the consequences will be carried out in accordance with the government's aid and reconstruction programmes by the areas that define the measures and criteria for the provision of aid. By adding new powers, the Law, in addition to the analysing the current situation, coordinating the renewal process and preventive competencies, also assigns the Office the responsibility for reviewing all activities performed by local self-government units, public companies and other forms of organizations founded by the Republic of Serbia, so that the review team formed by the Director of the Office, in addition to proper supervision and internal audit, must also review all documentation. Given the extent of the damage and the need to spend funds in a transparent and targeted manner, the Law defines the sources of funds (national, provincial, and local budgets as well as donor funds), but also governs the issue of public procurement and simplifies its procedures. In the interest of transparency, public administration bodies and other users of public funds are obliged to report to the Office once a month on all financial and non-financial inflows and outflows of funds intended for elimination of the consequences in flood-affected areas and publish these reports on the Office's website.

FINANCING THE RECOVERY AFTER THE FLOODS IN MAY 2014, THE REPUBLIC OF SERBIA

The Republic of Serbia requested international assistance for response and reconstruction due to insufficient funds (Government of the Republic of Serbia, December 2014). Based on this report, the Donors' Conference was held in Brussels in July 2014. The grants collected by Serbia totalled to 220.7 million euros (Office for Assistance and Reconstruction of Flood-Affected Areas, 2015). The biggest donor was the European Union with more than 170 million euros. Among other resources, the European Union has financial instruments at its disposal to support the governments that are unable to cope with the consequences of disaster. The European Union Solidarity Fund was set up to respond to major natural disasters and to express European solidarity with disaster-affected regions in Europe. The Fund was set up in response to the severe floods in Central Europe in the summer of 2002. Since then, it has been used for 107 natural disasters, covering a range of different catastrophic events, including floods, forest fires, earthquakes, storms, and drought. The EUSF can provide financial assistance to Member States and countries engaged in accession negotiations. Each application must be received by the Commission within 12 weeks of the first damage caused by the disaster. For slowly developing disasters, such as droughts or health emergencies, this deadline is set at 12 weeks after the first official action against the emergency. The Commission assesses the application and - if the application is accepted - proposes an amount of aid to the European Parliament and the Council, which must approve it. Once the funds are available in the EU budget, the Commission decides to grant the aid to the state concerned, which receives it immediately and in a single instalment. Once the aid has been disbursed, the state concerned is responsible for its implementation, including the selection of measures and their audit and control. Emergency measures can be financed retroactively from the first day of the disaster. The EUSF is not a rapid response instrument to deal with the consequences of a natural disaster. The financial aid can only be granted to the applicant state after an application and budget procedure that can take several months to a year. Once approved, the funds are made available in a single instalment (EC, 2002:3).

The needs report has made a significant contribution to prioritising the recovery/ reconstruction process in Serbia. The Government issued decrees with reconstruction programmes for each of the affected sectors, on the basis of which the reconstruction process was carried out after the May floods in Serbia. In addition to the donor funds, the Government borrowed 300 million US dollars. The loan is intended for recovery. The repayment period of the loan is 30 years, and the grace period is 18 years. The interest rate varies during the repayment period, but at the time of signing it was 1.5 % (National Assembly of the Republic of Serbia, 2014).

The period before the floods is characterised by a low percentage of insurance

coverage. According to the data provided by the insurance companies as at 31 December 2014, the estimated insured damage due to flooding in 2014 amounted to 4,695 million dinars, which corresponded to 2.5% of the total damage (National Bank of Serbia, 2014).

STRATEGIC FRAMEWORK OF RISK FINANCING IN THE REPUBLIC OF SERBIA AND THE USE OF FINANCIAL INSTRUMENTS

When analysing risk financing in the Republic of Serbia, the starting point in recent history is the establishment of an emergency management system, which was created with the establishment of the Emergency Management Sector within the Ministry of the Interior and the adoption of the Law on Emergency Situations (National Assembly of the Republic of Serbia, 2009). Article 70 of the Budget System Law of the Republic of Serbia, which was adopted in 2012, provides for funds for the permanent budget reserve. The permanent budget reserve is intended to finance expenditures and costs for the participation of the Republic of Serbia, i.e., local authorities, in eliminating the consequences of emergencies, such as earthquakes, floods, droughts, fires, landslides, snow, hail, animal and plant diseases, environmental disasters and other disasters, i.e., other extraordinary events that may endanger human life and health or cause large-scale damage (National Assembly of the Republic of Serbia, 2009). This is a maximum of 0.5% of total revenue and income from the sale of non-financial assets for the financial year. The decision on the use of funds from the permanent budget reserve is made by the Government on the proposal of the minister, i.e., the competent executive body of the local authority, on the proposal of the local administrative body responsible for finance. The report on the use of funds from the permanent budget reserve is submitted to the National Assembly, i.e., the local authority assembly, together with the budget final statement of accounts.

The Law on Reconstruction Following Natural and Other Disasters, adopted in 2015 as a systemic law, stipulates in Article 14 that funds for assistance after natural and other disasters are to be provided from the following sources: the budget of the Republic of Serbia, donations, contributions, and gifts, proceeds from borrowing, proceeds from the sale of financial assets, funds from public enterprises and other forms of organisation established by the Republic of Serbia, as well as other sources in accordance with the law.

The Natural Disaster Risk Financing Programme for the Republic of Serbia was adopted by the Serbian Government in 2017. The incentive for the adoption of such a programme was certainly the financial impact of natural disasters on the state budget in the past. This programme should help the Government, the economy and the population to gain access to financial protection, such as adequate budget reserves and risk transfer solutions, including insurance (the Government of the Republic

of Serbia, 2017). One of the specific objectives of the Program is to help affected households and small and medium-sized enterprises to rebuild their assets through access to risk transfer instruments. This means that the Government should play an important role in supporting the development of the national privately owned property insurance market, by working closely with insurance and reinsurance companies, to improve policies and regulatory decisions aimed at encouraging and promoting property insurance. The programme is followed by the Action Plan in which, among other things, measure 3.2 provides for organising campaigns to promote insurance against natural disasters and measure 3.3 for examining the possibility of introducing compulsory insurance of private property in the area most at risk. However, there is no information that these activities have been out by the Government.

In the aftermaths of May floods, the state took measures to prepare for potential natural disasters and signed a Loan with the International Bank for Reconstruction and Development for development policies in the field of disaster risk management with the option of deferred drawdown of funds in the amount of EUR 66,100,000 (National Assembly of the Republic of Serbia, 2017). The abbreviation for this financial instrument, which the World Bank makes available to its clients, is *CATDDO (Catastrophe-Deferred Drawdown Option)*. The loan repayment period is 20 years and the grace period is 10 years. The interest rate is variable and amounts to Euribor plus 0.95 %. Once the funds are drawn down, the Government pays an annual interest rate of almost 400,000 euros. The condition for fund drawdown is that the Serbian Government declares a state of natural disaster. In such case, the funds are in the RS budget within 48 hours. The loan is burdened with some other costs that are payable on the reserved (set aside) funds, i.e., on the funds that have not been drawn down. If no natural disaster occurs, the funds are not withdrawn. This is because a fee (so-called front-end fee) of 0.5 % is charged. The loan has a validity period of three years and can be renewed four more times for the same period. Each time the loan is renewed, a further fee of 0.25 % (165,000 euros) is payable.

When a disaster strikes, the poor people are usually hardest hit, and this loan ensures that the government can immediately use the money it has available at the time of the disaster. In this way, the funds previously earmarked in the budget for development projects do not have to be reallocated for recovery, but the funds are provided from an earmarked loan that is cheaper than the loans available at the time of the disaster. The Republic of Serbia used this loan for state programmes for the reconstruction of damaged or destroyed infrastructure in the area of responsibility of the local self-government units, for urgent work to restore water protection facilities, damaged and destroyed residential buildings and public facilities damaged by floods.

CONCLUSION

It is not easy for developing countries to deal with the impacts of natural and other disasters. Serbia's annual budget is not sufficient to provide adequate financial support for damage caused by disasters, which are occurring with increasing frequency due to climate change. Since 2014, following the experience of the enormous floods, Serbia has taken steps to improve its disaster risk financing policy. However, as the insured risks are low throughout the country, especially for private property, the burden of recovery lies with the state authorities. Appropriate risk transfer, insurance and reinsurance arrangements make it easier for individual countries to cope with the consequences of disasters. Reliance on donor funds is uncertain and the implementation of an appropriate risk transfer policies, such as compulsory insurance of property against disasters, would largely ensure financial resilience. The loan that the state borrows saves the budget in the event of a disaster. Although it costs the state in the event of non-withdrawal/non-drawdown, we can compare it to insurance, which is paid even if no accident occurs. In Serbia, insurance penetration is still very low even after severe floods. This leaves the burden of recovery on the public budget. The use of various financial instruments can ensure that countries with a high risk of certain hazards are also financially resilient to disasters. The implementation of appropriate measures and the use of a combination of financial instruments in the event of disaster, such as special-purpose loans, insurance, reinsurance, and appropriate budget planning would certainly contribute to the financial resilience and responsibility of developing countries such as Serbia.

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POSSIBILITIES OF AGRICULTURAL DROUGHT INSURANCE IN SERBIA USING INDEX INSURANCE

Ljiljana Popović[1]
Associate Professor, University of Novi Sad, Faculty of Technical Sciences,
Department for Industrial Engineering and Management

1 e-mail: ljiljana.popovic@uns.ac.rs, https://orcid.org/0000-0002-9158-0148

POSSIBILITIES OF AGRICULTURAL DROUGHT INSURANCE IN SERBIA USING INDEX INSURANCE

Summary: Drought is a phenomenon intuitively very understandable, but quantitatively and qualitatively difficult to describe. Quantification, qualification and metrics are necessary in order to discuss drought in an analytical and scientific way. Indicators are one of the formal approaches. Modelling an adequate index that quantitatively and qualitatively describes the drought in the study area is a basic precondition for drought index insurance.

Index insurance that uses meteorological and climatological parameters is a specific way of insurance that requires a detailed analysis of the climate conditions of study area and a high correlation between the selected index and the risk being insured. This type of commercial insurance does not exist on the territory of the Republic of Serbia. This paper presents the methodology necessary for examining the possibility of bringing drought index insurance to a market. In addition, the results of the analysis of the correlation of meteorological parameters with agricultural yield in Vojvodina are presented in order to examine the possibilities of introducing such an insurance product on the market of the Republic of Serbia.

Keywords: *financial resilience, insurance, drought, drought indices, agriculture*

DROUGHT AS A DANGEROUS PHENOMENON

The World Meteorological Organisation defines drought as a long-term absence or marked deficit of precipitation, a precipitation deficit leading to a lack of water for a given activity, and a period of abnormally dry weather such that the lack of precipitation causes a serious hydrological imbalance (WMO, 1992).

Drought is one of the greatest threats to the environment, but due to its complexity, little is known about it. It can occur in small areas, but can also cause problems at the scale of entire continents. In temporal terms, drought can be a feature of a short period, a week, but it can also characterise an entire decade, as evidenced by instrumental measurements and palaeo-climate reconstructions. Drought is a normal climatic phenomenon, but precisely because of its complexity, developing an early warning system is more difficult than for other hydrometeorological hazards (Pulwarty and Sivakumar, 2014).

Droughts usually occur regionally, extend over large areas and last longer than other hydrological extremes. Precisely for the reasons mentioned above, drought needs to be observed, monitored and analysed at the regional level (Milanović et al., 2012). In the Republic of Serbia, drought is not a regular phenomenon, although it occurs more frequently in the territory of Vojvodina (Mihailović et al., 2000; Jovanović et al., 2013).

Global warming has become increasingly evident in the 20th and 21st centuries, and a further rise in temperature is expected in the future. In addition to the global rise in temperature, the precipitation regime is also changing, leading to more frequent and more intense natural disasters (IPCC 2007). In the last century, the temperature in the Carpathian Basin has risen by 0.8 °C and precipitation has decreased by 60-80 mm. Consequently, the lack of water in the region is one of the greatest natural hazards, which can cause severe economic damage, especially in agriculture in dry years (Rakonczai, 2011). According to forecasts, this trend will continue in the future. (Lalić i sar., 2011)

Soil water is an essential part of the water cycle and a critical parameter for plant growth and development and crop yield (Dale and Shaw, 1965). In agricultural areas, drought can have serious economic consequences due to yield losses (Nikolova et al., 2012; Sepulcre-Canto, et al., 2014). Drought reduces the resilience of society by exacerbating the already entrenched vulnerability of drought-prone societies (Wisner et al., 2004). The impact of droughts does not only depend on the environment and climate of the region, but society also plays a very important role in the occurrence of droughts and especially in mitigating their consequences. Due to climatic extremes and the impact of hydrological and climatic hazards, the role of society and the importance of water management planning will increase in the future. Rural areas that depend primarily on agricultural production must learn how to increase their resilience to droughts and adapt to natural conditions.

In Serbia, agriculture and the food industry are of great importance and account for a large share of overall economic activity. The impact of climate change and weather extremes on the economy is particularly pronounced in countries like Serbia (a country in transition) due to the unenviable economic situation and lack of investment to improve production.

The consequences of the drought are particularly noticeable in Vojvodina, which is an agriculturally dominated area. In the last 1000 years, the Pannonian (Carpathian) Basin, where the Vojvodina region is located, has experienced very severe droughts. In the years 1142-1147, 1363, 1794 and 1863-65, droughts occurred that severely limited food and drinking water supplies and had serious socio-economic consequences (Pálfai, 1987).

Since 1988, the most severe damage caused by droughts has been recorded in the Republic of Serbia: 1990, 1993, 2000, 2003, 2008, 2012 and 2018. In 1990, the damage was estimated at 875 million euros (3.5 % of total income). In 1993, the damage was estimated at half a billion euros. In 2003, the damage reached 1 billion euros and in 2012 the estimated total damage caused by the drought doubled to 2 billion euros, of which the estimated damage to income in Vojvodina was around 1 billion euros (PKV, 2012).

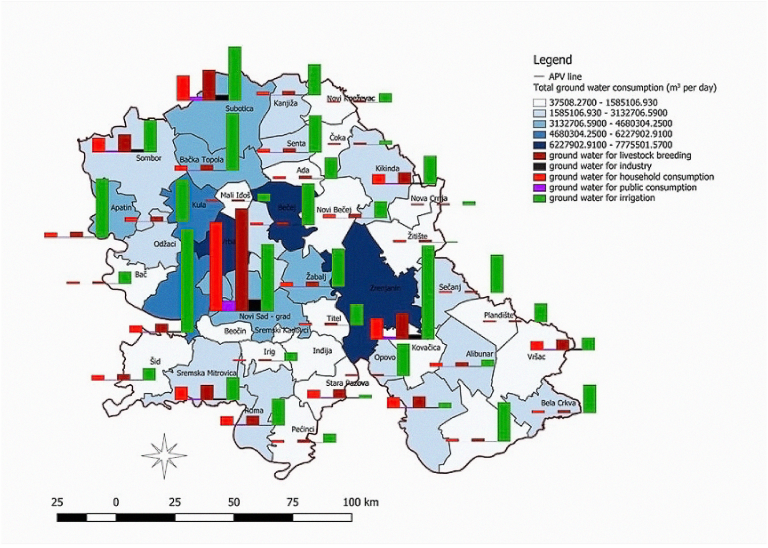
The most important measures for adapting agricultural production to climate change

can be categorised into short-term, medium-term and long-term measures. (Lalić, Mihajlović, & Podraščanin, 2011).

Long-term measures are the most effective adaptation measures, but they require significant economic resources, understanding and support from state and local authorities. The most important long-term adaptation measures are investments in irrigation systems and the development of drought early warning systems. Irrigation is the most effective preventive measure to manage drought risk, but this measure is not available to the majority of farmers in rural areas, who represent the most socially and economically vulnerable population group in Serbia. According to the 2012 agricultural census, only 3 of the total agricultural land in Serbia was irrigated in the 2011/2012 agricultural year. This data places Serbia among the last countries in Europe in terms of irrigation. It should be noted that the majority of agricultural production takes place in the Vojvodina region, which has an abundance of water and an extensive network of canals. Of concern is the fact that water from deep underground springs is used for irrigation (Figure 1), which should represent a drinking water reserve for the future (Ćosić et al., 2019).

Short-term measures refer to changes in habits and adaptation to newly created conditions. Short-term measures do not require significant investment in equipment and can be implemented in a very short period of time. Crop insurance is a short-term adaptation measure.

Figure 1: Total daily water consumption on the territory of Vojvodina (Ćosić et al., 2019)



Indexing the drought severity

Although the extent and impact of droughts are difficult to define, quantifying and qualifying them is important for assessing and comparing droughts. A whole series of indices and variable indicators have been developed for this purpose. There are over 100 known indices (Zargar 2011) that attempt to characterise the severity of drought.

Drought indicators are variables or parameters that characterise the state of drought, such as precipitation, temperature, discharge, groundwater level, soil moisture, etc.

Drought indices are calculated numerical representations of drought severity estimated from climatological or hydrometeorological data, including the aforementioned indicators. The aim of the indices is to measure the qualitative state of drought in an area for a given period of time. Technically, the indices are also indicators of drought.

The indices simplify the complex processes that take place in nature during a drought and provide useful information for various users and stakeholders. Indices are used to quantitatively assess the severity, location, occurrence and duration of drought events. The severity of the drought refers to the deviation from the normal value of the observed index. Severity thresholds can be set to determine when a drought occurs, when it ends and the geographical area it covers. The location of the drought refers to the geographical region affected by the drought. The occurrence and duration of a drought is determined by the approximate date of the start and end of the drought event.

Drought indices together with information on the exposure and vulnerability of the observed area (e.g., data on land use and yields) are essential for monitoring and predicting the impacts and outcomes of a drought event. Indices can also provide historical references for planning decision-makers and provide them with important information on the probability of drought occurrence or the frequency of droughts of varying severity.

Some of the indicators are very simple to calculate, such as the deviation from the normal (Hayes, 2003) and include one parameter, while there are also more complex ones that include several parameters, such as the Palmer drought index (Palmer, 1965).

The development and calculation of drought indicators depends on the availability of suitable data for the calculation. Indicators based on meteorological data collected at synoptic weather stations are called meteorological drought indices. The following ones stand out among them:

- Deviation from the normal (Hayes, 2003), often applied and attractive for public presentation;
- Decile (Gibbs and Maher, 1967), used in Australia;
- Pálfai Index - PAI (Pálfai, 2002), developed and applied mainly in Hungary;

- Drought Severity Index - DSI (Bryant et al., 1992), which is frequently used in the UK;
- Effective Drought Index - EDI (Byun and Wilhite, 1999), which takes into account the effective precipitation;
- Standardised Precipitation Index - SPI (Mc Kee et al., 1993), the most commonly used drought index;
- Standardized Precipitation Evapotranspiration Index (SPEI) (Vicente-Serrano et all, 2010), which is a derivative of the SPI and takes evapotranspiration values into account, among other things.

With the emergence of the Palmer Drought Severity Index - PDSI (Palmer, 1965), the characterisation of droughts began with a much more comprehensive picture of the water cycle and its elements. In particular, the PDSI includes the amount of available water in the soil in the calculation. Palmer also modified his index by creating PDSI derivatives, such as:

- Palmer Modified Drought Index - PMDI, developed for the needs of the US National Weather Service,
- Palmer Hydrological Drought Index - PHDI, which takes into account the hydrological impact on reservoirs and groundwater levels.
- Palmer Crop Moisture Index - PCMI, which estimates the evapotranspiration deficit and not the precipitation.

To date, there are numerous papers that criticise, evaluate or otherwise modify the original PDSI and its derivatives (e.g., Alley, 1984, Wells et al., 2004, Mavromatis, 2007). None of the drought indicators is fundamentally better than the others. However, certain indicators describe drought better when they are created for the specific needs of end users. (Monacelli et al., 2005)

All the indicators mentioned had to fulfil a number of criteria in order to obtain the status of indicators (Fuchs, 2012). The first and basic criterion is to meet the World Meteorological Organisation (WMO) definition of drought, which defines the drought index as an index associated with some of the cumulative effects of a long-term and unusual lack of moisture. Other criteria for defining the drought index are:

- the time scale of the index should be consistent with the nature of the problem
- the index should be a quantitative measure of drought and include its behaviour at large spatial and temporal scales and include an assessment of drought characteristics (intensity, duration, spatial distribution)
- historical data on the index value should be available or it should be possible to calculate the index on the basis of historical data on the parameters.
- It should be possible to calculate the index almost in real time and use it operationally.

The SPI index makes it possible to compare values from region to region, as it does not require any adjustment to climatic conditions, but is based on a statistical approach.

The WMO therefore requires all hydrometeorological organisations to calculate it. The SPI index is most commonly used to measure drought in the Pannonian Plain.

The continuous assessment of soil moisture allows dynamic monitoring of soil moisture development and drought occurrence. However, although soil moisture is an important parameter for determining drought in soil, continuous measurements of soil moisture are rare (Patel et al. 2009), and the ability to apply point measurements to larger areas is limited. These problems can be solved by using data obtained by remote sensing and observation of vegetation. The vegetation indices used for this purpose are:

- Normalised Difference Vegetation Index – NDVI (Tucker, 1979);
- Vegetation Condition Index - VCI (Kogan, 1990, 1995),
- Normalised Difference Vegetation Index Anomaly - NDVIA (Anyamba et al., 2001),
- Standardised Vegetation Index - SVI (Peters et al., 2002).

FINANCIAL RESILIENCE TO DROUGHT

Drought monitoring and early warning

Drought is a natural hazard caused by climate variability and cannot be prevented. However, the impact of drought can be reduced if drought is monitored and systematically managed. Monitoring relevant hydrometeorological parameters and building appropriate drought prediction models under the drought early warning and forecasting system would serve as a platform for decision making and drought mitigation.

As the occurrence of droughts has significant economic, environmental and social consequences, there were attempts to monitor and predict droughts in the early 1990s (the 1994 United Nations Convention to Combat Desertification). Later, several assessments were carried out at regional and international level. The most recent endeavours are in the direction of an early warning system (Global Drought Information System) that would provide a spatial representation of the lack of monthly precipitation on a global scale. For Europe, the European Drought Observatory system (EDO) provides information on drought. For south-eastern Europe, the Drought Management Centre for Southeastern Europe (DMCSEE) has announced the development of a regional early warning system.

In Serbia, the Hydrometeorological Institute of the Republic of Serbia has included the monitoring of moisture conditions and the determination of SPI values based on the amount of precipitation recorded in the previous 30, 60 and 90 days in its operational procedures since 2010 on the recommendation of the WMO.

Crop insurance against drought risks

There are two basic models of crop insurance, depending on how the risk is equalised, i.e. how the loss is assessed and paid: indemnity insurance (traditional) and index insurance (parametric) for the crop.

The first insurance model traditionally pays an insurance indemnity based on an assessment of the actual damage from a field inspection following a loss event. The most common products of this insurance model are:

- **Named peril crop insurance** is an insurance method that exists in most European countries. The most widespread insurance system for crops and fruit in Europe is hail insurance, which often also includes other individual risks (fire, flood, frost). This type of insurance system is also used in Serbia.
- **Multi-peril crop insurance** works in such a way that compensation depends on the estimated damage caused by any weather conditions. It is used in the USA, Canada and India, but also in several European countries such as Spain, Portugal, Austria, Greece, France, Italy, Luxembourg and Cyprus.
- **Crop revenue coverage** is a type of insurance available in Spain and the United States that excludes a loss assessment. Instead, the difference between the guaranteed yield and the actual yield is calculated, compensating farmers for any potential reduction in yield. In addition to weather disasters, this type of insurance also covers risks such as plant pests and diseases as well as market risks such as price collapse, etc.

The second model is based on the monitoring of meteorological parameters (indices) and the payment of pre-agreed indemnity if the monitored index deviates from the normal in the agreed value. Unlike traditional indemnity insurance, which is based on the assessment and payment of the actual loss when the insured event occurs, index insurance pays out the agreed amount when the conditions (event or situation) from the insurance contract are met, i.e. when the values of the monitored parameters - the index - deviate from the agreed reference base value defined for a specific geographical area. Index insurance is most commonly used in agricultural insurance and was developed as an alternative to traditional insurance of yields against a larger number of risks. However, it can also be applied to property and investment insurance against the consequences of weather and natural disasters. Any parameter (usually a meteorological parameter) that can be measured directly or indirectly and that has a negative impact on the economic activity of the insured, e.g., wind speed, amount of precipitation, air temperature, distance from the epicentre of the earthquake, crop yields and the like, can be used as a basic variable.

The most common index insurance is the index insurance of small farmers' harvests. Today there are three main types of this insurance:

- **Index crop insurance** is linked to a specific geographical area or administrative unit and is based on the future yield of that area. If the actual, current, regional

yield is below the expected average yield calculated for this region, the insurer is obliged to pay the agreed sum of money to all policyholders in this region equally. The insurance price and the insurance premium, which are paid equally by all policyholders in this region, are determined on the basis of the average regional yield. As the damage is compensated to all policyholders regardless of the amount of actual damage to their farms, it is necessary that the insured geographical areas/units are as homogeneous as possible in terms of climatic and microclimatic conditions.

- Unlike index crop insurance, which is based on the average yield of the region, **weather index crop insurance** takes the meteorological parameters of the region as the reference values of the contract, which is why this type of insurance is also known as parametric insurance. This insurance is linked to meteorological phenomena (rain, snow, air temperature, wind speed, etc.) in the region that may affect the reduction in crop yields. In such contracts, the limit value of the time index is defined and if the responsible institution (reference station) confirms that the value of the monitored time index is above or below the agreed value, the agreed compensation is paid under the insurance. Time derivatives could also be included in this category of insurance (Marković, 2010).
- **Satellite index crop insurance** uses remote sensing to measure and analyse the tracked index. The indices are created using time series of satellite images. This type of insurance has only recently begun to be used commercially due to the poor availability of satellite imagery. With the increasing use of remote sensing in agriculture, contracts like this will find wider application.

Parametric crop insurance is a good mechanism for insuring crops against meteorological disasters in developing countries where other, traditional insurance products are not always applicable, either because the insurance market is underdeveloped or simply because financial risk management mechanisms are not accessible due to poverty. In such environments, index insurance can be used as a mechanism to promote agriculture and rural development. In addition, this type of insurance can provide an alternative source of funding as part of a national or regional strategy to deal with natural disasters.

The basic feature of index insurance using meteorological or climatological indicators and indices is that the insurance contract guarantees a payment based on measurements of objective parameters (such as measured precipitation or air temperature) from a meteorological reference station (base station) during the agreed period. The weather parameters monitored must correlate as closely as possible with the damage to the insured crop (a specific type of crop). All policyholders in a given geographical area receive compensation from an insurance policy based on the same insurance contract and on the measurement of the time parameter from the same reference station. This insurance approach eliminates the need for actual damage assessment in the field.

Traditional crop insurance requires a direct assessment of the damage suffered by the farmer. Crop damage assessment requires significant financial resources and is not practically feasible in environments where the insurance market is not sufficiently developed.

MODELLING OF INDEX CROP INSURANCE AGAINST DROUGHT RISKS

A time index insurance contract is created on the basis of several parameters that characterise this type of insurance and are part of each contract.

- The index represents the quantification of a meteorological or climatological variable.
- A meteorological station is a base station for a specific geographical area where weather parameters are measured and is referred to as a reference station.
- Threshold refers to the value of the index (cumulative, average, minimum, maximum) that triggers the contract and from which the insurance benefit is paid.
- Insurance indemnity stands for the sum insured (lump sum) - a payment agreed in advance per unit of insured acreage. The indemnity can also be defined as an incremental, continuous payment, which is determined using the monetary value of the index.
- The payment tick defines the amount of money per unit of the index (e.g. dollars per mm of precipitation above or below the threshold) that is paid to the insured when the contract is activated.

Availability of weather data

The weather data for index insurance form the basis for risk assumption and loss equalisation in natural disaster insurance. Insurance companies (both local and international) set specific conditions for the policies for which they are willing to accept the risk. These conditions change according to advances in the methods used to measure weather phenomena, but in general there are some basic standards to increase the interest of insurance companies in this business (ISMEA, 2006):

- Historical weather data, preferably 30+ years of accumulated data to cover extreme risks
- Limited number of unavailable and out-of-range values, preferably less than 1% of observations are unavailable
- Reliability of collected data and availability of control stations
- Consistency of observation techniques, limited changes in instrumentation/ orientation/configuration
- Reliability of the data recording procedure, limited possibilities for data manipulation.

Selection of the index to be insured

The most important component of index insurance against natural disasters is the determination of a meteorological or climatological index, which serves as an indicator of risk exposure.

A meteorological index can be created from any combination of measurable meteorological variables and any number of meteorological stations that best reflect the end user's risk.

In agriculture, the relationship between crop yield and weather conditions can be very complex, yet measurable. For index-based insurance contracts, a measurable meteorological indicator that is closely related to crop yields or historical losses must be identified. An index can be constructed after collecting the time data.

If a sufficient degree of correlation between the meteorological index and the yield, i.e., the quality of the crop, is demonstrated, this information can be used as the starting index for the insurance contract. The index possibilities are unlimited as long as the initial data is of satisfactory quality.

A rainfall deficit below the minimum level and without irrigation can have a bad effect on the development of the crop and consequently lead to a lower yield. A simple cumulative indicator of the amount of precipitation caused by the rainfall deficit and yield reduction could be a good indicator for insurance. However, since drought as a phenomenon is difficult to define and measure, different indicators of drought need to be tested. In addition to precipitation, such indicators may include other meteorological parameters such as temperature or evapotranspiration.

CREATION OF A CROP INSURANCE MODEL AGAINST DROUGHT RISKS

The topology and relief of Serbia are diverse and vary in different parts of the country, from pronounced lowlands to hilly and mountainous relief. As the northern part of the country is strongly characterised by agriculture and is almost exclusively used for agricultural purposes, the crop insurance model was proposed for this area - the Vojvodina region.

When analysing the geomorphological and pedological characteristics of the area, it was found that Vojvodina is a very flat area characterised by very fertile soils. The morphological picture of Vojvodina is characterised by the large courses of the international rivers Danube, Sava and Tisa, which form the natural borders of the area under study. An analysis of the climatic characteristics of Vojvodina revealed that Vojvodina is located in an area with a temperate continental climate, which is very favourable for agricultural production. The analysis of average temperatures showed that there is a trend towards increasing average temperatures in Vojvodina, while the analysis of precipitation indicates periodic precipitation deficits and conditions for

the occurrence of drought. As mentioned above, irrigation is negligible as a drought risk management measure in Vojvodina.

For modelling an appropriate crop insurance product against drought risk, three indicators were identified that would be suitable for parametric crop insurance:

- monthly total precipitation,
- Standardised Precipitation Index (SPI) and
- Standardised Precipitation and Evapotranspiration Index (SPEI).

The reason for choosing precipitation, SPI and SPEI index for analysis purposes and investigating the influence of these parameters on crop yield was the availability of meteorological data in large time series as a basic prerequisite for the assumption of certain risks by an insurance company. The accuracy of an insurer's prediction is based on the law of large numbers.

For precipitation to qualify for index insurance, it must be indexed, and for this purpose the amount of precipitation is used as an insurable index for drought. The amount of precipitation takes into account the sums of precipitation in the individual time units: month, season, growing season, year, etc., and not the mean values as with other meteorological elements.

The Standardised Precipitation Index - SPI (Mc Kee et al., 1993) is one of the indicators that characterise moisture conditions. The calculation of the SPI for any location is based only on the amount of precipitation recorded during the observed period. The SPI index indicates the number of standard deviations, i.e., the percentage of precipitation deviations from the normal value that are above (positive SPI values) or below the mean (negative SPI values). The main advantage of using the SPI over other indicators is that precipitation is the only input parameter for calculating the SPI. A possible limitation can be the length of the precipitation time series. A precipitation time series of at least 30 years is required for the SPI calculation. Due to its probabilistic nature, the SPI is well suited for risk management and can be transferred to a professional underwriter.

The Standardised Index for Precipitation and Evapotranspiration - SPEI (Vicente-Serrano et all, 2010) as an index is an aggregate of the SPI, i.e., its modification. The SPEI uses the difference between precipitation and evapotranspiration instead of precipitation for the calculation. By introducing the value of the difference between precipitation and evapotranspiration instead of only precipitation, an improvement of the SPI method was expected. The accuracy of the SPEI index is largely influenced by the choice of the calculation function for evapotranspiration (Frank et al., 2017). Based on the agreement with the occurrence of historical droughts in Vojvodina, the SPEI calculation based on the Hargreaves method for calculating potential evapotranspiration, which follows the logistic distribution, was tested and evaluated as the most suitable for the conditions in Vojvodina (Frank et al., 2017).

Data on monthly total precipitation and monthly average temperatures measured at 7 hydrometeorological stations in Vojvodina (Figure 2), owned by the Hydrometeorological Institute of the Republic of Serbia, were used to calculate the drought indicator. The daily data series obtained by observation over a period of 61 years were used.

In order to determine the impact of selected drought indicators on crop yields, a 33-year time series of average wheat and maize yields by cadastral municipality was used. The analysis covers 40 cadastral municipalities in Vojvodina. Data on the average yield of individual farms at the cadastral municipality level were used for the analysis, as it was assumed that these farms do not irrigate their crops.

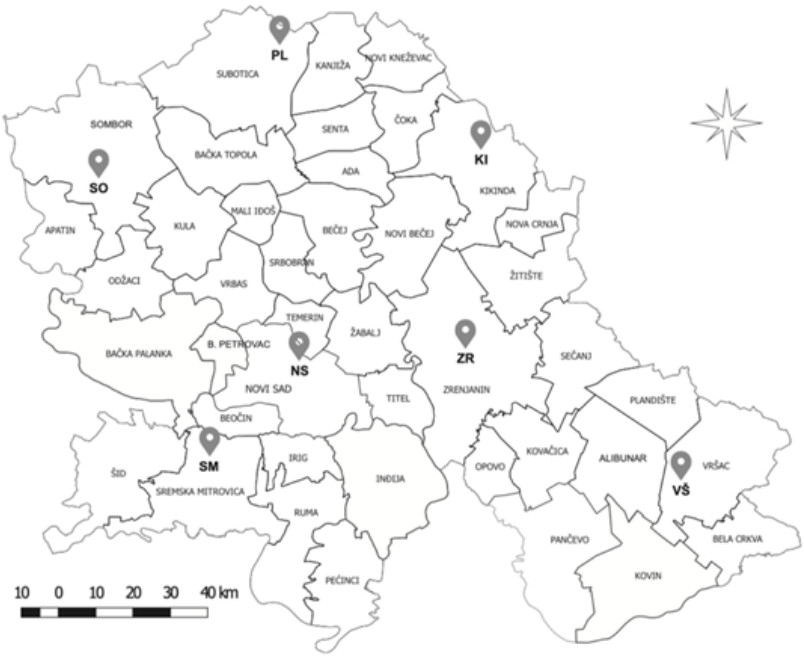


Figure 2: Spatial arrangement of hydrometeorological stations in Vojvodina owned by RHMZ

The analysis of the homogeneity of the time series of data used for the calculation of the drought indicator showed that the data are homogeneous, which confirms the reliability of the meteorological stations as reference stations for the preparation of index-based insurance contracts.

The availability of historical data and the reliability of the observation network for meteorological parameters fulfil the prerequisite for the existence of a data infrastructure to create an insurance model based on the measurement of index values.

By analysing the spatial correlation of the time series of the analysed indicators

between the meteorological stations, it was found that there is a significant spatial dependence between the phenomena due to the high values of the correlation coefficients between the meteorological stations. As a result, the spatial basis insurance risk was reduced to a minimum.

In the spatial analysis of the influence of the analysed drought indicators on yield, indices with equally long precipitation time series were selected for the creation of a maize panel model. The evaluation of the model parameters showed that all three analysed indices (precipitation, SPI and SPEI) have a statistically significant influence on crop yield (Figures 3, 4 and 5), i.e. that the drought indices can be used as reliable indicators of crop exposure to drought risk and are therefore suitable for index crop insurance.

Below you will find a representation of the spatial distributions of the analysed correlations.

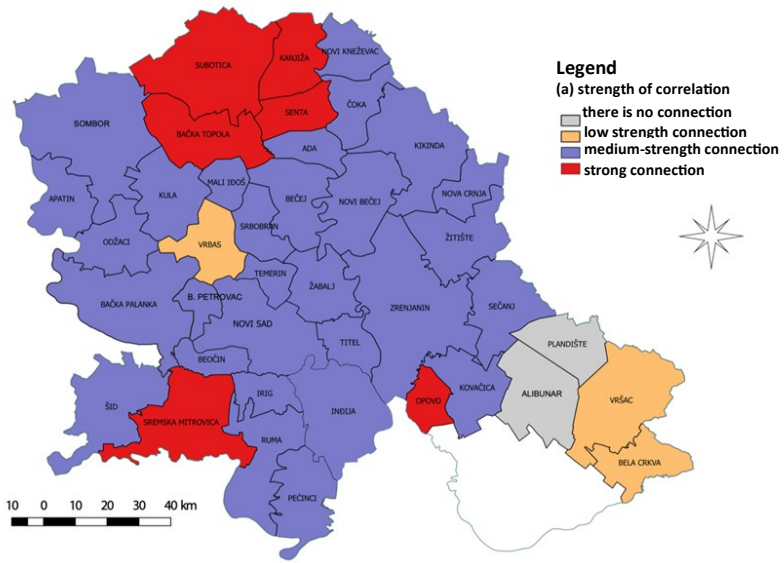


Figure 3: Spatial distribution of the correlation coefficient between average maize yields and cumulative four-month precipitation May-June-July-August, by municipality in Vojvodina

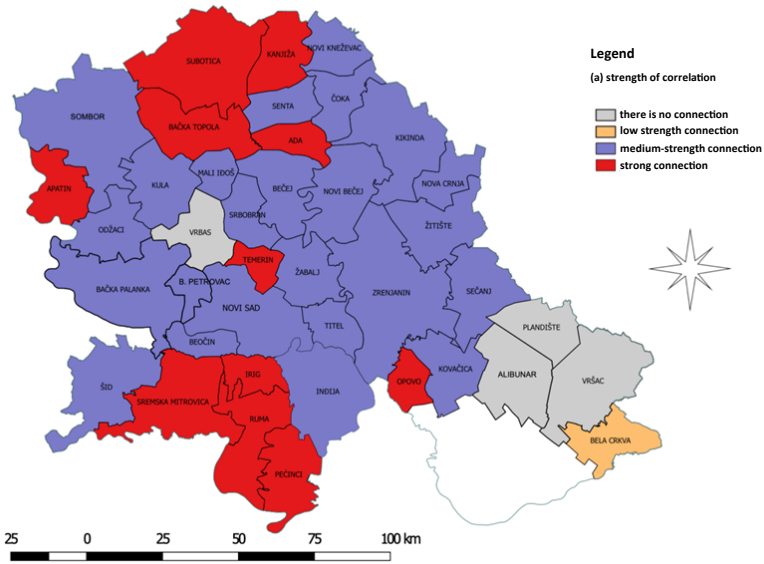


Figure 4: Spatial distribution of the correlation coefficient between the average maize yields and the drought index SPI4_August, by municipalities of Vojvodina.

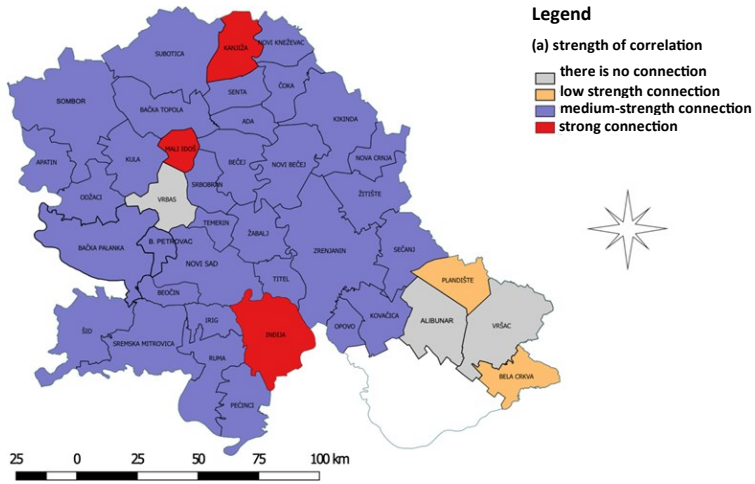


Figure 5: Spatial distribution of the correlation coefficient between the average maize and the drought index SPEI4_August, by municipalities of Vojvodina.

Further tests show that the analysed parameters do not have the same influence on the yield in Vojvodina. With additional analyses, it is possible to determine which of the analysed parameters has the most statistically significant and highest correlation with yields, which certainly depends on the type of crop grown in a given area.

CONCLUSION

As far as crop insurance in Serbia is concerned, farmers do not have an adequate insurance product that would respond to the increasingly frequent weather disasters that affect agricultural production, especially when it comes to crop insurance against the risk of drought. Index insurance using meteorological and climatological parameters does not exist on the territory of the Republic of Serbia.

For modelling an appropriate crop insurance product against drought risk, three indicators were identified that would be suitable for parametric crop insurance: precipitation, Standardised Precipitation Index (SPI) and Standardised Precipitation and Evapotranspiration Index (SPEI).

Statistical analyses confirmed the justification for finding a solution for drought risk management in agriculture in Vojvodina. Index insurance is recognised as a short-term measure that is most effective in increasing farmers' resilience to drought. Modelling an appropriate drought index was the basic prerequisite and basis for insuring this risk.

The aim of the insurance is to provide protection against unfavourable weather conditions that occur in years with extremely bad weather conditions and is not intended for areas where the climatic conditions are generally not suitable for insurance, i.e., where unfavourable weather conditions occur frequently. Usually, but not always, insurance policies are designed to protect against risks that occur once every seven to ten years or less. It is assumed that other, cheaper and more effective risk management strategies will be used to deal with more frequent but less severe risks. Climate risks, including drought risk, are influenced by climate change and the frequency of extreme events is changing. To ensure that a high frequency does not affect the sustainability of the insurance system, index-based insurance contracts have the option of managing the insurance risk by shifting the payout thresholds (which trigger the payment of the agreed compensation). This makes it possible to overcome the aforementioned limitation.

Finally, it is necessary to mention the legal limitations that this type of insurance may have, as the current legislation in the insurance sector does not recognise index insurance as an available form of insurance in the domestic market, but this can also be easily overcome through amendments to the Law on Insurance.

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THE HEALTHCARE SYSTEM RESILIENT TO DISASTERS

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INTERNATIONAL AND NATIONAL LEGAL FRAMEWORK FOR RESPONDING TO PUBLIC-HEALTH THREATS AS EMERGENCY SITUATIONS[1]

Marta Sjeničić, PhD[2]
Principal Research Fellow, Institute of Social Sciences, Belgrade

1 This paper was written as part of the 2023 Research Programme of the Institute of Social Sciences with the support of the Ministry of Science, Technological Development and Innovation of the Republic of Serbia

2 e-mail: marta.sjenicic@gmail.com

INTERNATIONAL AND NATIONAL LEGAL FRAMEWORK FOR RESPONDING TO PUBLIC-HEALTH THREATS AS EMERGENCY SITUATIONS

Summary: For emergencies of international concern, the most relevant document is the International Health Regulations (hereinafter: IHR). The World Health Organisation has decided to amend the IHR, as violation of them were identified during the pandemic and there were indications that it was not sufficiently effective. Reports presented at the WHA in May 2021 pointed out the need to develop stronger monitoring and evaluation mechanisms to identify and learn lessons from the COVID-19 pandemic. Perhaps most importantly, countries may have breached the IHR by failing to cooperate in the fight againstCOVID-19.

As far as Serbia is concerned, the 2016 Law on the Protection of Population from Communicable Diseases introduced novelties that bring it in line with international legislation. During the COVID-19 pandemic, stricter measures to protect population from communicable diseases, were introduced into the Law and implemented. During the pandemic, IT equipment was delivered to Institute of Public Health of Serbia and to 23 regional health institutes. The equipment should be used by infectious and other diseases experts to better coordinate their activities in the fight against the COVID-19 pandemic.

Although measures have been prescribed and implemented in Serbia and globally, the overall impression is that during the COVID-19 crisis numerous challenges for leadership at all levels of decision-making, lack of patterns and culture of communication, non-involvement of all interested parties important for problem identification and efficiency of the system have been revealed.

Keywords: *legal regulation, World Health Organisation, International Health Regulations, public-health emergency of international concern, international cooperation*

INTRODUCTION

The emergency situation (hereinafter: the ES) is defined by several national laws: the Law on Disaster Risk Reduction and Emergency Management (Art. 2, Para.1), the Law on Protection of the Population from Infectious Diseases (Art. 2, Para. 1) (hereinafter: the Law) and the Law on Public Health (Art. 2, P.1). In line with these laws, ES is a state that occurs by declaration of the competent authority when the risks and threats or consequences of disasters, extraordinary events and other hazards to the population, the environment and property are of such magnitude and intensity that their occurrence or consequences cannot be prevented or eliminated by regular measures of the competent authorities and services and it is therefore necessary to use special measures/forces and means with an enhanced work regime to mitigate

and eliminate them.

Public health emergency of international concern (hereinafter: PHEIC) is an extraordinary event that poses a threat to the public health of other States through the international spread of disease and may require a coordinated international response (International Health Regulations, 2005: 9).

There are also other national regulations that are relevant to public health: Public Health Strategy in the Republic of Serbia 2018-2026 and other health strategies (development of mental health, tobacco control, development of youth health, HIV strategy), the Law on Health Care, the Law on Health Insurance.

The most relevant international legal mechanism for the prevention for threats to public health is International Health Regulations (hereinafter: IHR). There are also several treaties that are relevant for human rights and thus also the right to health: Universal Declaration of Human Rights, International Covenant on Economic, Social and Cultural Rights and International Covenant on Civil and Political Rights. The World Health Assembly (hereinafter: WHA) can also issue recommendations and strategies in accordance with to Art. 23 of the Constitution of the World Health Organisation (hereinafter: the WHO) (Kreppenhofer, 2020/2021: 24).

In addition, there are relevant international and EU legal mechanisms in various areas that are considered to be of common importance for all EU Member States (communicable diseases, rare diseases, tobacco, cross-border healthcare, biomedicine, etc.). The competencies of the European Union are divided into exclusive competences (which belong exclusively to the EU), shared competences (with the Member States, which covers most areas) and coordinating competences (in which the EU supports, coordinates and complements the activities of the Member States in accordance with Art. 6 of the Treaty on the Functioning of the EU). Public health belongs to the last area of competence: the protection and improvement of human health – an area that remains largely a matter of national status policy and is thus managed by the Member States it in accordance with their own constitutional and cultural traditions (Sjeničić and Milenković, 2019: 506-507). Triggered by the COVID 19 pandemic, newly adopted EC regulations are already in place: Proposal for a Regulation of the European Parliament and of the Council on serious cross-border threats to health and repealing Decision No 1082/2013/EU Regulation on the extended mandate of the European Centre for Disease Prevention and Control (ECDC) and the Emergency Framework Regulation to confer additional powers on the European Health Emergency Preparedness and Response Authority (HERA).

For emergencies of international concern, the IHR are the most important, which are analysed in the following text together with their implementation during the COVID-19 pandemic.

INTERNATIONAL HEALTH REGULATIONS – CONTENT AND IMPLEMENTATION

The IHR are a binding treaty that contributes to global public health security by providing a framework for coordinating the management of events that may constitute PHEIC and that can improve the capacity of individual countries to detect, assess, notify and respond to these emergencies. The IHR were adopted in 1969. The need for their revision resulted from the increase in international traffic and travel, and thus the increased risk of the spread of infectious diseases in the international environment. In 2005, an intergovernmental working group formed by the WHO expanded the IHR, which entered into force in 2007. Serbia is one of the 194 member countries of the WHO, and one of the 196 countries that ratified the IRC.

The IHR allow the WHO to coordinate a global disease surveillance network consisted of surveillance systems with each state to detect outbreaks that could escalate into international health emergencies and report them to the WHO (Hathaway and Phillips-Robins, 2020,: 1). States have internal laws that govern reporting in emergency situations and focus on threats that jeopardise public health within the state in emergency situations. When it comes to the obligations prescribed by the IHR, state signatory states should fulfil these until 2012, but the adoption could be postponed until 2016.

The IHR not only allow the WHO the ability to declare an emergency, but also impose four main requirements on the WHO members. first, they must notify the WHO within 24 hours of any public health event in their territory that might constitute an international public health emergency in accordance with the Annex 2 of the IHR (Figure 1). After states had sent a notification to the WHO, they must keep the WHO informed with "timely, accurate and sufficiently detailed" information about the public health event. Second, states must improve their national capacities to prevent, detect, and respond to the spread of diseases that pose a threat to the international community. States can decide for themselves how they will fulfil this obligation, but they must "uphold the purpose" of the regulations through their national efforts. Third, states are limited in in their ability to respond to disease outbreaks once they have occurred. The regulations instruct countries to only take those measures that are supported by scientific evidence, proportionate to the risks and respectful of human rights. In general, health measures must follow the WHO recommendations, although states are allowed to impose additional measures in certain circumstances. Finally, governments must notify the WHO of any public health measures they take that constitute a "significant interference" with international travel – i.e., delaying the entry or departure of travellers or goods by more than 24 hours – and provide the reasons and evidence for the measure (Hathaway and Phillips-Robins, 2020: 2).

ANNEX 2
DECISION INSTRUMENT FOR THE ASSESSMENT AND NOTIFICATION OF EVENTS THAT MAY CONSTITUTE A PUBLIC HEALTH EMERGENCY OF INTERNATIONAL CONCERN

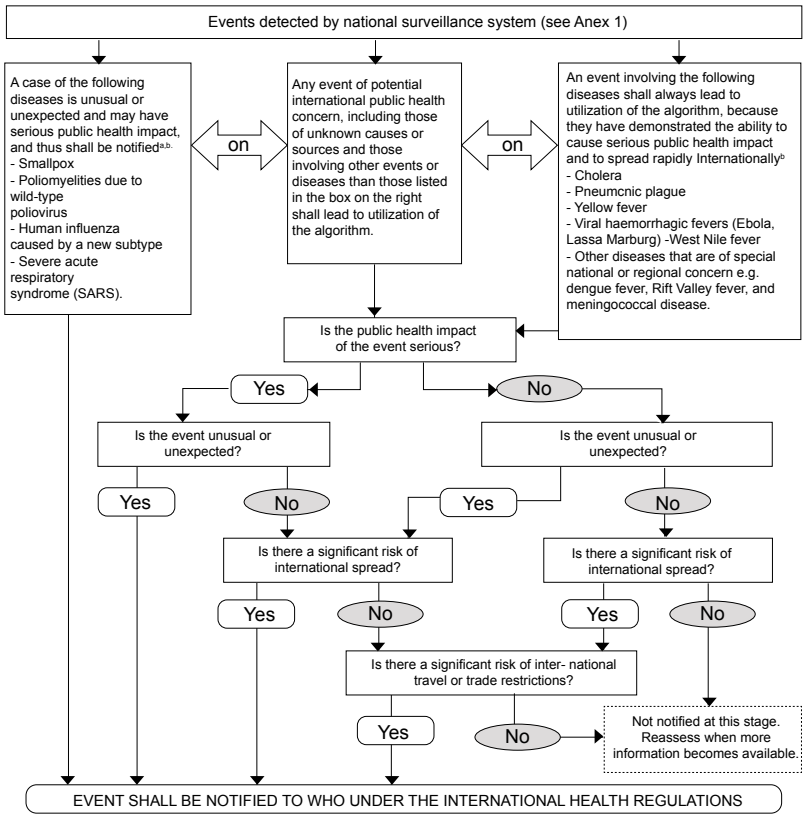

Figure 1: Annex 2 of the IHR

The WHO Director-General determines whether an event is a PHEIC in accordance with the criteria and the procedure set out in the IHR (the IHR, 2005, Art. 12) on the basis of information received, in particular from the State Party on whose territory the event occurs, and issue recommendations. The basic activities of the WHO appointing a focal point; assisting signatory states in assessing public health risks through information, consultations and verification process; informing states on the existence of risk; recommending public health measures; assisting states in investigating the existence of epidemics and fulfilling the requirements of the IHR.

The WHO has set up an IHR Emergency Committee for the coronavirus disease pandemic, which met on 13 October 2022 for its last, thirteenth meeting to date (the WHO, 2022). In addition to recommendations to strengthen COVID-19 surveillance, it was decided that the IHR should be amended due to the identified breaches during the pandemic and evidence of their possible insufficient effectiveness.

POTENTIAL VIOLATION OF THE IHR DURING THE COVID-19 PANDEMIC AND THE INITIATIVE TO AMEND THEM

Despite various reforms implemented over years that have enhanced the WHO's normative, technical and operational capabilities in relation to public health threats, the outbreak of the COVID-19 has demonstrated that the WHO was unable to prevent the international spread of the pandemic (Müller et al., 2021: 32). China first reported a cluster of novel coronavirus-like infections to the WHO on 31 December 2019, but the disease was already circulating in Wuhan a few weeks earlier. Even after China reported the cluster of cases on 31 December, it took the WHO a month to declare a PHEIC (Hathaway and Phillips-Robins, 2020: 3). The Emergency Committee withheld the declaration because it did not know the source of infection and was reluctant to declare a pandemic to prevent transmission (Sohn et al., 2021: 3). Incidentally, the same critic criticism also applies to the delayed declaration of the Ebola outbreak in West Africa as a PHEIC in 2014, while the WHO's overall response to the SARS outbreak was evaluated positively overall (Müller et al., 2021: 24).

The WHO's regulations require states to generally follow its recommendations when responding to disease outbreaks. When states take health measures that go beyond WHO recommendations, these measures must be as effective as (or more than) WHO's recommendations, follow scientific principles and evidence, not be more disruptive to international travel or "more invasive or intrusive to people" than "reasonably available alternatives" and be implemented with "full respect" for "human dignity, human rights and fundamental freedoms." (Hathaway and Phillips-Robins, 2020: 4). The introduction of measures to protect the public health of the population, such as movement restrictions, curfews, work restrictions for businesses in various sectors, bans on gatherings and events, travel restrictions, quarantine, isolation, social distancing measures, etc., have been the way to reduce virus transmission in most countries. The application of these measures had an impact on restriction of human rights, but also on the state of democracy in certain countries (Nikolić Popadić and Milenković, 2021: 188). The IHR restrictions stipulate that each country is able to detect and notify the WHO of new infections. In reality, however, it is not possible for all countries in the world to accurately detect the substance of new infections and even identify and report their countermeasures to WHO (Sohn et al., 2021: 3).

The questions were already being asked during the pandemic: what approaches have proven effective in addressing the global health challenges associated with COVID-19, what efforts need to be scaled up to end this pandemic, and what can we learn from these findings about preventing future pandemics. Three reports presented at the WHA in May 2021 were tasked with answering these questions: (i) the IHR Review Committee, (ii) the Independent Panel for Pandemic Preparedness & Response, (iii) and the Independent Oversight and Advisory Committee. Among other conclusions,

the three reports point out the need to develop stronger monitoring and evaluation mechanisms to identify and learn lessons from the COVID-19 pandemic. Perhaps most importantly, countries may have breached the IHR by failing to cooperate in fight against the COVID-19 (Seidler and Wientzek, 2021: 2-3). The control and sovereignty that members have retained undermines the WHO's ability to act efficiently and effectively in the event of a public health emergency, especially in a global political climate where some individual states choose to go it alone and forego global solidarity initiatives (Müller et al., 2021: 40).

Among the IHR problems that were continuously raised, the COVID-19 highlighted: 1) the provision of notifications and information based on the evaluation of potential PHEICs. 2) the timing of WHO's PHEIC decisions and declaration, procedures and warning systems, 3) infectious disease response measures against the IHR, 4) the WHO's lack of funds (Sohn et al., 2021: 4).

Holistically, when considering the purpose of the IHR and the intentions of its drafters, it is clear that, the IHR as a legal instrument does not place the WHO or its individual members in the strongest position to deal with unknown, contagious, and long-lasting and large-scale disease outbreaks. The IHR have not been drafted in such a way that the WHO has the necessary tools and, above all, sufficient flexibility to act in such circumstances. The IHR are characterised by rigidity and constraints that allow members to retain decisive control. In addition, although the IHR contain provisions for the prevention and control of disease outbreaks and their international spread, they hardly contain any permanent and wide-scale response measures. (Müller et al., 2021: 40-41).

FURTHER STEPS AND WHERE WE ARE

The actions related to the IHR that were proposed at the 73rd WHA session, held in November 2020, and that were to follow after the evaluation process, were, in short:

First, in terms of compliance: 1) the states failure to comply with certain obligations under the IHR, particularly in terms of preparedness, contributed to the COVID-19 pandemic becoming a protracted global health emergency; 2) Responsibility for implementing the IHR must be transferred to the highest level of government, as the WHO found that it had little power to convince states to follow the provisions of the IHR in the midst of a crisis (Hathaway and Phillips-Robins, 2020, p.6); 3) A robust accountability mechanism to assess and improve compliance with the IHR obligations would strengthen preparedness, international cooperation and timely notifications of public health events.

Second, in terms of early warning, notification and response: 4) Early warning is important to initiate timely action; 5) Early response requires better collaboration, coordination, and trust; 6) Applying the precautionary principle in the implementation of travel-related measures would enable early action against an emerging pathogen

with pandemic potential.

And the third, in terms of funding and political commitments: 7) Effective implementation of the IHR requires predictable and sustainable funding at both national and international levels; 8) A new era of international cooperation is needed to better support the implementation of the IHR.

The potential benefits of coordinated multilateral approaches, but also the slow pace and frustrations of reaching consensus between different countries, were clearly visible at the WHA session held in May 2022. Health leaders from around the world wrestled with relatively incremental changes to health security mechanisms, agreeing only to initiate a two-year process to modernise the IHR (Bristol, 2022: 1). Perceived failures in the response to COVID-19 and other health emergencies, have highlighted the need for faster and more effective communication between counties affected by outbreak and the WHO, as well as mechanisms to improve the compliance with the IHR. Decisions adopted at this year's WHA session call on the countries to submit proposals for amendments to the IHR to a newly designated Working Group on Amendments to the IHR by the end of September. The working group will develop a package of targeted amendments for the 2024 WHA session based on those proposals and input from the IHR Review Committee convened by the WHO. A separate decision specifies how much time countries have to express reservations about new amendments and sets the effective date to one year after approval (Bristol, 2022: 1).

SERBIAN LEGISLATION AND IMPLEMENTATION OF THE IHR IN SERBIA 2021

As already mentioned, the prevention and control of infectious diseases in Serbia is regulated by the Law on Protection of Population from Infectious Diseases and a number of regularly adopted by-laws, as well as by-laws adopted in connection with COVID-19. The Law regulates the list of notifiable infectious diseases, measures to protect against infectious diseases, and other related issues. Law and stemming by-laws mainly regulate conventional surveillance of infectious diseases, which is based on structured data that is reported regularly. The surveillance of infectious disease is carried out by the Centre for Disease Prevention and Control, a department of the Institute of Public Health of Serbia „Dr. Milan Jovanović Batut" (hereinafter: IPHS). The epidemiological reporting and monitoring of public health threats is based on structured, but also unstructured data from various (in)formal sources of information. The IPHS has established the Communication Centre (hereinafter: the CC) as a National Focal Point within the Centre for Disease Prevention and Control. The tasks of the CC are: data collection, threat assessment and verification, archiving and dissemination of information, support to regional institutes and institutes for public health (Tiede et al., 2013: 76), reporting on infectious diseases that pose a

potential threat, communication and cooperation with relevant institutions and support to the implementation of the IHR. The CC is the channel, the tool for data collecting, processing and exchange and for supporting the regional institutes for public health (Sjeničić and Miljuš, 2014: 5).

Regional institutes for Public Health play an active role in epidemiological reporting and they appointed Coordinators for the IHR. At the level of the Republic of Serbia (hereinafter: the RS), the network of Coordinators was formed to enable fast and efficient communication. This network is important for communication with the CC in the IPHS, but also for contact between regional institutes. Coordinator notifies the CC of the occurrence of a specific event in the territory for which s/he is responsible (Sjeničić and Miljuš, 2014: 6).

The 2016 Law introduced novelties that brought it in line with international legislation: surveillance and reporting in accordance with case definitions; measures prohibiting travel, movement, traffic in the event of infection; appointment of the IPHS as the National Focal Point for IHR. During the COVID-19 pandemic (in 2020), stricter measures for protection of population from communicable diseases, were included in the Law.

The United States Agency for International Development, in partnership with the United Nations Development Program, delivered equipment to the IPHS and to 23 regional health institutes. The provided IT equipment was to be used by infectious and non-infectious disease experts to better coordinate their activities in the fight against the COVID-19 pandemic.

In addition, at the time of the COVID-19 pandemic, a number of related by-laws (decisions, orders) were adopted related to restrictions on entry into the RS, movement within the RS and other precautionary measures. They stipulate, for example, that a written notice with a health warning about the measures to be followed to prevent the occurrence, spread and suppression of COVID-19 would be posted at the entrance to the RS, in visible places at border crossings. It was also regulated that other written notifications in the form of a health warning could be delivered during passport control. Bus carriers with valid international licences for the transport of passengers by road transport were only allowed to deviate from the approved timetable, which is an integral part of the license, if there was a declared need for certain international passenger transport and the approval of foreign countries to carry out passenger transport on their territory in accordance with the current epidemiological situation (Zekavica and Sjeničić, 2020: 56; Sjeničić, 2020: 64-67; Sjeničić, 2021: 28-30).

The social distancing measures were all prescribed in binding documents, and were gradually introduced, from the date of the declaration of the emergency situation on 16 March 2020. On 16 March 2020 the checks for travellers at airports and other border crossings and quarantine measures were introduced. The Commission, which allowed transit traffic, as an exception to entry into Serbia and movement within

the country, was formed. The city and intercity local transportation were reduced to minimum (Sjeničić, 2020: 36).

Although many measures were prescribed and implemented, the overall impression is that during the COVID-19 crisis, numerous challenges for leadership at all levels of decision-making, lack of patterns and culture of communication, non-inclusion of all interested parties important for problem recognition and efficiency of the system were revealed ever since the beginning of the crisis development.

CONCLUSION

When considering the purpose of the IHR and the intentions of its drafters, it becomes clear that the IHR as a legal instrument do not put the WHO or its individual members in the strongest position to deal with unknown, contagious, and long-lasting large-scale disease outbreaks. The IHR have not been not drafted in such a way that the WHO has necessary tools and, above all, sufficient flexibility to act in such circumstances. The IHR allows members to retain decisive control, and what is more, while the IHR contain provisions to prevent and control disease outbreaks and their international spread, they hardly contain any permanent and wide-scale response measures. Future global health governance reforms should aim to improve and enhance prevention, preparedness, and response to a wide-range of health emergencies that may arise in the future. To this end, the WHO has initiated the process to amend the IHR. So far, world health leaders agreed on relatively incremental changes to health security mechanisms, agreeing only to initiate a two-year process for modernising the IHR.

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PROTECTING PUBLIC HEALTH IN EMERGENCIES

Slađana Jović, PhD[1]
Full professor, University of Belgrade, Faculty of Security Studies

1 e-mail: sladjana.jovic@fb.bg.ac.rs

PROTECTING PUBLIC HEALTH IN EMERGENCIES

Summary: Current global health threats of the 21st century include infectious disease pandemics, bioterrorism, the use of biological and chemical weapons, food-borne diseases, natural disasters, chemical or radio-nuclear incidents, and the health consequences of wars, conflicts, climate change and migration over the last decade. Protecting public health in the face of multiple health risks and threats to international and national security requires numerous proactive and reactive measures to reduce vulnerability to events that jeopardise the collective health of populations around the world. The most common health problems in disasters/emergencies are injuries, psychological problems due to emotional stress, the spread of infectious diseases and the increase in the number of patients with endemic diseases. All these problems require a special organisation of the health care system and the entire social community in order to better protect public health. In the Republic of Serbia, the area of public health protection in emergency situations is very well regulated by various laws. In practise, the national system for protection and rescue and public health protection in disasters has shown a high level of preparedness and has responded adequately to the challenges. Areas that still require improvement include the prevention of infectious diseases in emergency situations, psychosocial support and assistance for at-risk populations, including professionals and volunteers, as well as enhanced support for marginalized communities, which remain extremely vulnerable even in times of peace

Keywords: *public health, disasters, health threats, vulnerability, marginalised groups*

REGULAR AND EMERGENCY SITUATION IN THE COMMUNITY

Numerous health risks and threats in the modern world can threaten international and national security and cause a normal situation in a community to become an emergency. A normal (regular) situation in a community means that the safety of the population is not threatened and that systems, government facilities and services such as health and veterinary services, undamaged infrastructure and means of communication, and regular supplies of water, food and foodstuffs are functioning normally. The work of municipal services for the disposal of solid and liquid waste, funeral services and the maintenance of general hygiene in a regular situation are taking place without interruption. The ecosystem is in balance, the presence and activity of pathogens is normal, as are the health problems of the population related to illness and death.

An emergency situation suddenly and drastically disrupts the social and ecological balance in the affected area, which worsens the sanitary and epidemiological situation

and can lead to mass suffering of the population, major damage to the infrastructure and increased need for assistance from the population, which the affected community is often unable to resolve on its own and with its own resources. An emergency situation is defined as an unexpected, sudden and immediate threat to the health and lives of people, animals and plants in a specific area caused by the effects of nature in the form of weather disasters, earthquakes, fires, tornadoes, tsunamis and the like, or by human activity such as technical and technological hazards and acts of war. Whether a situation is classified as an emergency or a disaster depends primarily on the actors directly and indirectly involved in the situation. An emergency situation is initially a hazard that is resolved by a predefined action plan and the resources currently available. However, if the emergency situation exceeds the possibilities of overcoming it with the planned measures and resources, then it becomes a crisis situation. If no suitable way is found to deal with the emerging crisis, or if it is dealt with in an inadequate manner, a state of catastrophe is reached (Jakovljević, 2011).

Emergency situations are often fertile ground for the development of epidemics or pandemics of infectious diseases (ECDC, 2020) as they can drastically disrupt the social and ecological balance in the affected areas and lead to a deterioration of the sanitary and epidemiological situation.

According to *the Law on Disaster Risk Reduction and Emergency Management*, an emergency situation is a condition created by the declaration of a competent authority when the risks and threats or the resulting consequences for the population, the environment and material and cultural assets are of such magnitude and intensity that their occurrence or consequences cannot be prevented or eliminated by the regular measures of the competent authorities and services, which is why it is necessary to use special measures, forces and means to mitigate and eliminate them, with an increased workload.'' (Official Gazette of the RS, 2018).

The emergency management system enables the management and command, control and coordination of emergency services in disasters, i.e. in all types of emergency situations. (Mlađan et al. 2012). The proclamation of a state of emergency at the level of the Republic falls within the competence of the Government, the proclamation of a state of war and a state of emergency within the competence of the Assembly of the Republic. A state of emergency may be declared for part or all of a municipality, a city or part or all of the territory of the Republic of Serbia. The basic task of public health in emergency situations is to protect public health. All public health measures and activities aimed at maintaining and improving public health also represent the general interest of society as a whole (Affun-Adegbulu, 2018).

LEGAL BASIS FOR PUBLIC HEALTH AND OTHER SYSTEMS' RESPONSE IN EMERGENCY SITUATIONS

The main laws that regulate the response of the health system and the entire social community in emergency situations are the Law on Emergency Situations (2012), Law on Disaster Risk Reduction and Emergency Management (2018), Law on Health Protection (2019), Law on Public Health (2016), Law on Protection of the Population from Infectious Diseases (2016) and Law on the Amendments to the Law on Protection of the Population from Infectious Diseases (2020).

According to our legislation, healthcare is conceived as an organised, comprehensive activity of society, the fundamental aim of which is to achieve the highest possible level of health protection for citizens and families.

The Law on Health Protection regulates the healthcare system in the Republic of Serbia in regular and emergency situations. *Health protection* as an organised and comprehensive activity of society includes the implementation of measures to maintain and improve the health of citizens, the prevention, suppression and early detection of diseases, injuries and other health disorders, as well as timely and effective treatment and rehabilitation. In addition, the information needed by the population or individuals to act responsibly and exercise the right to health must be provided.

The general interest of health protection is the prevention and elimination of health consequences caused by natural and other disasters and emergencies.

The Law on Public Health regulates the areas of action of public health, responsibilities, planning, the implementation of activities related to the maintenance and improvement of the health of the population and the method of financing. The aim of this Law is to exercise the public interest by creating the conditions for maintaining and improving the health of the population through the comprehensive activities of society.

Public health is a set of knowledge, skills and activities aimed at improving health, preventing and suppressing diseases and prolonging and improving the quality of life through organised activities of society. *The public health system* is a system that creates the conditions for maintaining and improving the health of the population through the activities of public health organisations and participants

The areas of action of public health are: 1) physical, mental and social health of the population; 2) health promotion and disease prevention; 3) environment and health of the population; 4) working environment and health of the population; 5) organisation and functioning of the health system; 6) dealing with crisis and emergency situations".

The Law stipulates that public health activities in crisis and emergency situations include the following: 1) assessing the risk to public health associated with crisis

and emergency situations; 2) acting in accordance with the law regulating activity in crisis and emergency situations and in accordance with the national response programme of the health sector in crisis and emergency situations in cooperation with the competent authorities and services; 3) preparing protection and rescue plans and action plans for crisis and emergency situations; 4) providing and sharing information in crisis and emergency situations in accordance with the law and action plans."

*The national body for managing the response of the health secto*r in crisis and emergency situations is formed, proposed and activated by the Minister of Health, as are the public health institutes and bodies in the area for which they have been established, where they coordinate and carry out their activities. The national body and the public health institutes and organisations determine the necessary measures to be observed by legal entities, entrepreneurs and natural persons to whom the measures apply.

The Law on Disaster Risk Reduction and Emergency Management regulates disaster risk reduction, prevention and strengthening the resilience and preparedness of individuals and communities to respond to the consequences of disasters. The system of disaster risk reduction and emergency management is of particular interest to the Republic of Serbia and is part of the national security system.

According to the above-mentioned Law, a *disaster* is an natural event or a technical and technological accident, *the consequences* of which threaten the safety, life and health of a large number of people, material and cultural assets or the environment on a large scale, and the occurrence or consequences of which cannot be prevented or eliminated by regular measures taken by the competent authorities, bodies and services;

A *natural disaster* is a phenomenon of hydrological, meteorological, geological or biological origin caused by the action of natural forces such as earthquakes, floods, torrents, storms, heavy rainfall, atmospheric discharges, hail, drought, rockslides or landslides, snowdrifts and avalanches, extreme air temperatures, accumulation of ice on the watercourse, pandemic, epidemic of infectious diseases, epidemic of infectious diseases in livestock farming and occurrence of pests as well as other natural phenomena of major proportions that can threaten the safety, life and health of a large number of people, material and cultural assets or the environment on a large scale;

A technical and technical accident is a sudden and uncontrollable event or series of events that have got out of control in the management of certain work equipment and in the handling of hazardous substances during production, use, transport, trading, processing, storage and disposal, such as, for example fire, explosion, accident, traffic accident in road, river, rail and air transport, accident in mines and tunnels, standstill of cableways for passenger transport, collapse of dams, accidents in electricity, oil

and gas plants, accidents when handling radioactive and nuclear material, serious soil, water and air pollution, the consequences of war destruction and terrorism, the consequences of which can threaten the safety, life and health of a large number of people, material and cultural assets or the environment on a larger scale;

According to Article 3 of the above-mentioned Law, disaster risk reduction and emergency management are a national and local priority. Everyone has the right to protection from the consequences of disasters without any discrimination, and the protection and saving of human lives takes precedence over all other protection and rescue measures. Citizens affected by the consequences of disasters have the right to assistance according to their needs and priorities, provided by humanitarian and other registered organisations in accordance with the Law, and if they have suffered major material damage, they also have the right to state assistance in accordance with a special law.

The Law on Protection of the Population against Infectious Diseases is the main normative document of the Republic of Serbia dealing with the prevention and control of infectious diseases. According to this Law, an epidemic of an infectious disease is declared by the Minister of Health on the proposal of the Republican Expert Commission for the Protection of the Population against Infectious Diseases and the Institute of Public Health. The Institute of Public Health of the Republic of Serbia coordinates the implementation of epidemiological surveillance on the territory of the Republic of Serbia in accordance with the recommendations of the European Centre for Disease Prevention and Control and the World Health Organisation.

Preventing the introduction of infectious diseases into the country and their transmission to other countries is an issue specifically addressed by the Law. To this end, the Minister of Health can order a ban on the free movement of the population, a ban on travelling to a country where a certain disease is epidemic, a ban on the movement of certain types of goods and products, etc. *The Rulebook on the notification of infectious diseases and special health problems* was adopted in 2017 and amended in 2018. It defines which cases are subject to the reporting obligation for infectious diseases.

THE MOST COMMON DAMAGE TO HEALTH IN EMERGENCY SITUATIONS AND THE PROTECTION OF PUBLIC HEALTH

Emergency situations in the Republic of Serbia require a special organisation of the health system and society as a whole in order to maintain public health. In recent decades, these have mostly been earthquakes, floods and major fires, as well as epidemics, including the COVID-19 epidemic, which developed into a pandemic and affected the whole world (Zhou et al. 2020).

In the event of an emergency, a rapid public health risk assessment will be conducted, mobile teams will be organised for deployment to the field and a permanent standby of health and other professionals in primary health care and hospitals will be established, while it is important to maintain security in the said facilities (Salamati and Udayangani, 2017). To keep the population informed and receive feedback, communication and command channels are established through available media for mass communication as well as multidisciplinary collaboration with other health system services and collaboration with other relevant sectors. It is important to establish cooperation with relevant health services, competent authorities of the local municipality and cooperation with other state sectors involved in the elimination of the consequences. (Mitrović, M., Gavrilović, A., 2013). Cooperation and coordination of activities with the non-governmental sector, including the Red Cross, Red Crescent, media, religious communities and NGOs, as well as their organised participation in the elimination of the consequences of an emergency situation are also very important

The most common damage to health in emergency situations are injuries (mechanical, thermal, chemical, radiation), emotional stress and trauma, epidemics of infectious diseases and a possible increase in endemic diseases, which also occur in the affected area, but in much smaller numbers. Each emergency situation creates specific epidemiological, hygienic and socio-medical problems, depending on the type, intensity, duration, suddenness and time of occurrence. After an unexpected event, there are sudden and drastic changes in the way of life, such as an interrupted water supply, deteriorating sanitary conditions and overcrowding in emergency shelters. In most cases, health services are overloaded and the established activities of institutes and facilities are interrupted in monitoring the epidemiological situation and implementing measures to prevent the spread of infections (Đokić, 2011).

Infectious diseases can be a cause, but also a consequence of emergency situations. The characteristics of epidemics that lead to emergency situations are the utmost severity of the disease with high mortality, the massive and explosive course of the disease, the risk of transmission to new areas and spread beyond the country's borders, as well as major economic and social consequences and the inability of the healthcare system to stop the epidemic. (Zhang et al. 2020).

Factors that influence the effectiveness of epidemic control are: the epidemiological situation prior to the emergency situation, the severity and extent of destruction of the community's infrastructure, climatic factors, the psychophysical preparedness, health culture and health awareness of the population at risk, and the willingness and ability of the health system to operate under emergency conditions.

The most important measures to protect public health during epidemics are the provision of hygienically safe drinking water and the constant control of its microbiological and chemical water potability as well as the provision of safe food

and the constant sanitary control of the transport, storage and distribution of food and the control of its microbiological and chemical water potability. Continuous sanitary control of general hygiene in public kitchens and the personal hygiene of staff involved in the preparation and distribution of food in collective accommodation centres is very important. Sanitary supervision of collective accommodation centres and the creation of conditions for maintaining personal and general hygiene, as well as sanitary supervision of solid and liquid waste disposal in collective accommodation centres and public kitchens should be carried out regularly. Continuous disinfection, disinsection and pest control are carried out and samples are taken for laboratory analysis. Immunization of the population is carried out in an organised manner when there is evidence for its use and recommendations from the World Health Organisation (ACIP, 2015; WHO, 2015). General epidemiological monitoring of the health status of the population at risk is also being tightened, as is monitoring through the ALERT system. (Zhang et al. 2020).

The above activities last from the first day of the emergency situation until the return to all characteristics of the regular situation. The activities of the healthcare system in emergency situations take place in two phases. The first is the acute phase of immediate danger, the so-called "survival phase", in which the most urgent obligation of the health care system is to care for the injured population by providing first aid, i.e., taking care of life-threatening injuries, through emergency medical assistance and initial psychological help for the people at risk (Van Damme et al. 2002). The number of casualties reflects the severity of the disaster, but is not the only indicator of the extent of the need for emergency medical assistance. At this stage, a rapid risk assessment is carried out and then the need for support in terms of personnel, material resources, medicines, hospital capacity and transport is defined, and if necessary, international assistance can be requested (Jevtić and Jevtić, 2017). Activities on the ground are carried out quickly, efficiently, in a coordinated and rationalised manner. The second phase is the phase of "coping with the consequences". It takes place through the reconstruction and relief system, lasts much longer and includes numerous activities that are undertaken until a regular situation is established.

The consequences of emergencies for the individual, family and community often include major life changes, the loss of a family member, job, material possessions and far-reaching changes to health (Clements, 2016). A stressful life event increases a person's general anxiety and vulnerability, and the development of irrational fears is also possible if a disposition is present. (Zotović, 2002). The first panic attack often occurs after a particularly stressful period, after stressful situations mentioned above and after some subjectively important problems that a person cannot solve.

In emergency situations, civilians are often forced to leave their homes or face the loss of loved ones, property, jobs, etc., all of which cause great stress. Victims of emergency situations are people who are directly affected or injured and need urgent and specialised medical assistance, people who are directly psychologically,

physically or materially harmed, and people who have lost their loved ones or have no information about their fate, as well as and witnesses of violence and disasters, as well as members of emergency and other services, professionals involved in the provision of assistance, but also in the rehabilitation of emergency situations. (Baez, 2011).

The most common psychological reactions of people who have survived an emergency situation are fear, anxiety, panic, crisis and stress reaction (post-traumatic stress disorder - PTSD). PTSD is a delayed or prolonged reaction to a stressful event, a situation that is extremely threatening to one's life or condition, and most often it is a disaster. An emergency situation is often accompanied by various forms of group reaction, especially among emotionally connected members of the group, which further promotes the intensity of the reaction of the individual members in the group. The attachment of the group members stems from the fear for the existence, not only of the individual, but also of the other members of the group (Nenadović, 2012).

The International Classification of Diseases, Injuries and Causes of Death recognises numerous illnesses in the group "Mental reactions and mental disorders" that are diagnosed as a result of stress in disasters: acute and transient psychotic disorders, reactions to severe stress and adjustment disorders, acute stress reaction, post-traumatic stress disorder, adjustment disorders, short-term depressive reaction, persistent depressive reaction, mixed anxious and depressive reaction, with dominant disorders of other emotions and behavioural disorders, reactions to severe stress, unspecified reactions, up to permanent personality changes after a catastrophic experience.

PSYCHOSOCIAL SUPPORT FOR THE POPULATION IN EMERGENCY SITUATIONS

The psychosocial support programme covers all the needs of those in need, apart from the basic biological needs necessary for survival. Specialised branches of medicine and psychiatry, "disaster medicine" and "disaster psychiatry", have been developed to better understand the problem and provide appropriate support to those at risk.

The consequences of an emergency situation depend on its extent and severity and, to a large extent, on the characteristics of the community, especially the development of the social network that provides support to those at risk.

Psychosocial support in emergency situations is provided by health institutions and institutions of all other social sectors, humanitarian organisations, international organisations, civil associations and associations of the vulnerable themselves, but also by the social support network consisting of family, group and community. The goals of psychosocial support for vulnerable people are to prevent and mitigate psychosocial stressors, strengthen the resilience and ability of vulnerable people to successfully cope with stressful situations, and mitigate and eliminate the

consequences of stress (Nenadović, 2012).

Much of public health promotes equity, quality and accessibility of healthcare (Afolabi, 2018). Public health is the science of protecting and improving the health of people and their communities. This work is done through the promotion of healthy lifestyles, research into the prevention of disease and injury, and the detection, prevention and control of infectious diseases. Public health is concerned with protecting the health of the entire population. This population can be small, like a local neighbourhood, or large, like an entire country or region of the world. (CDC, 2022).

Particular attention should be paid to marginalised groups who are at risk and extremely vulnerable even in normal situations. (Afolabi, 2012). Marginalised groups are disadvantaged, medically underserved or hard-to-reach groups that are more likely to be affected by health and social inequalities and often have poorer health and social outcomes in disaster/emergency situations. The extent of marginalisation is influenced by an individual's personal characteristics, including gender, ethnicity, education, employment and religious beliefs. They tend to be socially isolated groups due to their geographical setting (e.g., older people in long-term care facilities). Members of marginalised groups often do not fit into prevailing models of healthcare provision (e.g. black, Asian and minority ethnic (BAME) groups in Western countries), meaning that marginalisation affects access to, uptake of and experiences of healthcare services. Often, members of marginalised groups are inadequately covered by healthcare because they have limited engagement with healthcare providers (Cheshmehzangi, 2022).

The mental health of the population is extremely vulnerable in disaster conditions and available data also indicates significant ethnic disparities in access, experience and outcomes of mental health services, as well as the lack of training of health professionals in this area. Policy recommendations include: collecting data on the ethnicity of service users, making health professionals more aware of the cultural needs of black and minority ethnic groups, recruiting BAME staff to mental health services and improving community involvement (Hussain, 2022).

Psychosocial support can be compromised when those expected to help, professional rescuers and aid providers, are also under the influence of a traumatic event (Gačić, Jović, Terzić et al, 2021). The reactions of rescuers depend on the degree of openness, the ability to control reactions, the level of social intelligence, the willingness to cooperate and emotional stability. necessary rescue teams (responders) may show impaired cognitive functions and excessive identification with the victims due to work overload (Osborne, D. et al, 2013). The conflict role arises from the fact that the rescuers are in the role of the one who provides help and at the same time cannot fulfil their role as parents or partners to help their parents or children because in some situations they do not even know what is happening to their families. They are expected to be prepared for any scenario, which puts a lot of psychological pressure

on them. Numerous moral dilemmas arise from situations where they have to decide who to help first - a child, a pregnant woman or a frail elderly person. All this indicates that the rescuers themselves need support. In this sense, it is advisable to hold regular meetings, take advice from more experienced managers and colleagues, improve the organisational culture, talk about stress and pressure (ventilate problems) and carry out activities in pairs.

Readiness of professionals and volunteers refers to preparedness for a situation where strong emotional reactions are expected and knowing how to respond, how to promote calmness and positive coping. It is important that volunteers and professionals who come into contact with directly affected people are able to recognise the first signs of panic and be ready to help (Todorović, Vračević, Ric Richter, 2018). Training is an important part of disaster preparedness programmes.

Preparedness in a normal situation is paramount to rapid and effective response and protection of public health when unexpected emergency situations occur (FEMA, 2007). The activities of the health system and all other systems of societal importance are defined by existing legal frameworks. All response plans and guidelines should be updated every two years.

An adequate response to an emergency situation requires the activities of a large number of people and teams: emergency response team, decision makers at different levels, governments, citizens, media representatives. Their tasks range from simple monitoring of the development of the situation to very difficult decisions, which is why good cooperation, communication and understanding are of particular importance for the units and institutions directly involved in emergency management (Miljković, 2021).

Experience from the previous period has shown that the national security system of the Republic of Serbia, especially the health and social protection system and the protection and rescue system, is ready to respond preventively and reactively in emergency situations. In order to be even better prepared and coordinated, regional and international cooperation is required, which has so far been successfully led by the World Health Organisation (Jović, 2022).

Public health security encompasses a range of activities, both proactive and reactive, that are necessary to reduce vulnerability to events that jeopardise the collective health of populations around the world and whose absence has a negative impact on all aspects of society at a global level (Jović, Gačić, Jakovljević, 2017).

New global health threats in the 21st century include infectious disease pandemics, bioterrorism, biological and chemical weapons, food-borne diseases, natural disasters causing catastrophes, chemical or radio-nuclear incidents, and the health consequences of wars, conflicts, climate change and migration over the last decades (Gačić, Jović, Jakovlljević, 2017). Global prevention programmes should be prepared and led by the world's best experts in public health, surveillance, informatics,

management, laboratory systems and other relevant disciplines (Brouwers, 2018). Partnerships between countries and ministries of health are important to improve the quality and quantity of critical public health infrastructure and enhance global health and public safety.

CONCLUSION

Emergency situations require a special organisation of the healthcare system in order to better protect public health. Immediately after the occurrence of an emergency situation, a rapid risk assessment is required, followed by the determination of the necessary additional assistance in terms of personnel, material resources, medicines, hospital capacity and means of transport, and in the latter case, international assistance can be requested. The health problems most frequently encountered in emergency situations are injuries, psychological problems due to emotional stress, the spread of infectious diseases and an increase in the number of patients with endemic diseases that were already present in the area. During this time, psychosocial support for citizens is of great importance in addition to medical care. International co-operation in healthcare is a key factor in protecting and maintaining the public health of the population in all countries of the modern world.

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DEVELOPMENTAL TRENDS IN THE CRISIS, DISASTER AND TRAUMA PSYCHOLOGY

Boris Kordić, PhD[1]
Full professor, University of Belgrade, Faculty of Security Studies

1 e-mail: kordicjboris@gmail.com

DEVELOPMENTAL TRENDS IN THE CRISIS, DISASTER AND TRAUMA PSYCHOLOGY

Summary: The crisis, disaster and trauma psychology is a relatively new applied discipline of psychology that utilises the theoretical knowledge of psychology and the experiences of psychologists involved in crisis and disaster response teams to improve the practise of psychosocial support for groups and communities of people affected by crises and disasters. The paper presents the historical antecedents, the organisational aspect within the European Union, the basic principles and providers of psychosocial support, changes in the approach to psychosocial support as well as the target groups and their specific needs. Particular emphasis is placed on the recommendations for working with traumatised people resulting from the paradigm shift and the levels of competence that enable a selective approach to different responses to trauma.

***Keywords**: psychosocial support, crisis management, crisis resilience*

INTRODUCTION

Crisis, disaster and trauma psychology (CDT) is a relatively new term for the psychological discipline that deals with trauma and people's reactions to crises and disasters. In this paper, we will briefly introduce the subject of this discipline, how it has developed, how it is promoted within the EFPA (European Federation of Psychological Associations), and the principles of psychosocial support in crises and disasters. In particular, we will discuss the principles of psychosocial support, the levels of expertise in dealing with trauma, changes in the paradigm of psychosocial support and the specific needs of different target groups.

HISTORICAL DEVELOPMENT OF CDT PSYCHOLOGY

When we talk about the historical precursors of CDT psychology, we start from events in recent history that were characterised by major disasters that had a negative impact on people's psyche and that gave rise to the need to investigate the reasons for the negative effects, which psychological mechanisms are activated in response to disasters and how to overcome the negative state of the psyche and bring people to a psychological equilibrium. The advent of the railway made it possible to transport a large number of people at the same time, which in the event of accidents meant that a large number of people could die in an accident. John Erichsen (1867) investigated people's psychological reactions to railway accidents and wrote down his observations and thoughts in a study. He called the syndrome of psychological reaction to railway accidents "railway spine", and the syndrome was later named Eriksen's disease after him.

During the First World War, soldiers experienced a syndrome that they themselves

referred to as "shell shock". It consisted of symptoms such as fatigue, trembling, confusion, nightmares, hearing and visual disturbances. Soldiers with this syndrome were unable to function normally. At the time, many considered this syndrome to be a sign of cowardice or laziness. Due to the prevalence of the syndrome, the British Army appointed Charles S. Myers, a medically trained psychologist, to investigate the syndrome and suggest measures (Jones, 2010). Myers believed that the symptoms had a psychological origin and that there was repressed trauma behind them. He suggested that treatment should take place near the front line, but at a sufficient distance for soldiers to feel safe in the expectation of a speedy recovery and return to the unit. This principle is still applied in combat units today. However, due to the opposition of many who suggested military discipline as an approach, Myers withdrew from further participation in this programme. This inability of a huge hierarchical organisation such as the military to accept the nuanced recommendations of an innovative clinician (Jones, 2010) was repeated in World War II when Bion proposed a group work method to help at-risk soldiers return to units, or a selection method for officer training (Kordić, 2019). For the selection of officers, for example, Bion defined the criterion for group behaviour as whether a candidate could be a friend to his friend and an enemy to his enemy. success. It was assumed that Bion would be nominated to head the project, instead he was moved to a position where he could not be influential (Kordić, 2019).

Sigmund Freud (1919) also investigated war-related psychological disorders during the First World War and called them "war neurosis". The war neurosis was discussed at the First International Congress of Psychoanalysts in Budapest in 1918. Based on the psychoanalytical trauma theory, war neurosis is seen as a syndrome that occurs as a result of external traumas that break up the pre-existing neurotic structure of the personality. Symptoms such as nightmares, returning to traumatic events in consciousness, insomnia, withdrawal from people, represent spontaneous psychological attempts by the person to return to the traumatic event and process it in order to release the psychic energy associated with the traumatic event. During the First World War, Freud psychoanalysed his daughter Anna, who became a psychoanalyst thanks to this measure. One of the themes during the analysis was the fantasy of violence against children. Thus, Freud indirectly expressed the essence of war as violence transformed by the fantasy of humiliation (Kordić, 2001).

In the Second World War, the name "combat stress reaction" was used for psychological disorders caused by combat. The term denoted an acute reaction to combat that reduced combat ability and manifested itself through symptoms such as fatigue, slowed reaction time, indecision, disconnection from reality, and the like. In addition to these reactions to combat, which are a continuation of the shelling shock research of World War I, World War II confronted the world with the extreme genocide carried out against the Jews of Europe known as the Holocaust or Shoah. A special syndrome that occurs in survivors is called "survival trauma" because of the guilt of surviving,

and is accompanied by a series of symptoms such as physical ailments, severe sleep disturbances, nightmares with reliving of traumatic experiences, numbing of feelings, inability to describe traumatic experiences, short-term outbursts of anger, chronic apathy, and mild depression (Niederland, 1981). The next important observation that emerged from psychoanalytic work with descendants of Holocaust victims is the generational transmission of trauma (Faimberg, 2005). It manifests itself in such a way that the trauma is felt by the third generation of offspring. The traumas resulting from the Holocaust were followed by a "conspiracy of silence" due to disbelief in the reality of human destruction of such a scale and form (Kordić and Babić, 2018). It took a long time to start talking about the Holocaust. That is why today it is emphasized that it is almost impossible to treat traumatic disorders similar to the Holocaust on an individual psychotherapeutic level if the society as a whole has not recognized the traumatic nature of such events. There needs to be a public discourse about the historical truth of traumatic events (Bohleber, 2002).

Two world wars and a large number of traumatised people were not enough for psychiatrists to include specific disorders caused by traumatic events in diagnostic categories (Kordić and Babić, 2018). This only changed when the large number of traumatised Vietnam War veterans sought psychotherapeutic help. The diagnosis of PTSD - post-traumatic stress disorder - was officially introduced. And the US military was forced to authorise the disclosure of military secrets during psychoanalytic psychotherapy, because otherwise the therapeutic interventions had no effect, naturally with a certain number of psychoanalysts approved to work with the traumatised from the Vietnam War.

Today, there are a number of new forms of trauma where larger groups of people are at risk. In addition to the voluntary use of atomic bombs dropped on Hiroshima and Nagasaki in 1945 and a series of tests of new atomic bombs, nuclear disasters can also occur as accidents, as in the case of Chernobyl in 1986 and Fukushima in 2011. Large-scale natural disasters can lead to collective trauma. These include earthquakes, floods, tsunamis, hurricanes, heat waves, fires and the like. The 21st century is characterised by terrorist attacks such as the destruction of the World Trade Centre on 11 September 2001, bomb explosions in Madrid in 2004, London in 2005, Brussels in 2016 and the like. Terrorism affects the civilian population, is unpredictable and sudden and leads to constant vigilance and fear. Localised wars lead to large-scale population movements, which have their own traumatic consequences, such as the migration crisis in Europe in 2015. Migrants are confronted with the loss of their homeland on the one hand, and have to adapt to a new cultural environment that is generally not foreigner-friendly on the other. More recently, we have been confronted with the consequences of the Covid-19, a pandemic in 2020 and 2021 and the conflict in Ukraine, which began in 2022.

ORGANISATIONAL DEVELOPMENT OF CDT PSYCHOLOGY

As far as the organisational development of CDT psychology is concerned, it has its precursors in the founding of the Society for the Study of Traumatic Stress in 1985, which organised the 1st European Conference Traumatic Stress Studies in 1988. In 1992, the Society changed its name to the International Society for the Study of Traumatic Stress, and in 1993 the European Society for the Study of Traumatic Stress was founded (Vymětal, 2021). Within the European Federation of Psychologists Associations (EFPA), the Working Group on Disaster and Crisis Psychology was founded in 1997, from which the EFPA Standing Committee on Disaster and Crisis Psychology emerged in 2005, and in 2017 the name was changed to the Standing Committee on the Psychology of Crises, Disasters and Trauma (Rooze, 2017).

The Standing Committee on Crisis, Disaster and Trauma Psychology (SCCDTP) at EFPA gathers representatives of psychological societies from Europe to work together on the promotion and development of CDT psychology in Europe. The participation of representatives varies from mandate to mandate and in the most successful period included representatives of psychological societies from 28 countries. The SCCDTP organises meetings of its members at least twice a year and two symposia per year in different countries. The SCCDTP exchanges materials such as guidelines, recommendations (for journalists, managers, the elderly, children, psychologists), symposium presentations and makes these materials available on the EFPA and member societies' websites. Most of the materials are in English, with efforts being made to translate them into the languages of the member societies.

The SCCDTP initiates and participates in various projects. As part of one project, the European Survey of the Role Psychologists Play in Responding to Psychosocial Crisis and Disasters was carried out. The SCCDTP participated in the European project INHeRE on the protection of migrants, beneficiaries of international protection and refugees who have been sexually abused. The SCCDTP works together with the EU Centre for Expertise on Victims of Terrorism. Collaboration has been announced with the WHO/Europe, which has launched the Pan-European Mental Health Coalition, which will address psychosocial support in emergency situations.

The Standing Committee on Crisis, Disaster and Trauma Psychology aims to play a leading role in Europe by advising psychologists in development and providing and sharing expertise in crisis, disaster and trauma psychology, psychosocial crisis management, individual and community resilience building, operational and emergency psychology and evidence-based post-traumatic interventions to provide evidence-based best practise and build consensus on common European values and standards (Rooze, 2017).

PSYCHOSOCIAL SUPPORT IN CRISES AND DISASTERS

Marc Stein (2021) indicates the need for better clarification and differentiation of terms as one of the recommendations arising from experience with psychosocial support following disasters in Europe. The recommendation stems from the often inadequate and confusing use of terms. It is based on the fact that a potentially traumatic situation should not be equated with psychological suffering and pain. In other words, it is important to always make a clear distinction between events in the external environment and experiences in the inner world, i.e., the human psyche. For Stein, a potentially traumatic situation is an event that represents a real, potential or imagined threat (serious accident, violent death, rape, physical attack, serious illness, war, armed attack) that occurs suddenly and unexpectedly and is accompanied by feelings of helplessness, terror, despair, fear, loneliness, abandonment and the like. Mental suffering and pain represent a life experience that is more or less difficult to cope with, but does not affect psychological integrity, such as a severe loss (Stein, 2021).

A psychosocial approach should take into account the extent of the event that has occurred. Events, incidents or crises can differ in terms of their scope, impact and magnitude, as well as their complexity (OPSIC, 2016). Thus, there is a difference between between mass emergencies, disasters and catastrophes. Mass emergencies, such as a bus accident, are local or regional incidents that can be dealt with by conventional means and limited reinforcement, even if the incident is larger, more consequential and more complex than routine. A disaster, such as a plane crash, a major terrorist attack or a severe storm, is a crisis where local or regional actors are overwhelmed and require significant external support and infrastructure is at risk of destruction. A disaster, such as an earthquake, tsunami or war, is a crisis in which local and regional actors are no longer able to function and require external intervention, while the consequences are extensive or complete destruction of infrastructure.

There are other classifications of crises that are also useful. It is important that there is a definition of a specific classification and that the intervention programmes for psychosocial support are aligned accordingly. Crises affect the direct victims, the first responders to the crisis and other helpers (Tehrani, 2021). The impact of a crisis can take the form of death, serious injury, loss of housing, shelter, security, food, uprooting from the social environment, loss of infrastructure, social network and freedom. Victims may experience long-term psychological problems, including epigenetic transmission of trauma, secondary traumatisation, compassion fatigue and burnout. The response should plan how to meet the physical, social and psychological needs of all those affected by the crisis, taking into account the nature of the disaster, the extent of exposure and the vulnerable groups (Tehrani, 2021).

It is of utmost importance that psychosocial care is fully integrated into emergency

plans (Stein, 2021). Therefore, it is important that decision-makers are trained and sensitised to psychosocial concepts so that they have a clear understanding of what psychosocial care is, what its aims, possibilities and limitations are, and for whom it is intended. It is also important to understand that in addition to immediate psychosocial care, long-term psychological interventions are also required (Stein, 2021; Tehrani, 2021). It is also important that caregivers develop the ability to care for themselves to prevent the accumulation of stress and over-saturation that makes it difficult to relax (Kordić, 2018).

Principles of psychosocial support

Psychosocial support aims to satisfy basic human needs. Maslow (1943) developed one of the most famous theories of motivation. He categorised human motives into five major categories, which are arranged hierarchically:

- physiological (basic life needs such as water, food, shelter, sleep, clothing);
- security (safety, health, resources, employment, freedom of movement);
- social (belonging, feelings, family, friends, peers, interpersonal relationships, love);
- self-esteem (recognition, appreciation, success, power, respect from others);
- self-actualisation (self-fulfilment, creativity, meaning of life, ethical values).

McCann and Pearlman (1990) undertook a different categorisation of human needs. They distinguish between seven categories:

- frame of reference (having a stable frame of reference for understanding one's experiences);
- safety (feeling safe and reasonably invulnerable to injury);
- trust/dependence (trusting that others will fulfil our needs to a certain extent);
- respect (that others value us, that they recognise us and that we value others);
- independence (control over our own behaviour and merits);
- power (directing or exercising control over others);
- intimacy (feeling connected to other people and the community).

By combining the above two domains (Tehrani, 2021), the basic principles of psychosocial support centred on natural recovery (Hobfoll et al., 2007) were elaborated, namely:

- help people to feel safe;
- calm them down;
- promote self-efficacy so that they feel able to help themselves;

- promote social interaction, connection with others;
- giving a well-founded hope for the future.

The main objective is to promote and strengthen the crisis resilience of individuals and communities. Aid workers should treat those at risk with respect, understanding and sensitivity to their needs and their particular situation and never be intrusive. Special attention should be paid to the specific way of responding to a part of the population that has the so-called dark side of personality, which causes negative emotional reactions in the responder and the need to condemn the behaviour of a particular population group (Kordić and Babić, 2015).

Levels of competence in dealing with traumatised people

One of the basic rules of early psychosocial intervention in a crisis is to inform those at risk about reactions that are normal in crises and disasters, such as depression, anxiety, post-traumatic stress syndrome. Ignorance of the body's natural responses to emergency situations, such as the stress response, can exacerbate the negative effects of the response. Therefore, it is recommended that all people have at least the first level of expertise, which includes basic knowledge of trauma, so that they can recognise reactions to trauma in themselves and others. This is the level of familiarity with trauma.

The essence of trauma can be expressed as the overflooding of the psyche with stimuli that override or block cognitive functions and thus prevent the psychological processing of events (Kordić & Babić, 2018). Due to the reduced ability to symbolise the traumatic situation, there is a lack of understanding of the meaning of the trauma and a "black hole" is created in the psychological structure. The trauma is registered in the body and has a direct effect on the organic basis of psychological functioning (Bohleber, 2002). The person remains voiceless because s/he is unable to describe the trauma. S/he feels alone, hopeless and helpless. This is precisely why it is important that after a trauma a person is given the opportunity to be with another person who is able to show empathy and understanding and thus alleviate the traumatic experience.

The second level of expertise involves knowing the basic skills of working with trauma survivors, being able to listen, recognise, offer appropriate early intervention and provide adequate continuing care. These can be volunteers who have undergone training in psychological first aid or basic psychosocial support.

The third level of expertise consists of health professionals who are trained to work with traumatised people through psychological crisis intervention and counselling. They have received training in various forms of psychological crisis intervention.

The fourth level of expertise consists of mental health professionals, such as clinical psychologists, psychiatrists and psychotherapists, who have specialised in working with traumatised people and have the knowledge and skills for both early psychological

crisis intervention and long-term treatment of specific disorders caused by trauma.

A paradigm shift in the approach to psychosocial support

Victims of crises and disasters are commonly seen as helpless persons, which is related to trauma theory that emphasises a person's helplessness at the time of a traumatic event. While this view of the occurrence of trauma in crisis situations is justified, it does not refer the victim as a whole person with mechanisms to cope with and overcome the traumatic experience. This narrow view of the victim as a passive person suffering from the consequences of a traumatic event has a negative effect in the long term, as the victim continues to live in their passivity and derives secondary benefit from the situation by expecting constant help without being responsible for their condition. It is always more beneficial, both for the individual and for society as a whole, to see the individual as an active participant in the event and to count on their inner resources to overcome traumatic situations. In this way, from the outset of psychosocial care, victims are treated as individuals who are able to cope with the adversities that life brings and who are able to take responsibility for themselves and others as soon as the conditions are created for it and they recover from the initial shock.

In line with the previous discussion, it is also recommended to avoid the medical model of observing human reactions, which does not look at the person as a whole, but observes them from the point of view of "illness", i.e., what symptoms and disorders we see in the victim. The medical model initially turns the victim into a passive patient. If we avoid the medical model and see a person as a unique being, then we see the reactions to crises and disasters as crisis management mechanisms that show the extent to which a person is vulnerable or resistant to crises and what paths it chooses to return to its normal functioning. Avoiding the medical model also avoids an approach that deals exclusively with the consequences of a traumatic event, but instead applies an approach that works preventively to mitigate the effects of the traumatic event and strengthen coping mechanisms.

Particular attention should be paid to the circumstances in which the traumatic event took place or is taking place. Crises and disasters affect large groups of people and therefore it is wrong to consider victims as isolated individuals. The individual is a member of a social group or community affected by a traumatic event. It is therefore desirable to consider victims as social beings who, as individuals, see their personal misfortune in the context of the misfortune that has affected the entire group or community to which they belong. It is therefore important to count on the resilience of the community and the willingness to share the misfortune that has befallen us with others and to look for ways to overcome it together. Therefore, interventions should focus more on the community and its resilience and ability to cope with trauma, because in this way every member of the community is helped. For this reason, the clinical approach is increasingly being replaced by a community-centred

approach that uses the principles of preventive medicine. There are six principles of preventive medicine (Vymětal, 2021): preparedness (readiness), response (immediate activity), relief (continuous rescue action), rehabilitation (corrective action using social resources), recovery (return to normal functioning), resilience (support for development). In short, the paradigm shift consists in the following:

- from passive victim to flexible and active survivor,
- to observe the mechanisms of coping with and overcoming crises instead of symptoms and disorders,
- to focus on preventing negative consequences and strengthening resilience to crises instead of treating the consequences,
- to consider the victim not in isolation but as a member of a social group and community,
- to focus interventions on strengthening the resilience of the community and not only on the individual,
- to use a community-based approach that respects the principles of preventive medicine instead of a clinical approach.

Target groups and their specific needs

It is very important to distinguish between the usual help for adults who are victims of crises and disasters and certain groups who have specific needs. We will not go into recommendations for each of these groups here, but only indicate which groups are mentioned most frequently to emphasise the importance of tailoring the psychosocial support approach to these groups. These include children and young people, people with special needs (various forms of disabilities) and elderly people. This is a way of differentiating the categorisation in relation to the criterion of the ability to use individual resources in crisis and disaster situations.

In addition to the above criteria, the target groups should also be differentiated according to the role they play in coping with the crisis. Because of the role that the media outlets play in reporting on crises and disasters, an important target group is journalists and how to work with them to report objectively and reassuringly and to prevent the spread of misinformation and panic. Other important audiences include rescue teams, aid workers, volunteers, health workers and anyone else involved in the community response to crises and disasters.

CONCLUSION

The CDT psychology is an applied discipline of psychology in rapid development, especially in the face of the great challenges in today's world, which confront us with sudden and tragic events that have a traumatic effect on large groups of people and entire communities. Thanks to the networking of experts at regional and international level, the rapid transfer of knowledge and recommendations from experience and their dissemination within the framework of national psychological associations has become possible. Numerous guides and other materials are in use to support professionals in their work with target groups who are involved as helpers or victims of crises and disasters affecting larger groups of people and communities. Particular attention is paid to continuously increasing the effectiveness and efficiency of psychosocial support in crises, focussing on a proactive approach that adapts to working with larger groups of people and communities and draws on people's natural resilience to crises.

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MENTAL HEALTH AND PSYCHOSOCIAL SUPPORT IN CRISIS SITUATION

Marija Jevtić, PhD[1]
Scientific collaborator, Université Libre de Bruxelles (ULB), Research centre on Environmental and Occupational Health, School of Public Health

1 e-mail: marija.jevtic@ulb.be

MENTAL HEALTH AND PSYCHOSOCIAL SUPPORT IN CRISIS SITUATION

Summary: Mental health is necessary at every stage of life, from childhood and adolescence to adulthood. The Sustainable Development Goals (SDGs) call for the importance of promoting mental health and well-being in line with human rights principles and the standards of the Convention on the Rights of Persons with Disabilities (CRPD). The COVID-19 pandemic has highlighted the inadequate organisation of mental health systems and services around the world. This has had a detrimental impact on institutions, leading to a lack of cohesive social networks, isolation and marginalisation of many individuals with mental health problems, and fragmented and inadequate community-based mental health services. Natural disasters exacerbated by climate change, such as floods, storms, wildfires and heatwaves, have a direct and acute impact on human health and quality of life and have a huge impact on mental health. A major challenge is the rapidly changing environment and the fact that new generations of children are growing up in a different environment, full of risks due to climate change and various disasters, which is a potential trigger for psychological problems (depression, anxiety, suicide and other mental disorders). Everyone has an appropriate role to play in activities relevant to improving mental health - policy makers, service providers, civil society and people with experience of various mental health challenges, as well as the media. Mental health care should include the highest human rights standards and a better life for all people with mental health problems and psychosocial disabilities and their families (including relationships, work, family, housing and education). There is a need to work on creating resilient communities, a new generation that is more responsible in dealing with different crises and has better mental health. Rethinking all future crises (including wars, natural disasters and pandemics) is both a mental health issue and a social issue.

***Keywords**: Mental health, psychosocial support, crisis situation*

INTRODUCTION

By definition, individual health is not just the absence of disease, but complete mental, physical and social well-being. If we reflect on this definition, it is clear that health in continuity is unattainable. Mental, physical and social well-being is under serious scrutiny in this era of global challenges that are virtually impossible to overcome (WHO, 1948).

By definition, public health is the science and art of various endeavours and activities in the community that contribute to health and well-being, ensure basic needs, prevent the spread of disease, and insist on equity, social justice and support for individuals and populations without excluding anyone (Perez, 2003).

Numerous global challenges today pose a significant obstacle to achieving the goals for health and well-being, both physical and psychosocial. The Sustainable Development Goals provide a roadmap, as does the EU's Green Deal, which aims to find solutions that reduce the risk of crises and contribute to the management of various crisis situations (Jevtic & Bouland, 2018). In recent years, we have repeatedly experienced various crisis situations that have synchronised. It seems that the 21st century is a century of extreme events and major crises. The COVID-19 pandemic crisis has affected the whole world and stopped humanity in its normal activities (Jevtic et al., 2021). This crisis has helped to increase attention to mental health. Although the WHO has announced the end of the pandemic, there are still cases of infection with the COVID-19 virus, but no longer on a pandemic scale. All the while, climate change is present as a chronic crisis with no end in sight and a growing concern for humanity. Climate change affects not only people, but also the environment, agriculture, the urban environment, biodiversity, individuals and populations, affecting not only physical but also mental health. Mass non-communicable diseases are a manifestation of the pervasive health crisis. The antimicrobial resistance that medical professionals, doctors, various specialists, but also veterinarians and other experts are struggling with is also a new source of anxiety and concern about overcoming infectious diseases and various infections. There are more and more migration movements triggered by various reasons, and one of them is climate change. The reasons for migration are not just the conflicts and the numerous hotspots of humanitarian crises around the world. The pandemic crisis overlapped with earthquakes, floods, difficulties in realising equality and the rise of poverty. Today, the urban environment is the habitat for more than 50% of the world's population, and it is expected that by 2050 more than 70% of the world's population will live in cities. Inadequate air quality, the challenges of providing safe and hygienic drinking water and increasing noise are unfavourable external factors in the urban environment that pose an additional risk to mental health. Crisis caused by floods, fires, air, water and environmental pollution as well as inadequate infrastructure pose an additional challenge to the quality of life and well-being of city dwellers. 15 November 2022 was marked as the day it was announced that our planet has more than 8 billion inhabitants. The demographic data points to a sudden increase in the number of inhabitants, albeit unevenly. This unevenness provides room for new migrations triggered by various emergency and crisis situations (Poljanšek et al., 2017; EM-DAT, 2020).

GLOBAL CHALLENGES AND MENTAL HEALTH

Numerous global challenges today mean that crisis and emergency situations are a reality and an everyday occurrence and that we can expect them to worsen rather than calm down. It is therefore important to emphasise what all crises have in common. Reduced community resilience, system vulnerability, which is primarily due to individual and population vulnerability, and insufficient capacity to respond adequately to the crisis, which is primarily due to mental health impairment.

The World Health Organisation (WHO) defines mental health as a state of well-being in which an individual fulfils his or her potential, can cope with stressful situations, can work productively and fruitfully and is able to contribute to society. Mental health does not mean the absence of unpleasant emotions such as anger, sadness and the like, considering that we are all exposed to various difficulties and stresses. However, it enables us to successfully manage these emotions by utilising our resources (Sartorius, 2002).

Feelings of fear, helplessness and anxiety therefore accompany all crisis situations, and depression, anxiety and panic reactions are increasingly common. The common denominator of all crisis and emergency situations, whether short or long-term, local or global, massive or limited, is fear and the risk of damage to mental health.

Strengthening mental health in the community and psychosocial support based on all these factors should therefore be an indispensable element of strategies for coping with and overcoming crisis situations and preventing mental disorders. This is supported by documents summarising the significant work of scientists and experts within the multidisciplinary and interdisciplinary expertise of the European Commission's Joint Research Centre's Centre for Disaster Risk Management (Jevtic et al., 2021; Poljanšek et al., 2017).

Earthquakes, floods, droughts, fires and other extreme phenomena leading to crisis situations have characterised the European continent and other regions (Croatia, Serbia, Slovenia, Bosnia and Herzegovina, Germany, Belgium, France, Turkey...) in recent years. We witnessed severe weather events that hit the Western Balkans region, devastating large parts of the green belt and causing significant damage to infrastructure. A storm in France in 2023 also claimed lives. Practically all continents were affected, not just Europe. In addition to these disasters, which are largely due to climate change, we are experiencing a pandemic crisis declared by the WHO, but we still have the problem of illness, absenteeism and losses in organisations (WHO, 2022).

In addition, conflict hotspots and humanitarian crises that citizens thought (or hoped) would not flare up, claim many lives (children and adults), waste money and destroy resources. Efforts should be invested to help both the people affected by the humanitarian crisis and the aid workers involved in the crisis (European Commission, 2024).

Crisis situations cause “storms, tornadoes, floods” in souls, and the overwhelm of difficult feelings also reaches epidemic proportions. The public health significance of crisis situations is therefore enormous, and the responsibility of decision-makers to act in emergency and crisis situations to preserve mental health is unquestionable. One of the priorities of public health is therefore not only to act in crisis situations and save lives, but also to preserve mental health, both through prevention and strengthening resilience, and by acting during and after the crisis to prevent the consequences of trauma for the individual and the community. (WHO, 2019).

Mental health is therefore just as important as physical health and is necessary at every stage of life, from childhood and adolescence to adulthood, including caring for the elderly. The Sustainable Development Goals (SDGs) clearly call for the promotion of mental health and well-being while respecting human rights, and it is important to emphasise that this is in line with the Convention on the Rights of Persons with Disabilities (CRPD) (UN, 2007).

PANDEMIC CRISIS AND MENTAL HEALTH

The COVID-19 pandemic has highlighted the weaknesses of mental health systems and services around the world. This has had a negative impact on institutions and organisations, leading to a lack of cohesive social networks, isolation and marginalisation of many individuals with mental health problems, and fragmented and inadequate community-based mental health services. In addition to the fight against the virus, the pandemic crisis has also revealed the great vulnerability of individuals and populations in terms of mental health. In urban environments, the risk of mental health impairment was obviously greater than in rural environments, which could more easily bear the burden of a sudden change in lifestyle (Jevtic et al., 2022).

In addition to the importance of mental health interventions for the general population, it is also important to emphasise the importance of psychosocial support and mental health risk for human resources in healthcare, which is evident and pervasive. During the pandemic crisis, psychosocial support for health workers has been provided through individual and diverse initiatives, mainly through voluntary actions. However, it would be necessary for voluntary initiatives to evolve into systemic solutions for supporting the healthcare sector, taking into account the existing future risks (Backhaus et al., 2023).

NATURAL DISASTERS, CLIMATE CHANGE AND MENTAL HEALTH

Natural disasters, exacerbated by climate change as a chronic crisis and accompanying phenomena such as floods, storms, forest fires and heatwaves, directly and acutely affect human health and quality of life and have enormous consequences for mental health. A major challenge is the rapidly changing environment due to human impact and the fact that new generations of children are growing up in a different environment, full of risks due to climate change and various disasters, which is a potential trigger for mental health problems (depression, anxiety, suicidal tendencies and other mental disorders). Policy makers, service providers, civil society and people who have experienced certain psychosocial challenges have their place and role to contribute to mental health in the community.

Mental health care should include the highest human rights standards and a better life for all people with mental health problems and psychosocial disabilities and their families (including interpersonal relationships, work and organisational culture, family, housing and education). Working to build resilient communities is crucial to prepare young and future generations to deal more responsibly with different crises and to be better able to maintain mental health through education, preparedness and acquired resilience.

On a broader level, there is a need to change the mindset in relation to all future crises (including wars, natural disasters and pandemics) and to realise that the issue of mental health is a broader societal problem that goes beyond the health sector and requires the most comprehensive public health approach possible in line with the principle of "health in all policies" (WHO, 2019).

Research shows disorder-specific patterns in relation to certain social connections after a disaster. Depression is found to occur simultaneously in people who are connected in some way, while the risk of PTSD increases with social fragmentation. This points to the need to examine the sociocentric capacity of post-disaster mental health to better understand the potential of post-disaster social interventions (Valles et al., 2020; Bryant et al., 2017).

MIGRATION AND MENTAL HEALTH

Migrations are primarily motivated by the desire for better living conditions, i.e., as an alternative strategy for a better quality of life. The most frequent migrations are those from the countryside to the city. The unfavourable economic situation is an important reason, but it is important to emphasise that migration increases after disasters in order to improve the migrants' family income. Natural disasters, which are increasingly frequent and intense due to climate change, lead to migration, emphasises the IFRC report (IFRC, 2021; WHO, 2011). Frequent and severe natural

disasters force people to migrate in search of safer places and a better life (Adger et al., 2021; Chumky, 2022). In 2019, 4.1 billion people worldwide were at risk of natural disasters. Storms and floods not only pose a major public health problem, but also cause significant financial losses worldwide, estimated at tens of billions of dollars (Szmigiera, 2021).

According to the International Disaster Database, floods and storms can affect large areas of the world and are estimated to affect between 2.9 and 1.9 billion people worldwide (EM-DAT, 2020). In addition, a special report published by the IPCC in 2018 warns that the duration, frequency and intensity of extreme weather events will increase as a result of climate change and that millions of people will be exposed to the consequences and effects on mental health, among other things (IPCC, 2018). All these facts point to the importance of comprehensive psychosocial support and interventions aimed at maintaining mental health.

The importance of psychosocial support in crisis areas due to humanitarian crises and conflicts is unfortunately increasing. People's lives are at risk, and the consequences for the civilian population include not only the impairment of physical health but also short- and long-term mental health (trauma, post-traumatic stress syndrome, depression and numerous other consequences (IPCC, 2018).

INSTITUTIONAL FRAMEWORK FOR MENTAL HEALTH SUPPORT IN CRISIS SITUATIONS

The institutional framework for mental health support in crisis situations can be seen as a network at international level, bringing together organisations and institutions of an international character that prioritise mental health in their strategic actions.

In addition to the leading international organisation dedicated to health (and mental health) - the World Health Organisation (WHO), then UNICEF - we should also mention the European association dedicated exclusively to mental health - the Mental Health Europe Association, as well as professional associations such as the Group Analytic Society International - GASi and the International Society for the Psychoanalytic Study of Organizations - ISPSO.

The World Health Organisation (WHO) plays a major role in supporting mental health and crisis situations. The provision of psychosocial support is essential, both during the crisis and immediately afterwards, but also long enough after the crisis situation. Based on its experience from numerous crises on the ground, WHO provides guidance and relevant documents to help member countries prepare for a crisis situation, strengthen community resilience and improve organisation within countries at national level. It is important to emphasise that the negative factors of the environment are caused by anthropogenic action, but natural factors also contribute significantly to crisis situations, which also have consequences for mental health (WHO, 2014).

National levels have their specificities, and this was also demonstrated during the COVID-19 pandemic, where different healthcare systems with different organisational capacities and capabilities, as well as decision-making at the level of national leaders, had some indirect and direct impact on mental health. Psychosocial support for the population has so far proven to be an intervention of great importance. Improving preventive measures focussing on potentially vulnerable groups and the entire potentially vulnerable population is necessary to prevent major psychological trauma and mental health of people. In particular, it is necessary to consider the needs in the context of the risks posed by urbanisation and to make appropriate use of the opportunities offered by digitalisation and the application of a comprehensive approach to the development of a sustainable community (Lapão et al., 2023).

PSYCHOSOCIAL SUPPORT IN CRISIS SITUATIONS - OVERVIEW OF CAPACITIES AND EXAMPLES

Psychosocial support in crises should be an indispensable part of the aid package for the population in order to save lives and prevent damage to physical health. The experiences of floods, earthquakes, the consequences of climate change, migration, the COVID-19 pandemic and other numerous challenges that often occur simultaneously are a strong argument in favour of continuous activities to strengthen capacities to support the population in maintaining mental health.

The COVID-19 pandemic has not only shown the importance of the impact of the virus on physical symptoms and physical health, but also on mental health, not only of patients but also of medical staff (doctors and nurses). The WHO declared a pandemic, but the consequences for mental health remain a long-term task that needs to be addressed. An example of this is a unique study by the international COPERS team conducted in several European countries, as well as studies by other research teams, which indicate that mental health is affected by complex life events such as the COVID-19 pandemic and that differences in the degree of resilience can be observed in the population. National studies on mental health and individual and community resilience during the pandemic provide heterogeneous results, and additional research on mental health outcomes is needed to better understand the impact of the pandemic on mental health in Europe (and beyond). The findings of the COPERS study and similar studies can contribute to the development of community resilience, community preparedness for future similar crises, and the development of appropriate health and social policies (Backhaus et al., 2023).

The experience of dramatic events such as the mass killings that occurred in Serbia in May 2023 shows the scale of the problem and the need to work more intensively on prevention, but also to provide assistance and reduce the negative impact on the mental health of the population. These events, although not global and not long-lasting, have certainly caused a major “mental” earthquake that has affected the

entire society, not only in Serbia, but also in the region and beyond. The question is whether we are able to overcome the challenges in the education sector and whether we can overcome fear and insecurity and mistrust towards the education system as a result of these events.

In approaching mental health preservation, it is essential to adopt a holistic approach, taking into account various types of crises, their potential and often overlapping effects, their long-term impact, the need to assist populations across all categories, and the necessity of strengthening the capacities of caregivers.

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE ACTIVITIES

Mental health is inextricably linked to physical health and the role of the health system is to adapt standards in relation to the expressed and unexpressed needs of the population. The mental health of health professionals and caregivers must be "trained" and strengthened through various trainings and preparations for emergencies and crisis situations.

Maintaining mental health goes beyond health systems. Therefore, it is important that lifelong education and the educational process devote sufficient time and attention to mental health, mental hygiene, as part of the routine of life, and that at the same time the entire population, caregivers and professionals are adequately prepared for self-help, mutual support and professional help in potential crises and long enough afterwards.

Mental health education should therefore be an integral part of the educational process in different ways and involve all stakeholders in the community in order to increase community preparedness to deal with different crises and strengthen community resilience.

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NATURAL DISASTER CAUSED BY THE MASS OCCURRENCE OF HUMAN INFECTIOUS DISEASES: SELECTED LEGAL ISSUES AND EXPERIENCES FROM COVID-19 – EUROPEAN UNION AND POLISH PERSPECTIVE

Katarzyna Mełgieś, PhD[1]
War Studies University in Warsaw – Faculty of Law and Administration
Katarzyna Miaskowska-Daszkiewicz, PhD[2]
John Paul II Catholic University of Lublin – Faculty of Law, Canon Law and Administration

1 e-mail: katarzyna.melgies@gmail.com

2 e-mail: katarzyna.miaskowska-daszkiewicz@kul.pl

NATURAL DISASTER CAUSED BY THE MASS OCCURRENCE OF HUMAN INFECTIOUS DISEASES – SELECTED LEGAL ISSUES AND EXPERIENCES FROM COVID-19 – EUROPEAN UNION AND POLISH PERSPECTIVE

Summary: The article deals with the issue of selected aspects of the legal qualification of threats leading to crisis situations. The analysis also includes legal instruments for an appropriate response to these threats. The risk factor we focus on is an infectious disease, whose mass spread primarily affects the healthcare system, but - as the unprecedented experience of the COVID-19 pandemic shows - can paralyse the functioning of the state and society in many dimensions. We focus primarily on the fundamental aspect, namely the decision of the authorities, both at national and EU level, as to whether the COVID-19 pandemic is a natural disaster. This finding is the reason for the introduction of extraordinary, episodic solutions. They can certain areas of socio-economic life, but also interfere with rights and freedoms. The experiences of the coronavirus pandemic have forced the review of the effectiveness of systemic solutions, including legal solutions to prevent and combat an epidemic of infectious disease epidemic in humans.

***Keywords**: COVID-19, legal tools, natural disaster, pandemic, public health, tasks of public authorities*

OUTLINE OF THE PROBLEM - THE CONCEPT OF DISASTER

Since the dawn of its history, humanity has to deal with various types of "plagues" that decimated people on many continents, such as the "Black Death", i.e. the plague that prevailed in 14th-century Europe, or the Spanish flu, that led to mass death in the second decade of the twentieth century, up to the latest effects related to the COVID-19 disease caused by the Sars-Cov-II virus. New infectious diseases have accompanied developing societies for centuries and will continue to accompany mankind. According to the World Health Organisation (WHO), the emergence of new, as yet unknown epidemics or even pandemics of infectious diseases is only a matter of time (WHO, 2018: 14-15; Piret & Boivin, 2021: 2).

Thus, due to their nature, infectious diseases are the subject of special attention by authorities at the international level, and appropriate agreements and strategies for joint actions to reduce the risk of disasters, including natural disasters, have been adopted. First of all, the Sendai Framework for Disaster Risk Reduction 2015-2030 was adopted at the Third UN World Conference in Sendai, Japan, on 18 March 2015. It is the result of stakeholder consultations that began in March 2012 and intergovernmental negotiations from July 2014 to March 2015, which were supported

by the United Nations Office for Disaster Risk Reduction at the request of the UN General Assembly.

The Sendai Framework is the successor instrument to the Hyogo Framework for Action (HFA) 2005-2015: Building the Resilience of Nations and Communities to Disasters. The HFA was designed to give further impetus to global work under the 1989 International Framework for Action for the International Decade for Natural Disaster Reduction, and the Yokohama Strategy for a Safer World: Guidelines for Natural Disaster Prevention, Preparedness and Mitigation and its Plan of Action, which was adopted in 1994 and the 1999 International Strategy for Disaster Reduction.

There is no doubt that the COVID-19 pandemic has made it clear that the consequences for human health, the environment, society and the economy can be devastating. Already with a formal declaration of COVID-19 as a global pandemic, the WHO Director-General, Dr. Tedros Adhanom Ghebreysus determined that preventative and reactive health and safety measures had to be taken that would ultimately change the lives of people worldwide (WHO, 2020). Indeed, after more than two years of a full-blown pandemic, we can say with absolute certainty that it belongs to the large-scale emergencies (Miaskowska-Daszkiewicz, 2021: 421). This raises the question of whether a pandemic caused by an infectious disease should be categorised as a natural disaster. This is a condition recognised in Polish national and EU acquis and justifies special actions of public authorities. At the same time, however, as we will try to demonstrate in further analyses, practise has revealed ambiguities in the understanding of the term "natural disaster", and thus different approaches to the COVID-19 pandemic from this perspective.

The United Nations International Strategy for Disaster Reduction defines a disaster as a serious disruption in the functioning of a community or society that causes widespread human, material, economic or environmental losses that exceed the ability of the affected community or society to cope using its own resources (UNIDSR, 2009: 9). The World Health Organisation (WHO) defines a disaster as a sudden ecological phenomenon of sufficient magnitude to require external assistance. The WHO's widely recognised concept of a disaster also refers to three aspects. It is an event that disrupts the daily functioning of a community or society, causes material, economic or environmental losses, and overwhelms local capacities. As far as the causes of disasters are concerned, they are usually categorised into 3 types: natural disasters, man-made disasters and hybrid disasters.

The concept of a natural disaster encompasses natural phenomena above and below the earth's surface, meteorological phenomena and biological phenomena relevant to the topic of this paper. As indicated in the literature, the natural processes (or hazards) that are triggers for natural disasters are broadly divided into six categories: geophysical, meteorological, hydrological, climatological, extraterrestrial (residues from asteroids, meteorites) and biological (Chaudhary & Piracha, 2021, p. 1102).

As the authors quoted above point out, "A hazard originating from a biological substance, e.g., venom, mold, or a vector carrying disease-causing organisms, exposure to which poses a threat to other living beings or humans. Locust swarms, algal blooms, infestations of poisonous wildlife, and vector-borne diseases such as plague, malaria, dengue fever and Covid-19 are some examples of this hazard". So, there is no doubt that the COVID-19 pandemic is a natural disaster. This is, of course, only one of the views, as another approach can also be found in the literature, which refers to the categorisation of the COVID-19 pandemic as a natural disaster. The differences between these situations are pointed out which at the same time require a separate approach, although the similarities of the problems are not ignored (Wang et. al., 2021).

It should be emphasised that the concept of a disaster cited above, including the categorisation of its types, is not normative and therefore not legally binding, either at EU level or at the level of individual countries.

Jurisdiction over natural disasters be should be understood as outlined in normative acts at both international and national levels - at least at a certain general level - that cover the conditions that can cause such events and the bodies responsible for deciding on their occurrence.

This is invaluable in the perspective when national authorities take extraordinary measures in the event of a natural disaster, which often interfere with human rights, such as freedom of movement or assembly. The justification for this type of action results from Article 4 of the International Covenant on Civil and Political Rights adopted by United Nations General Assembly Resolution 2200A (XXI) on 16 December 1966, according to which "In time of public emergency which threatens the life of the nation and the existence of which is officially proclaimed, the States Parties to the present Covenant may take measures derogating from their obligations under the present Covenant to the extent strictly required by the exigencies of the situation" or from Article 15 of the European Convention for the Protection of Human Rights and Fundamental Freedoms signed in Rome on 4 November 1950, according to which "In time of war or other public emergency threatening the life of the nation any High Contracting Party may take measures derogating from its obligations under this Convention to the extent strictly required by the exigencies of the situation, provided that such measures are not inconsistent with its other obligations under international law".

The sphere of legal certainty and legal protection, values that are common to rule of law states, includes the legal definition of the conditions for deciding that a natural disaster has occurred.

EUROPEAN UNION PERSPECTIVE

Considerations of the normative acquis of the EU should be preceded by a determination of its competence in the field of regulating the issue of a natural disaster caused by an infectious disease.

When looking for the sources of EU competence in the field of creating a legal framework for disasters, it should be noted that the Treaty on the Functioning of the European Union (TFEU, 2012: 47-390) does not directly define this competence. However, taking into account that any disaster has a potential impact on the safety of human health, it can be concluded that the EU has shared competences with the Member States in this respect, based on Article 4.2 k) of the TFEU. The shared competences are conceived as competition competences. They can compete alternatively or cumulatively (Parol, 2013: 65).

The EU can also take supporting, coordinating or complementary action at European level to protect and improve human health (TFEU, Article 6 Letter A). It seems obvious that the risk factors of disasters, especially natural disasters know no borders and that cross-border measures are needed to combat them.

At the same time, several provisions of the TFEU provide for the possibility of the EU taking actions in the event of a natural or man-made disaster. An example of this would be Article 196 of the TFEU, on the basis of which the Union encourages cooperation between Member States in order to improve the effectiveness of systems for preventing and protecting against natural or man-made disasters. It is important to note that the EU cannot harmonise of the laws and regulations of the Member States in the field of disaster protection.

Another example would be the solidarity clause from Article 222 of the TFEU, according to which the Union and its Member States shall act jointly in a spirit of solidarity if a Member State is the victim of a terrorist attack or a natural or man-made disaster.

Other Treaty provisions that directly refer to the occurrence of a natural disaster as a factor that may activate the EU are Article 122 Par. 2 of TFEU, which foresee Union financial assistance to a Member State, which is in difficulties or is seriously threatened with severe difficulties caused by natural disasters or exceptional occurrences beyond its control.

It should also be noted that the EU's action in the event of a natural disaster is not limited to its Member States. We can also mention Article 214 of the TFEU on humanitarian aid, according to which EU can provide *ad hoc* assistance, aid and protection to people in third countries who are victims of natural or man-made disasters.

It should be emphasised that although the TFEU uses the terms natural disaster and

man-made disasters in several places, it does not specify any premises on the basis of which situations should be classified as such. This raises the question of whether only natural disaster or man-made disasters can lead to action at EU level? What about a hybrid disaster? Is it also questionable which entity decides on the occurrence of a natural or man-made disaster: the EU or a Member State? Does the lack of natural disaster declaration - as in Poland, which will be discussed later in this study - preclude the possibility of using EU support mechanisms? Or is perhaps the EU and its bodies that decide autonomously to recognise a particular situation as a disaster? Since it is not possible to exhaustively determine the substantive preconditions of a constantly changing crisis, the decision on whether to update the precondition of a disaster will always be a political one. However, it should be guaranteed that it must be reviewed by experts in a given field, in the case of an infectious disease - by epidemiologists.

When it comes to the COVID-19 pandemic, it seems *prima facie* that the pandemic caused by a biological factor can be categorised as a natural disaster. This is of course true if we rule out the human factor in the activation of this virus in Wuhan.

The assessment of the EU institutions in this regard is interesting, as Council Regulation (EU) 2020/521 of 14 April 2020 activating the emergency support under Regulation (EU) 2016/369, and amending its provisions taking into account the COVID-19 outbreak assumes that the emergency support is necessary as a result of a disaster within the meaning of Article 1. And in this provision, we have *expressis verbis* named COVID-19 pandemic. The COVID-19 pandemic was therefore considered a disaster, without specifying its nature. The Emergency Support Instrument (Hereinafter: ESI) was established in 2016 (Council Regulation (EU) 2016/369) and activated for the first time in response to the influx of refugees and migrants into the Union. The positive experience with the use of the ESI in the migrant crisis prompted the EU to also use it during the COVID-19 pandemic. According to the Commission's assessment, "ESI was designed to allow for a comprehensive and flexible response to the urgent, evolving and diverse Member States' needs emerging during the pandemic" (Report form the Commission to the Council from 28.7.2022).

The unprecedented experience of the Covid-19 pandemic has demonstrated that the Union and the Member States must be better prepared to respond to large-scale emergencies affecting several Member States simultaneously. For this reason, the EU institutions have decided to include the pandemic in 2021 as a situation triggering the Union Civil Protection Mechanism (Regulation EU, 2021/836). This mechanism serves to protect against all kinds of natural and man-made disasters, including the consequences of acts of terrorism, technological, radiological or environmental disasters, marine pollution, hydrogeological instability and acute health emergencies occurring inside or outside the Union. The COVID-19 pandemic should certainly be categorised as a natural disaster related to acute public health emergencies according to the terminology proposed in the above-mentioned Regulation.

The opportunity to categorise the COVID-19 pandemic as a natural disaster was provided by the Court of Justice of the EU in case no T-665/20, Ryanair DAC v European Commission. The Court had to assess the compatibility with the internal market of state aid granted to an airline operator that had suffered economic losses in connection with the pandemic (TFEU, Article 107 Par. 2 Letter B).

In its decision, the European Commission expressly confirmed that the aid measure in question was intended to compensate Condor for its "losses due to the cancellation or rescheduling of flights exclusively due to the imposition of travel restrictions in the context of Covid-19 outbreak". However, in its judgment of 9 June 2021, the Court of Justice of the EU did not address to this problem on the merits, but annulled the contested decision for lack of sufficient justification.

Although the legal qualification of the COVID-19 pandemic as a natural disaster has not yet been confirmed by the Court of Justice of the EU, it has not yet been ruled out. It should be pointed out that the Court of Justice, could also conclude that the COVID-19 pandemic is not a natural disaster, but is one of the exceptional occurrences, that also justify the state aid within the meaning of the internal market.

POLISH PERSPECTIVE

In accordance with the principle that the EU cannot harmonise of the laws and regulations of the Member States in the field of disaster protection (Article 196 Par. 4 of the TFEU), the legal possibilities resulting from the Polish legal framework for dealing with an emergency situation caused by a pandemic should be reconstructed.

The legal instruments adopted at the national level in relation to the term *natural disaster* are subject to autonomous regulation at the level of the Constitution of the Republic of Poland and at the level of ordinary laws.

The state of natural disaster is qualified as one of the extraordinary constitutional measures that can be introduced in situations of particular danger, when the constitutional measures are insufficient (Article 228 item 1 of the Constitution). These instruments are formally recognised in the following constitutionally qualified cases: state of natural disaster, state of emergency and martial law. The purpose of these instruments is to counter threats and save the common good in emergency situations (Banaszak, 2012: 1086). Each formal case depends on different circumstances, but they share a common feature: they refer to all those cases when the action of public authorities is obstructed on the basis of and within the limits of the law, so that the Constitution prescribes a separate procedure and specific rules for their action (Tuleja, 2020, p. 6). On the other hand, they serve to ensure the protection and safety of an individual in a situation where there is a real and direct threat to his/her life and health (Florczak-Wątor, 2020: 9).

The constitutional *ratio* of extraordinary measures is to address threats to

fundamental constitutional values in order to protect human rights while allowing for greater restrictions, in a way that allows for modifications to the principle of separation of powers by extending the powers of executive authorities. The formal aspect of the constitutional emergency situation consists of distinguishing three types of emergencies and assigning certain characteristics to the laws that establish the grounds for extraordinary measures, as well as the regulations and the manner in which they are introduced (Tuleja, 2020: 10).

Them are all legal instruments introduced into the normative system to protect another constitutional value: the security of citizens in emergency situations, i.e., in those situations in which the regular instruments are ineffective. Security in the light of Article 5 of the Constitution determines the fundamental task of public authorities. It should be stressed that the concept of security in the cited constitutional provision should be understood in the broadest sense as a state that provides a sense of security and stability and guarantees their protection. This is not only about security of a political or military nature, but also about legal, material, social and environmental security (Florczak-Wątor, 2016: 283) and, finally, about health security which is closely linked with the right to healthcare as referred under Article 68.1 of the Constitution (Mełgieś & Miaskowska-Daszkiewicz, 2017: 262). In the development of the healthcare system, public authorities have a special constitutional duty in connection with the fight against epidemic diseases (Article 68 sec. 4 of the Constitution), which are recognised as particularly dangerous phenomena (Bosek, 2021b: 214; Mełgieś, 2022: 224). In view of this, it is emphasised that public authorities are obliged to act not only when security is threatened, but also to monitor the security of citizens and strengthen their sense of trust and stability as elements of trust in the state and the protection it guarantees (Miaskowska-Daszkiewicz, 2008: 492).

The Constitution does not define the term of *natural disaster* and focuses more on the principles of the introducing of a natural disaster and the functioning of the state, including specific rules restricting fundamental rights and freedoms. According to Article 232 of the Constitution, in order to prevent or eliminate the consequences of a natural disaster or a technological accident that has characteristics of a natural disaster, the Council of Ministers may introduce a state of natural disaster in a part of the national territory or in the entire national territory for a specified period not exceeding 30 days. The state of natural disaster may be extended with the consent of the Sejm. In the light of the above constitutional regulation, a natural disaster can be considered as a natural disaster or technological accident with the characteristics of a natural disaster without further specification. The normative terms of this concept are defined under the Law of 18 April 2002 on Natural disaster (Journal of Laws of 2017). Before going into the details of this Law, it is worth taking a look at the other constitutional determinants of natural disasters to better understand the concerns raised in the rest of the paper.

The basic principles of the formal declaration of a natural disaster as an exception

constitutional measure are formulated under Article 228 of the Constitution as the principles: of exceptionality, legality, proportionality, effectiveness and efficiency, protection of the legal order and finally protection of the representative bodies (Garlicki, 2002: 424-426; Prokop, 2005: 17-18).

In the constitutional law doctrine, it is assumed that the particularly dangerous situation referred to in Article 228 sec. 1 of the Constitution constitutes a serious threat. The particularly dangerous situation within the meaning of Article 228(1) of the Constitution is a serious and immediate threat to the fundamental interests of society and the normal functioning of public institutions (Wojtyczek, 1999: 250). On the other hand, "ordinary constitutional means" are understood to mean all means of action that are available to the state and local authorities that can be used in a normal situation", i.e., when no exceptional means are used. It is about taking actions that are typical for public authorities, such as issuing legal enactments, making decisions in individual cases, and even taking actual actions within the scope of the public authorities' competence. A situation in which ordinary constitutional measures are not sufficient to counter the threat justifies the use of extraordinary measures, which may make it possible to declare a state of natural disaster (Wojtyczek, 1999: 251; see also Prokop, 2005: 19-21). In addition, academics emphasises that when describing concept, the premise of a situation of special threats that cannot be eliminated by the usual constitutional means expresses the principle of exceptionality and subsidiarity of extraordinary measures. Their essence is that the elimination of the threat is not possible by any other, alternative means (Działocha, 2005: 3). In other words, the introduction of a particular extraordinary measure is a *sine qua non* condition for the elimination of a particular threat. It is also rightly pointed out that this premise should be understood as a whole and therefore the introduction of an extraordinary measure is always permissible if the ordinary constitutional measures are not sufficient to counter the threats (Wojtyczek, 1999: 253).

The three conditions for the legality of the introduction of extraordinary measures are as follows: Firstly, the introduction must be based on the law; secondly – it must be made by a regulation issued on the appropriate constitutional and statutory basis - in the case of a natural disaster, this is a regulation of the Council of Ministers; and finally, the regulation should additionally be made available to the public. This means that the ordinary announcement of the regulation in the Official Gazette is not sufficient, it must also be made available to the public. It is important that the decision of the Council of Ministers to introduce a state of natural disaster is not subject to review by the Sejm at the stage of its adoption. It does not have to be approved, nor can it be repealed (Steinborn, 2016: 1613).

Respect for the principle of proportionality and effectiveness and efficiency requires that the actions taken as a result of the introduction extraordinary measures must correspond to the degree of threat and should aim at restoring the normal functioning of the State as soon as possible. The first part of this provision therefore expresses the

principle of proportionality, and the second part the principle of purpose limitation (Steinborn, 2016: 1612).

Finally, the principle of protection of the legal order requires that during a state of natural disaster, as an extraordinary measure, no changes may be made to the Constitution, the electoral regulations for the Sejm, the Senate and local government bodies, the Law on the Election of the President of the Republic of Poland and the laws on constitutional extraordinary measures. The aforementioned prohibitions are intended to prevent the state of natural disaster from being used to change the constitutional order.

It is worth mentioning, that the Constitution provides that public authorities may specify the principles, scope and manner of compensation for the loss of property resulting from the restriction of the freedoms and rights of persons and citizens at a time that requires the introduction of extraordinary measures, including in the event of natural disaster. To this end, the Law of 22 November 2002 on the compensation of property losses resulting from restriction of human and civil rights and freedoms during a period requiring the introduction of extraordinary measures was adopted (Journal of Laws No. 2023, item 1955). On the other hand, the Constitutional Court pointed out in its case law that a situation that can be assessed as a natural disaster is not tantamount to an absolute obligation on the part of the state to provide material assistance to people who have been harmed by the forces of nature. According to the Constitutional Court, the nature and extent of the disaster, as well as the severity of its effects and the number of victims, can determine whether and which measures are taken to provide material support to the affected citizens.

The Court therefore considers it advisable to create a universal regulation in which the legislator - within the limits of its discretionary powers - lay down the procedure and conditions for deciding on the granting of assistance to the victims of various natural disasters and the forms of such assistance, so that in future it would no longer be necessary to adopt episodic regulations in this regard (Constitutional Tribunal post of 6.3.2001, S 1/01, OTK 2001, No. 2, item 35.).

From the point of view of the mass occurrence of human infectious diseases, the premise of a threat to public order may be particularly important, i.e., the concurrence of the conditions of different extraordinary measures: the state of emergency and the state of a natural disaster cannot be ruled out (Wojtyczek, 1999: 254). In other words, the conditions that are decisive for the introduction of a state of natural disaster can justify the introduction of the state of emergency. This is the case when the conditions set out in Article 230 of the Constitution are met: a threat to the constitutional order of the State, the security of citizens or public order. In the constitutional law doctrine, it is assumed that the public order referred to in Article 230 Para. 1 of the Constitution is a state existing in the internal relations of the state, characterized by the harmonious coexistence of a community of citizens, guaranteed

by legal norms, and observed in practise and ensuring the security of citizens, peace and order in public life, including the uninterrupted functioning of public institutions (Prokop, 2005: 82-87). It is emphasised that public order is a position that enables the normal functioning of the state and society (Wojtyczek, 1999: 189; Brzeziński, 2007: 206-207). In the light of the strategic document National Security Strategy of the Republic of Poland issued by the President of the Republic of Poland, the epidemic of infectious diseases is categorised not only as a threat to health security, but also to the general security of the state, which undoubtedly results from the scale of the social, economic or health effects associated with it (Decision of the President of the Republic of Poland of May 12, 2020). At the same time, it is pointed out that, in accordance with the principle of proportionality, the institution of natural disaster should be used first and if this extraordinary instrument is ineffective, a state of emergency could be declared (Florczak-Wątor, 2020: 7).

As mentioned above, the provisions of the Constitution do not define the scope of the term "natural disaster". The legal construction of this term was introduced in the provisions of the Law on Natural Disasters. The definition assumes that a natural disaster can manifest itself as a natural disaster or technical failure, the effects of which threaten the life or health of a large number of people, property on a large scale or the environment in large areas, while assistance and protection can only be effectively carried out through the use of extraordinary measures, in cooperation of various bodies and institutions as well as specialised services and formations operating under unified command (Article 3.1.1).

The legal limits of a natural disaster (Article 3.1.1.) define situations or occurrences related to the term mentioned. These are, in particular, atmospheric discharges, seismic shocks, strong winds, intense precipitation, prolonged extreme temperatures, landslides, fires, droughts, floods, ice phenomena on rivers and seas, lakes and water reservoirs, mass occurrence of pests, plant or animal diseases or diseases that infect humans or the action of another element. What is important, however, is that the disaster, at least in terms of its scale, was caused by forces of nature that humans could not control (Winczorek, 2000: 295). However, it is worth mentioning that that a natural disaster can also be caused by events in cyberspace and terrorist activities (Article 3.2). In the light of above, a natural disaster can be declared under the Constitution to combat the spread of infectious diseases (Steinborn, 2016: 1626; Działocha, 2005: 2). In other words: infectious disease could be a factor in a natural disaster, but the scale of the threat as well as other elements of the legal definition determine the formal introduction of the extraordinary measure. Bearing in mind the subject of this paper, we limit our considerations to the term "natural disaster" and the triggering factor: infectious disease, leaving aside technical failure as an example of a natural disease.

An infectious disease can be considered a cause of a natural disaster if it threatens the life or health of a large number of people, property on a large-scale or the environment

in large areas. The assessment of the extent of these events is the responsibility of the authority that introduces the state of a natural disaster. At the same time, there is no consensus as tot when a certain number of people should be considered "a large number" of people. What is certain is that the status of a natural disaster cannot be introduced in every case of a natural disaster, but only when such a situation can be considered a natural disaster in the legal sense (Prokop, 2005: 108; Brzeziński, 2007: 217).

There is also a consensus that the introduction of a natural disaster – which only causes a serious threat or disruption to the functioning of the state economy - is not justified (Prokop, 2005: 111-112).

As a matter of fact, the purpose of introducing a natural disaster is to prevent the effects of the threatening factors and to eliminate the effects when they occur. However, it is possible that the effects of a natural disaster have not yet materialised, and the introduction of the state of emergency serves to enable actions to be taken to prepare for the approaching danger (Prokop, 2005: 115), but the above position may raise doubts from a principle of point of view.

The main legal consequences of the introduction of the state of a natural disaster are as follows: the first one is the obvious strengthening of executive power in the area where the state of natural disaster has been introduced, which enables that competent authority to issue binding instructions to other entities that are not subordinate to it under regular conditions. Another one is the obligation of close cooperation between all local authorities, regardless of their administrative location and area of activity, as well as the obligation to cooperate with private entities, and finally, the involvement of all types of rescue forces, including the military.

After the formal introduction of the state of a natural disaster, the authorities are allowed to public authorities to choose from an extended catalogue of restrictions on civil rights and freedoms prohibited in regular laws, as well as to introduce the obligation to provide personal and material benefits. The Law on Natural Disasters authorises the Council of Ministers, among others, to order the suspension of the activities of certain entrepreneurs (Article 21.1.); to prohibit certain types of business activities (Article 21.1.2.), to require persons to undergo medical examinations, treatments, preventive vaccinations and other measures, preventive measures and treatments necessary to combat infectious diseases and the effects of chemical and radioactive contamination (Article 21.1.5), and, to require persons to undergo quarantine (Article 21.6.). However, neither the Constitution nor the Law contain specific provisions on how these measures are to be ordered.

Although the regulations on natural disasters seem to be comprehensive at first glance, the question remains as to when exactly the extent of the spread of an infectious disease justifies or even obliges public authorities to declare a state of natural disaster? This question remains valid in the context of the issues discussed,

as in parallel to the legal solutions adopted for extraordinary situations qualifying as natural disasters, the Polish legislator has introduced a comprehensive regulation on the prevention and control of infectious diseases, which is laid down in the Law of 5 December 2008 on the Prevention and Control of Infections and Infectious Diseases in Humans (Consolidated Law: Journal of Laws of 2023, item 1284) and in special Law of 26 April 2007 on Crisis Management (Consolidated Law: Journal of Laws of 2023, item 122).

Although the last of the law cited refers to crisis situations, it should not be lost sight of it. It is dedicated to crisis management, i.e., the activity of public administration bodies as an element of national security management, which consists of preventing crisis situations, preparing for them, bringing them under control through planned activities, responding in the event of crisis situations, removing their effects and restoring resources and critical infrastructure. The legislator recognises a crisis situation as a situation that has a negative impact on the safety level of people, large assets or the environment, causing significant limitations in the operation of the competent public administration bodies due to the inadequacy of the available forces and resources. There is no doubt that the epidemic of an infectious disease is a high-risk factor for the emergence of a crisis situation, which has been included in the National Crisis Management Plan.

It is interesting to note that the Constitutional Court has pointed out that a "crisis situation" is something quite different from a constitutional state of emergency and should be included in the normal functioning of the state. The Law thus sets a crisis management system that is applicable in the event of dangers that require special measures but do not meet the conditions for the introduction of one of the states of emergency (see judgment of 21 April 2009, file ref. K 50/07, OTK ZU No. 4/A/2009, item 51; Bosek, 2021b: 215).

When we turn to the Law on Infectious Diseases, we should start from the premise that we operate in the framework of the usual legal measures that can be used by public authorities to prevent the spread of infectious diseases, and, in the event of epidemic outbreak, to combat its effects.

The Law focuses on establishing rules and procedures for the prevention and control of infectious diseases in humans. This includes identifying and monitoring the epidemiological situation and taking anti-epidemic and preventive measures to neutralise sources of infection, interrupting the spread of infections and infectious diseases, and immunising people at risk of infection. It defines an infectious disease (Article 2.3) as a disease caused by a biological pathogen. The Law recognises as biological pathogens the cellular microorganisms or products produced by them that are capable of causing symptoms of disease, external and internal parasites of humans or products produced by them, acellular particles capable of replication or transfer of genetic material, including genetically modified cell cultures or products produced

by them (Article 2.2.). The Law distinguishes between two different approaches for an "ordinary" infectious disease and an infectious disease that is a particularly dangerous and highly contagious disease. As can be seen from the definition of a particularly dangerous and highly contagious disease, it is an infectious disease that spreads easily, has a high mortality rate, pauses a particular threat to public health and requires special control methods, including cholera, plague, smallpox, viral haemorrhagic fevers (Article 2.4).

Recognised as a systemic Law in this respect, containing a set of basic principles and legal instruments to be used in particular situations legally classified as state of epidemic threat or epidemic. The term *epidemic* has been provided with normative designations and is qualified by the occurrence of infections or infectious diseases in a given area in a specifically greater number than in the previous period, or the occurrence of infections or infectious diseases that have not previously occurred (Article 2 point 3). At the same time, the Law does not specify the exact extent of the spread of the disease, so this assessment should be related to the current facts and the increase in the endemic factor, which is not positively assessed in the doctrine (Bosek, 2021b: 218; Bosek, 2022:181).

The purpose of introducing special situations, legally categorised as a "state of epidemic threat" or "state of epidemic" is to enable the competent authorities to efficiently achieve the goals and related tasks of preventing and ultimately combating the spread of infectious diseases. This categorisation formally made by a regulation adopted by the Voivodeship (if the epidemic affects the territory of the voivodship) or the minister responsible for health (if the territory affected exceeds the Voivodeship territory) and leads to a change in the legal status of the functioning of public authorities and the society.

It should be emphasised that the introduction of one of the aforementioned qualified legal statuses was left to the discretion of the competent executive authorities, and, it seems, actually serves to enable them to effectively adopt epidemic control and preventive measures specified in the Law in order to minimize the effects of the epidemic. The other provisions contained in the Law on the Control of Infectious Diseases therefore apply, but with a modified competence model that allows the competent authorities to achieve a normatively specific goal under the conditions of a spreading disease. Thus, also in the case of the two special states, tasks related to the implementation of a comprehensive epidemiological supervision programme will be carried out, including comprehensive epidemiological research (along with an assessment of the current situation), monitoring of morbidity and mortality due to infections, comprehensive implementation of prevention and modern diagnostics and treatment of infectious diseases.

It is rightly pointed out that the law is the legal core of the epidemic control and protection of the Republic of Poland as a systemic solution (Bosek, 2021a: 11).

Contrary to the title of the Law, which suggests that it focuses on legal and medical relations, the analysis of the content of the Law leads to the conclusion that the act interferes with a wide spectrum of personal and economic relations, and indirectly even with civil and political relations (for example, the provisions on quarantine and isolation could affect the exercise of electoral rights) (Bosek, 2021a: 11).

In particular, the Law authorises the Voivodeship, the minister responsible for health matters and the Council of Ministers to declare an epidemic emergency or state of epidemic and the associated restrictions, instructions and prohibitions which are introduced on the basis of regulation not the Law. This interferes with the guarantees of rights and freedoms, the restriction of which must be assessed in the light of Article 31 Para. 3 and Article 2 of the Constitution of the Republic of Poland. This means that a constitutionally permissible restrictions of fundamental freedoms and rights is only permissible upon a law enacted by the Parliament not regulation issued by the executive authorities.

At the same time, it is emphasised that the Law does not establish a universal model to combat the economic and social impacts of the epidemic, as it does not independently define a single model to mitigate all the effects of the epidemic, nor does it authorise the executive authorities to regulate these issues in regulations. Mitigating the economic and social impacts of an epidemic often require numerous legislative amendments adapted to the state budget and the extraordinary circumstances of a specific threat or epidemic outbreak.

So how should the solutions adopted in Polish law be assesses as to whether a rapidly spreading infectious disease is a factor that justifies the declaration of a natural disaster - understood as an extraordinary measure under constitutional law or is it a prerequisite for the normal functioning of the state and its authorities?

From a dogmatic point of view, it can be assumed that the extraordinary measure regulated by constitutional law e.g., the “state of natural disaster” is a different normative category than the categories “state of epidemic” and “state of epidemic threat” which are regulated by the Law on Infectious Diseases. The constitutional regulation is of overriding nature and state that the introduction of an extraordinary measure is only permissible if it is impossible to counteract the threats by ordinary means.

In practise, the phenomenon of the epidemic and its effects are also so difficult to assess a priori that only the assessment of the executive authorities authorised to declare a state of a natural disaster (Council of Ministers) or an epidemic threat and a state of epidemic (Voivodeship, minister responsible for health, Council of Ministers) depends on the categorisation of a given state in the category regulated by Law on Infectious Diseases or to the category of extraordinary measure, in particular a natural disaster (Bosek, 2021a: 20; Bosek, 2022: 209). It is argued that the nature of the administrative discretion implies that the authorised body can take different

decisions in the same factual situation, and that despite the differences in content, all decisions that fall under the covered by the administrative discretion must be considered legal (Bosek, 2021a: 20). A different position can also be found in legal doctrine, according to which, by virtue of the fact that it concerns the powers of public authorities, it imposes on these authorities an obligation to declare state of a natural disaster, provided that the conditions specified in this provision are met. There can be no question of discretion in the administration acting at its own discretion in this respect, but it is bound by the instrumental exercise of powers (Tuleja, 2020: 9).

Poland's experience resulting from the major challenge of the COVID-19 pandemic shows that the adopted legal solutions are not precise enough and do not provide a clear answer as to whether the spread of the infectious disease and its effects in the dimensions we have experienced in the case of the Sars-Cov II virus (pandemic) allow this situation to be recognised in the legal sense as a natural disaster or a state of epidemic - subject to the autonomous nature of each of these states, and thus a separate legal qualification for each of them. It should be emphasised that the Polish legal system has yet been confronted with a situation such as the one that arose in connection with the COVID-19 threat. The reasons for this were the large number of people infected, easy transmissibility of the virus, the lack of effective treatments and the relatively high mortality rate in certain groups of people in certain periods. The specificity of the situation caused by this pathogen consists in: the long duration and unpredictable end of the pandemic, the spread of the threat, probability of the collapse of the healthcare system under the burden of the pandemic (Coronavirus (COVID-19) in Poland - Statistics & Facts). The path chosen by the Polish authorities is based on declaring a state of epidemic, without taking any steps related to the introduction of a state of emergency or a state of natural disaster (Mełgieś, 2021: 378). It should be noted here that although the Law is considered systemic, it does not always definitively correspond to the conditions under which a specific epidemic develops and progresses according toits own nature and dynamics. Since the Law on Infectious Diseases does not establish a universal model to combat the economic and social effects of the epidemic, in the sense that it does not independently define a single model for mitigating all the effects of the epidemic, nor does it authorise the executive authorities to regulate these issues in regulations, it was necessary during the COVID-19 to introduce a number of episodic regulations in order to mitigate economic and social impact of the epidemic, taking into account the state budget possibilities and extraordinary circumstances of a specific threat (Bosek, 2021a: 11).

The challenge for the legal system was the necessity to introduce widespread isolation of people, which was previously the only effective measure against the spread of infection, which meant a significant interference in the sphere of fundamental freedoms of an individual (Tuleja, 2021: 8). To this end, public authorities used the regulations issued on the basis of statutory authorisations set out in the Law on Infectious Diseases, as a rapid response to the dynamically changing circumstances

of pathogen development was required. This involved an unauthorised restriction of the rights and freedoms of people, which, in accordance with the Constitution, can only be introduced by virtue of law (Article 31(2) of the Constitution). From the perspective the rule of law, such measures were questioned both by academics and by the courts, which had to pass judgements on the basis of the aforementioned regulations. (Tuleja, 2021: 17; Florczak- Wtor, 2020: 6).

The experience gained during the pandemic made it possible to reformulate an approach to the presented issue according to which the authorisation contained in Article 232 of the Constitution, due to the fact that it concerns the powers of public authorities, imposes on those authorities the obligation to introduce a state of a natural disaster, provided that the conditions specified in this provision are met. There can be no question in the administration acting at its own discretion in this regard, but it is bound by the instrumental exercise of power (Tuleja, 2021: 9). The assessment of the actual situation from the point of view of the occurrence of threats and the need to prevent them by means of specific measures may be relevant in a given case. However, with regard to the COVID-19 pandemic, such an assessment should not be disputed (Tuleja, 2021: 9; Florczak-Wtor, 2020: 7).

New informal concepts emerged in the legal doctrine, such as: "hybrid state of emergency" or *"de facto state of emergency"*, which refers to the actual situation during the COVID-19 pandemic in Poland (Tuleja, 2020: 13; Kardas, 2020: 9). This means, that the material conditions for the introduction of a state of a natural disaster were met, so the Council of Ministers was obliged to issue a regulation introducing this state and announce it, but did not fulfil this obligation. Formally, therefore, there was no introduction of a state of a natural disaster in accordance with Article 228 Para. 2 of the Constitution. However, such a term is not sufficient to solve many legal problems that arose during the pandemic. The Constitution only recognises the normal state and the state of emergency. It does not provide for intermediate states (Tuleja, 2021: 13).

Although there are views in the law doctrine on the possibility of declaring a de facto state of emergency, though not *de jure,* or a material state of emergency, though not formally, or even a hybrid state, the authors of these views do not negate the fact that no state of emergency has been declared in a way that is compatible with the Constitution. (Kardas, 2020: 9). The conditions for the introduction a state of a natural disaster already exist at the time of the outbreak of the epidemic - even if it does not yet have any concrete effects, e.g., the death of those infected people. Failure to introduce a state of a natural disaster can be seen as a violation of the constitution and is a reason to hold the authorities accountable (Florczak-Wątor, 2020: 6-7).

In conclusion, it is difficult to qualify a rapidly spreading infectious disease as an unambiguous premise for the formal state of a natural disaster is difficult. This is due to the concept of natural disaster and the specificity of the conditions for the

introduction of the state of emergency depend on dubious subjective opinion: "Their interpretation depends not only on the events themselves (events covered in the form of general clauses), but also on the opinions of the competent authorities and the expectations of citizens, which are shaped by the authorities, the opposition and the media". (Brzeziński, 2007: 40; Kurzępa, 2017: 60.)

CONCLUSIONS

The analysis of the normative space has shown that the legal instruments at EU level do not provide a clear answer that an infectious disease, including the COVID-19, is automatically and *per se* a factor responsible for a natural disaster. EU authorities have responded to the current situation with various ad hoc instruments, sometimes resorting to episodic solutions, by calling a spreading disease a natural disaster or an emergency or even an acute health emergency. However, it should be borne in mind, that there is no guarantee that such a categorisation will be valid over a longer period of time.

In Poland, although the conditions for introducing the state of a natural disaster in the normative definition seem to be sufficiently detailed, the obligation of the authorities to make such a decision turned out to be controversial, as the government decided to introduce completely new categories, namely the state of epidemic threat and then the state of epidemic.

However, it must to be emphasised that the decision to qualify a certain situation as a state of a natural disaster or to negate such a need requires reflection each time and is a political decision. Reflection takes time, which in turn can be invaluable when it comes to threats to the most valuable values, namely human life and health. The law then appears as an imperfect instrument that reacts to reality with a delay.

In the view of doubts expressed, it might be worth considering replacing the concept of disaster, regardless of its type, with the concept of emergency situation in the regulations. Certainly, a consensus on this matter would be useful for both decision-makers and citizens. It would provide the authorities with certain, unquestionable grounds (including an obligation) to act, while citizens - in the event of interference with their rights and freedoms, would have a guarantee of the existence of the limits of these restrictions, including in terms of time.

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ENVIRONMENT AND CLIMATE CHANGE ADAPTATION - HOW CLIMATE CHANGE RESILIENCE REDUCES THE RISK OF DISASTERS?

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CLIMATE REFUGEES – A CHALLENGE OF THE 21ST CENTURY

Dejana Jovanović Popović[1]
Full Professor University of Belgrade, Faculty of Security Studies

1 e-mail: dejana@fb.bg.ac.rs

CLIMATE REFUGEES – A CHALLENGE OF THE 21ST CENTURY

Summary: Climate change is one of the most pressing issues on the international stage in this century. Many studies predict a large number of people who will migrate due to environmental changes. The urgent challenge of legal protection for climate or environmental refugees will undoubtedly be one of the most difficult goals to achieve. Existing legal instruments are inadequate as there is insufficient consensus on definitions and responsibilities. The paper presents attempts to close this legal gap.

Keywords: *climate refugees, environmental refugees, climate change, legal protection, temporary protection*

INTRODUCTION

The end of the 20th century is characterised by a shift in the focus of security researchers from state and military threats to a much broader range of threats. Some of these are related to environmental degradation caused by current and projected global climate change, which can be widespread and have far-reaching consequences. We are seeing more and more people being displaced from their homes or areas not only due to political persecution or economic stagnation, but also due to natural disasters, poor development programmes and environmental degradation.

The effects of climate change, such as rising sea levels, extreme weather events, droughts and water scarcity, deforestation and ocean acidification, are undermining people's security and leading to new or old migration flows of people in search of better living conditions. As a result of the above-mentioned negative trends in environmental change, a large number of people are forced to migrate temporarily or permanently to other areas.

It is difficult to estimate the exact number of people who will be forced to leave their homes due to climate change. It varies depending on methods, scenarios, timeframe and assumptions, but based on the existing literature, it can be assumed that the climate refugee crisis will surpass all previously known crises in terms of the number of people affected. Although wealthier countries will be somewhat better able to withstand the pressures of climate change and its associated negative consequences, the affected populations of poorer countries will be dependent on the protection and support of the international community, regardless of whether their migration pathway is internal or international (Biermann & Boas, 2010).

Without an official definition of the term environmental or climate refugee, and due to the lack of any form of official recognition in international law, individuals forced to migrate across international borders due to climate change or environmental degradation may continue to be, as the International Organisation for Migration puts

it, "homeless in both the literal and figurative sense" (IOM, 2008, p.36).

CURRENT ISSUE: CLIMATE CHANGE

The US Environmental Protection Agency (EPA) states that *climate change* is a significant change in climatic conditions, such as temperature, precipitation or winds, that lasts a decade or longer and can be caused by the following factors: natural processes, changes in the intensity of solar radiation or human activities that affect the composition of the atmosphere and the Earth's surface (deforestation, urbanisation, desertification). *Global warming* often refers to an increase in the temperature of the troposphere and thus contributes to changes in global climate patterns. It is caused by increased emissions, mainly of carbon dioxide, methane and nitrous oxide (EPA, 2017).

The United Nations Intergovernmental Panel on Climate Change (IPCC) is the leading scientific body for the assessment of climate change at international level. The United Nations Environment Programme (UNEP) and the World Meteorological Organisation (WMO) founded the IPCC in 1988 with the primary aim of gathering and reviewing knowledge about the risks of anthropogenic climate change and its socio-economic impacts.[2] The IPCC's Third Assessment Report (AR3) from 2001 finally established climate change as a global political issue. The AR3 stated that the warming in the last 50 years of the twentieth century was "likely" due to the increase in greenhouse gas concentrations (the term "likely" represents a probability of 66–90%) (IPCC, 2001: 10), while the IPCC Fourth Assessment Report (AR4) stated that the increase in anthropogenic greenhouse gases was "very likely" (>90%) (IPCC, 2007: 10). In 2014, the IPCC declared with 95 per cent certainty ("extremely likely") that humans are the main cause of current global warming (IPCC, 2014: 4). It also emphasises that stabilising the temperature rise to below 2°C above pre-industrial levels requires urgent action, otherwise we could face increasing technological, economic and social challenges. Accordingly, the risks of climate change to health, livelihoods, food security, water supply, human security and economic growth are expected to increase at a global warming of 1.5°C and are likely to increase further if the temperature rises to 2°C (IPCC, 2018: 9). The AR4 identified three potential consequences of climate change that could pose significant security threats: the increasing scarcity and variability of renewable resources, sea level rise and the intensification of natural disasters.

Climate change is expected to have a profound impact on the quality of life of millions of people around the world. Many areas are expected to warm, but some will warm faster than others. Some parts of the world may become more fertile and

2 The IPCC uses the term climate change to refer to changes in the climate over time, whether due to natural changes or as a result of human activities. In contrast to the IPCC, the United Nations Framework Convention on Climate Change uses the term climate change to refer to climate change that is directly or indirectly attributable to human activities that alter the composition of the global atmosphere and that is in addition to natural climate variability.

better suited to growing crops that could not survive at current temperatures. Other areas may simply become too warm to live in. Overall precipitation is expected to increase, but at the local level such trends are far less certain. One of the most dramatic changes would be the accelerated collapse of the West Antarctic Ice Sheet, which could lead to a catastrophic rise in sea levels and changes in ocean circulation. Other changes could lead to a weakening or reversal of the Gulf Stream and make the western hemisphere uninhabitable. Many changes will be gradual, but the possibility of unexpected climate change should not be ruled out.

FIGHT OR FLIGHT: CLIMATE VS. ENVIRONMENTAL REFUGEES

Starting with Lester Brown, who used the term "ecological refugees" in 1976, many authors and institutions have since begun to address the issue of migration in the context of climate and environmental change. In this context, new terms have been introduced, such as: "forced environmental migrants", "environmentally motivated migrants", "climate refugees", "environmentally displaced persons", "ecological refugees", "eco-refugees", etc. The differences between these terms are less important than what they have in common: all of these terms point to an existing link between environmental degradation and human migration, which provides an analytically useful and politically relevant basis for expanding the rights of environmental refugees.

Many definitions have been criticised for treating the concept of environmental refugees too vaguely and simplistically. The concept of environmental refugees is a very complex and diffuse issue, as it is difficult to isolate environmental factors from other migration factors, e.g., economic ones. Another difficulty is to determine whether someone is forced to migrate or whether it is a voluntary migration (Dun & Gemenne, 2008: 10).

The concept of *environmental refugees* refers to people who are forced to leave their place of residence due to environmental change or environmental degradation that threatens their lives (Jovanović Popović & Milinčić, 2015: 39). The United Nations Environment Programme presented one of the first proposals for the definition of environmental refugees in 1985 (Morrisey, 2012: 36). One of the most frequently cited definitions of environmental refugees undoubtedly comes from Essam El-Hinnawi, who states that "environmental refugees are persons who have been forced to leave their ancestral home temporarily or permanently due to significant environmental disturbances (natural and/or man-made) that threaten their livelihoods and/or seriously affect their quality of life. Environmental disturbance in this definition means the impact of any physical, chemical and/or biological change to the ecosystem (or resource base), whether temporary or permanent, that is unsuitable for human life" (El-Hinnawi, 1985: 4).

Climate-induced migration can be considered a subcategory of environmental migration, and according to the definition, climate refugees are: "groups of people who, due to force majeure or sudden progressive environmental change resulting from climate change that negatively affects their lives or living conditions, are either forced to leave their homes or have chosen to do so, either temporarily or permanently, and who move within or across the borders of their country" (IOM, 2008a: 18-19).

Biermann and Boas define climate refugees as "people who are forced to leave their homes immediately or in the near future due to sudden or gradual changes in the natural environment associated with at least one of the three consequences of climate change: sea level rise, extreme weather events, and droughts and water scarcity" (Biermann & Boas, 2010: 67). The authors have identified the lack of conceptual clarity and consensus as a major problem hindering research on climate refugees, especially comparative research and data collection.

The term refugee is controversial. Some authors and international organisations such as the United Nations High Commissioner for Refugees (UNHCR) prefer to use the term environmentally displaced persons due to the legal implications of the term refugee (UNHCR, 2020). What Birman and Boas argue in favour of using the term climate refugees in both scientific and political discourse is that people displaced by climate change will certainly cross borders, but for the most part will remain within the borders of their own state. The term refugee has a strong moral connotation of social protection in most cultures and religions. Using this term will give the protection of climate refugees the legitimacy and urgency it deserves.

Although the exact number of people who will be displaced as a result of global warming is impossible to determine, scientists estimate that the number will be between 50 million and 250 million over the next 50 years (McAdam, 2007: 1; Stern, 2007: 77). A report by the International Organisation for Migration states that up to one billion people could be displaced by 2050 due to climate change and environmental degradation (IOM, 2008a: 12).

The triggers for forced migration can be categorised into two main groups: climatic and non-climatic. Climatic triggers for forced migration include climate processes and climate events (Brown, 2008: 17-18). This categorisation is based on the time frame. *Climate processes* include rising sea levels, salinisation of agricultural land, desertification, increasing water scarcity, food insecurity, etc. *Climatic events*, on the other hand, include sudden and dramatic hazards such as monsoon floods or storms. This forces people to evacuate their homes much more quickly than slower processes (e.g., rising sea levels).

OVERCOMING THE LEGAL VACUUM

Under the current international legal system, classic refugees are persons in need of assistance and physical protection. Legal protection is the basis of the international regime for classic (political) refugees. It is important to emphasise that legal protection for environmental refugees (as well as for economic migrants) is zero compared to political refugees. One of the main reasons for the non-recognition of environmental/ climate refugees lies in the fact that there is no internationally recognised definition. The lack of a universally accepted definition of environmental refugees means that their displacement in extreme weather conditions does not include access to financial benefits, food aid, shelter, hospitals or the education system. Environmental or climate refugees are not recognised as a problem in any binding international agreement. At the international level and also in Serbia, the major challenge is to find an adequate legal protection that is in line with the generally accepted and ratified new convention that environmental or climate refugees are truly entitled to.

Sui Generis Regime: Establishing a protocol to combat displacement caused by climate change

As attempts to revise the 1951 Refugee Convention or to create a completely new convention have so far failed (Dimitrijević, 2010), scientists Frank Biermann and Ingrid Boas have proposed to create a specific and unique protection for climate refugees as an addition to the United Nations Framework Convention on Climate Change (UNFCC) of 1992. The Protocol on the Recognition, Protection and Resettlement of Climate Refugees is based on five principles (Biermann & Boas, 2010: 75-76):

1) The principle of planned resettlement and displacement is a fundamental principle, as most climate impacts are foreseeable. Accordingly, the proposed climate refugee regime does not focus on responding to emergency situations, but on planned and voluntary resettlement over a longer period of time.

2) The principle of resettlement rather than temporary asylum, as most ecologically displaced people cannot return home.

3) The principle of collective rights for the local population. This applies to vulnerable cities, provinces or small island states affected by climate change (in contrast to the Geneva Convention, which is based on an individual approach).

4) The principle of international assistance to states. This measure is proposed because climate change-induced displacement is mostly internal displacement. Accordingly, the protection system should focus on supporting governments, local communities and authorities to protect the people on their territory and on funding resettlement programmes.

5) The principle of burden-sharing in the reception of refugees at the international

level, as climate change is a global problem and industrialised countries bear the main responsibility in this regard.

An Executive Committee for the Recognition and Resettlement of Climate Refugees would ensure the effective implementation of this protocol through the establishment of a dedicated Climate Resilience and Refugee Resettlement Fund (CRPRF). The main advantage of this solution is that it links the protection of climate refugees with state responsibility in relation to climate change. However, the disadvantage of this plan is that it restricts the category of refugees to be protected and only offers international protection to climate refugees (European Parliament, 2011: 45).

In her contribution, the scientist Angela Williams proposes an alternative in the form of a regionally orientated regime under the auspices of the UN Framework Convention on Climate Change. Although the Kyoto Protocol to the Framework Convention on Climate Change calls for regional cooperation on adaptation measures, the author is of the opinion that climate refugees should be explicitly recognised in the post-Kyoto period. This would facilitate the development of regional programmes to address this issue (Williams, 2008).

The issue of climate refugees can be a double-edged sword in climate negotiations. Christel Cournil argues that it could either encourage states to react quickly and enshrine the legitimacy of climate refugee protection in international law, or conversely it could be counter-productive and encourage some countries to back down, which of course slows down 'climate' progress (Cournil, 2009).

The concept of temporary protection

Many countries have mechanisms in place to grant temporary protection (Temporary Protected Status – TPS) to people displaced by a sudden disaster. The scope of protection is defined in law, but often, as in the case of the European Union and the United States, an executive decision by the Council of the European Union and the Secretary of Homeland Security is required before the protective measures can take effect.

The signatory states would be obliged to grant temporary asylum to the protected persons until the conditions for their safe return are created. This status is not linked to the right to citizenship that exists with refugee status. Instead, it focuses on the provision of material assistance and humane treatment until effective protection is re-established for the citizens of the threatened state (Magnigny, 1999: 503).

Temporary Protected Status in the United States

Temporary Protected Status was introduced by the US Congress as part of the Immigration Act of 1990. Temporary Protected Status is currently administered by the United States Citizenship and Immigration Services and allows the Secretary of Homeland Security to designate citizens of a particular country or territory for TPS

protection.

Temporary Protected Status is a discretionary status in the United States intended to provide refuge to individuals who are fleeing potentially dangerous situations in their home country or do not wish to return there. Protection is not granted automatically. Rather, the Secretary of Homeland Security 'grants' the status to a country before its citizens can qualify for protection.[3] Temporary Protected Status is a bilateral agreement for which three conditions must be met. First, the affected country must be in a temporary state of armed conflict, environmental disaster or other extraordinary devastation that temporarily prevents the return of its nationals. Secondly, the affected country is not in a position to organise the return of its nationals adequately. Third, a country at risk must make a formal application to the U.S. government to be eligible for TPS (Wasem & Ester, 2008). This means that in cases where countries could be permanently devastated, as in the case of the potential flooding of small island states (Tuvalu, the Maldives and a dozen other island states formed the Alliance of Small Island States in 1990), TPS is unlikely.

Temporary protection in the European Union

The Directive on temporary protection in the event of a mass influx of displaced persons into the EU was adopted in 2001. It could potentially refer to a sudden influx of people due to environmental or climate change, although this is not explicitly defined, (De Moor & Cliquet, 2009). The EU Temporary Protection Directive was designed as an exceptional mechanism to respond to a mass influx of displaced persons resulting from internal armed conflict, external aggression, generalised violence or massive human rights violations or other circumstances that seriously disrupt public order. The protection in the event of a mass influx of displaced persons in Chapter 1 (Article 2d) refers to persons "coming from a particular country or geographical area, whether their arrival in the (European) Community is spontaneous or assisted, for example through an evacuation programme" (Council of the European Union, 2001: 14).

The intention of this Directive was not to include the influx of climate or environmental refugees, but rather to deal with the influx of people fleeing to or near Europe from similar conflicts that took place in the former Yugoslavia, for example (Cournil, 2009: 7).

Examples of good practise in the protection of environmental migrants are the Nordic countries, in particular Sweden, Finland, Norway and Denmark, which have included environmental refugees in their immigration policies. Sweden and Finland have measures similar to those in the USA (Kolmannskog & Myrstad, 2009; Leighton 2010). Denmark, on the other hand, decides at its own discretion to grant

3 This status allows the beneficiary to work. It can be granted for a period of 6 to 18 months and can be extended if conditions in the country of origin have not improved. However, it is a temporary status, i.e., persons with TPS are not eligible to apply for U.S. citizenship unless there is a specific act of Congress.

protection to victims of famine or drought, especially single women and families with small children (UNHCR, 2009). The Finnish Law on Asylum also stipulates that a person can be "granted asylum if they are "threatened with the death penalty, torture or other inhumane treatment or violation of human dignity [...] or if they cannot return to their country of origin due to an armed conflict or environmental disaster [...]" (Ministry of the Interior of Finland, 2010). Permanent residence can be granted in individual cases, and in the case of a mass influx, a permit can be granted for up to three years.

Given the empirical data that speaks only of possible climate change in the future, as well as the possibilities of migratory movements, it remains uncertain whether (and which) EU countries will ever be faced with a "mass influx" of climate/ environmental refugees so large as to overwhelm regular asylum procedures and justify exceptional - temporary - protection on a *prima facie* basis (according to evidence that, if unchallenged, would be sufficient to prove a person's claim or fact).

CONCLUSION

According to many predictions by the most important world organisations and academic institutions, climate change will cause a refugee crisis of enormous proportions However, climate or environmental refugees are not a recognised category in international law. There is no doubt that they need protection under international refugee law, as their countries of origin are often unable to provide it for various reasons.

From a legal and practical perspective, the Convention Relating to the Status of Refugees (1951) and the 1967 Protocol are insufficient to offer protection to climate or environmental refugees. Furthermore, the UNHCR avoids using the term environmental refugee and even criticises it because it is not recognised in international refugee law. There is a clear gap in the existing international legal system and no competent institution or legal framework that directly addresses the legal status of climate or environmental refugees.

Part of the problem is related to the lack of an official definition of this category of people, which is crucial for policy makers to protect the rights of vulnerable people. The question is how to close this legal and normative gap, i.e., who should take responsibility? The solution lies in finding a clear and official definition of climate or environmental refugees as well as defining the exact scope of the circumstances/ environmental changes that lead to migration before their international legal recognition is achieved. The complexity of the issue also arises from the large number of hypotheses dealing with displacement, the uneven geographical impact of climate change and the varying resilience of countries.

Although the extension of the Geneva Refugee Convention is often mentioned as one of the possible options to solve the actual gap in refugee protection, there is a

consensus that this is neither a realistic nor a desirable scenario. The creation of a specific new legal framework for environmental refugees is also unlikely. Another option being discussed at a global level is the inclusion of a protocol on climate refugees in the 1992 United Nations Framework Convention on Climate Change. At the moment, the legal debate is limited to climate refugees. As things stand, the concept of temporary protection for environmental refugees has the best chance of success at global level.

The specific response to the threats posed by climate change varies from country to country due to their geographical, demographic, cultural and political circumstances. Therefore, there are also proposals that suggest that the international community should look for solutions beyond international mechanisms, conventions and definitions and instead focus on regional and national solutions to the specific challenges that climate change may pose in terms of climate or environmental refugees.

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ENVIRONMENTAL RISKS POSED BY MERCURY PRESENCE IN SOIL AND GROUNDWATER – CASE STUDY OF THE FORMER CHEMICAL COMPLEX HAK1, TUZLA

Zvjezdan Karadžin, PhD[1]
Associate professor, Faculty of Mining, Geology and Civil Engineering Tuzla

1 e-mail: zvjezdan.karadzin@untz.ba

ENVIRONMENTAL RISKS POSED BY MERCURY PRESENCE IN SOIL AND GROUNDWATER – CASE STUDY OF THE FORMER CHEMICAL COMPLEX HAK1, TUZLA

Summary: Problem of environmental risks posed by former and current operations of the chemical and heavy industry and the Tuzla thermal power plant is highly emphasized in Tuzla region.

Large-scale industrial development took place in the Tuzla region during in the 1970s of the previous century, when the chemical complex consisting of the two factories HAK 1 and HAK2 was constructed. The chemical industry became the most important development factor for Tuzla, and Tuzla became internationally recognised as an industrial town. Production in these factories was carried out with considerable disregard for environmental protection, which was a quite a common practice in the 20th century.

The paper deals with the assessment of the contamination of soil, groundwater and building materials with mercury in the former chemical industrial complex HAK1, which was carried out as a part of the project "Reducing Pollution from Harmful Chemicals and Wastes in Mediterranean Hot Spots and Measuring Progress to Impacts in Bosnia and Herzegovina funded by the United Nations Environment Programme (UNEP) and the GEF Mediterranean programme.

Keywords: *Chemical industry, chlorine, mercury pollution, environmental risks*

INTRODUCTION

The research area covers the chloralkali industrial complex, which consisted of two industrial units HAK 1 and HAK 2. Polyol was produced in HAK 1, while toluene diisocyanate was produced in HAK 2.

There was pollution from various pollutants at this area, including mercury pollution. The basic product of HAK 1 was polyol, while HAK 2 produced TDI (toluene diisocyanate).

The company was organised as a complex of several units within one circle whose main goal was the production of "polyols". The production of chlorine was carried out in the electrolysis plant. The electrolysis process included usage of mercury cells.

Figure 1. Electrolysis plant – current state

Mercury is one of the most dangerous pollutants in aquatic ecosystems, and its ecological and toxicological effects depend on the type of mercury compounds in these environments, surface or groundwater. The chemistry of mercury in aquatic ecosystems is very complex, and it is difficult to predict the effects of mercury in the natural environment. The sediments of aquatic ecosystems act as both sinks and potential sources of mercury, and once mercury is deposited in the sediment, it can pose a long-term threat to aquatic organisms. Depending on the prevailing physical, chemical and biological conditions, mercury compounds can interconvert, pass from the sediment into the water phase, enter the food chain, be emitted into the atmosphere or be transported by surface and underground flow to new, uncontaminated locations.

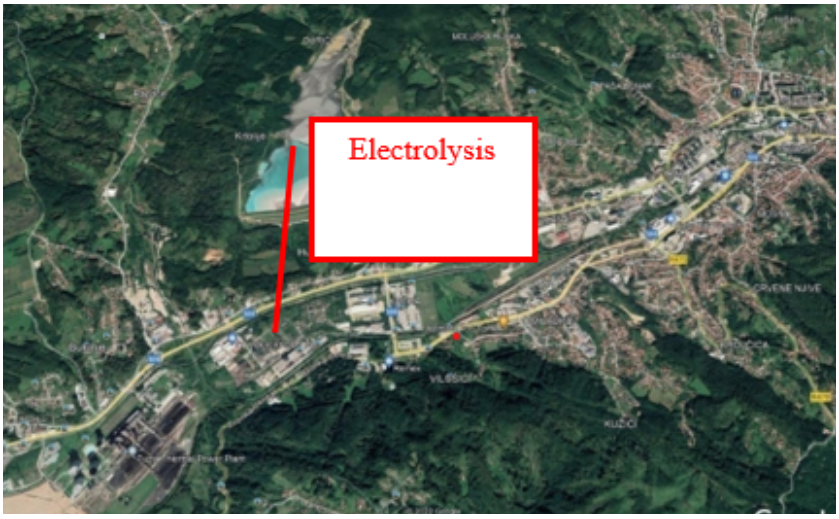

Figure 2 - Location of pollution with Hg in the area of industrial complex - research area (Source Google Earth)

SITE INVESTIGATION METHODOLOGY

The plan was to drill 20 boreholes to a depth of 15 meters. The drilling depths was adapted to the lithological elements drilled from the point of view of possible transfer of mercury and its compounds. The boreholes were practically distributed in profiles parallel to the Jala River (east-west direction) and with a denser concentration of boreholes around the electrolysis plant, depending on access possibilities. Geological supervision of boreholes was carried out by an expert in field research and an expert in hydrogeology, and laboratory representatives took daily samples for laboratory mercury content analysis.

The research objectives were adapted to the "Guidance on the management of contaminated sites[2]. Based on analyses of previous investigations, it is determined that a detailed investigation will be performed in order to:

- understand the local geological and hydrogeological conditions;
- describe the extent and distribution (vertical and lateral) of contamination;
- characterise the actual migration of contaminants and possible transformations;
- obtain data to identify and assess potential adverse effects on public health and the environment.

SITE GEOLOGY AND HYDROGEOLOGY

Geology

The "Kreka" lignite basin is a geological structure located in the wider Peripanonian area and in the immediate north-western vicinity of the cities of Tuzla, Lukavac and Živinice, covering an area of about 200 km2. The basin has been geologically explored by numerous researchers for many years (over 100 years) and its geological structure is fully known.

In principle, four such cycles are distinguished, in which 4 coal seams are formed, with clay in the layer above and sand in the layer below The Kreka lignite basin comprises four coal seams, namely: bottom, main, I and II roof lignite seams (Karadžin et al., 2005: 17)

The following figure shows the development pattern of the Upper Miocene and Pliocene-Quaternary sediments in the area of the Kreka Coal Basin.

2 UN Environment Programme, Minamata Convention on Mercury

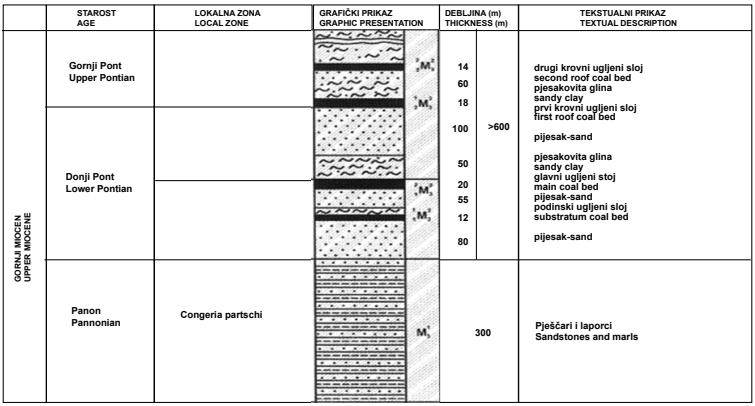

Figure 3- Scheme of upper Miocene and Pliocene - Quaternary sediments development in the area of the Kreka Coal Basin

Geological structure of the research area

It is important to emphasise that the area of former HAK1 site is located directly at the top of the "Ravna trešnja" anticline of the Kreka lignite basin, in the open upper part of the anticline, which is covered by alluvial deposits of the Jala River (see the geological map in the attachment).

The characteristics of the geological structure in the area of the HAK 1 facilities and the immediate surroundings also result from this location. The HAK1 facilities are built on the axis of the core (electrolysis plant) and partly on the north-eastern wing of the anticline (production of propylene oxide) and comprise the package of upper Miocene deposits, from the underlying stratum of the bottom coal seam (panon-M_3^1 to the outcrop of the floor coal seam $^1_1M_3^2$), all covered by alluvial sediments of the Jala River. The HAK-electrolysis facilities are located on the axis the "Ravna trešnja" anticline.

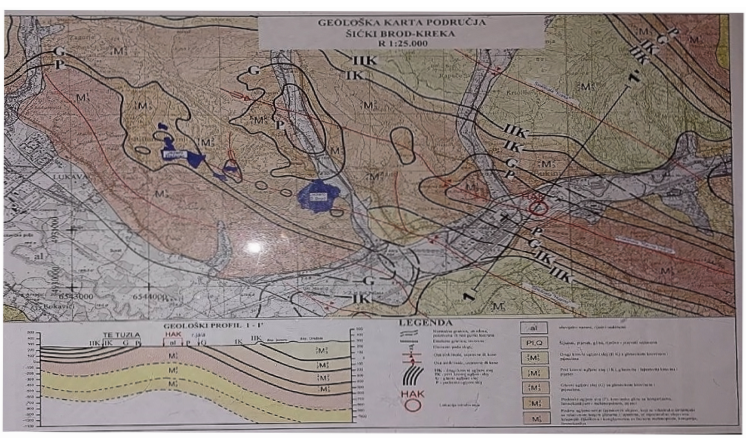

Figure 4. Geological map of the research area

In its current state, artificial infrastructure structures, roads, green areas and production facilities are located directly on the surface of the terrain. The original alluvial sediment of the Jala Valley was replaced by sand material from the PK "Šićki brod" bottom sand of the coal seam roof – $^{2}_{1}M^{2}_{3}$) to improve the bearing capacity and foundation of the buildings,. The lithological composition of the original alluvial material was determined by the lithological characteristics of the rocks in the structure of the upstream flow of Jala River.

Hydrogeology

The HAK1 site is located in the valley of the Jala River, which is characterised by a relatively narrow width ("1 km) and an average height of 211 meters above sea level. The depth of the alluvial deposit is 10-13 meters (see borehole profiles). The composition of the alluvial deposit is generally sandy-clay in the upper part and gravelly in the lower part. The historical data on the construction of HAK1 show that indigenous clay material with low bearing was replaced to a considerable extent by secondary sand, as the bearing capacity of the soil had to be improved for construction purposes. As a result, gravel-sand sequences predominate in the expanded profile, improving overall improve the filtration characteristics of the alluvial aquifer.

Based on the 19 boreholes in the narrower area of the HAK, it was determined that the mean depth of the alluvial aquifer (depth from the surface to the geological substrate) is 12.6 meters. The base of the alluvial aquifer (substrate) is formed by the podinian sand series of the podinian coal seam, previously described as M_3^1(see point 2.5), which in the structure of the wider area represents the vertices of the "Ravna Trešnja" anticlinal.

In the profile of the alluvial deposit, the sandy gravel component dominates and the clay component is present, in the form of a thin surface covering 1.5-2.5 meters or intercalation (lens) in the inflated profile.The proportion of gravel deposits in the lower part of the profile average 35.5%, the proportion of sand 34.5% and the proportion of clay deposits 30%. Sand and gravel together form h_{sr} = 9.11 meters while clay is represented by h_{sr}=3.84 m from the vertical profile of the alluvial aquifer.

Such ratios of representation and the discontinuous lenticular form of the clay interlayers within sandy and gravelly layers predestine the alluvial deposits to act as a significant hydrogeological collector (aquifer) in the HAK 1 area under consideration. On the north-western side, this aquifer is border longitudinally by the regulated bed of the Jala River, and on the downstream south-western side, it extends continuously along the course of the river and into the area of TE Tuzla to its confluence with the Spreča River. On the south-eastern side, the alluvial aquifer is bordered by the transition to the hilly area of the settlements of Nikešići and Vilušići and Bolinac Hills (403meters above the sea).

In the described alluvial aquifer in the HAK area, an accumulation of groundwater

with a free level (Unconfined aquifer) is formed, the hydrodynamic characteristics are typical for this type of aquifer (Andrejaš et al, 2021). The aquifer is fed on the basis of infiltration of rainwater on the surface of the distribution, and peripheral groundwater contact, and drainage is generally directed towards the Jala River and peripheral groundwater discharge. A number of exploratory boreholes were (5 boreholes) to permanently monitor the groundwater level a one-time measurement of the groundwater and the groundwater level after 24 hours was conducted for all exploratory boreholes (18 boreholes). Base on this data, the interpretation of the groundwater distribution is shown in Figure 5 (Karadžin et al, 2023).

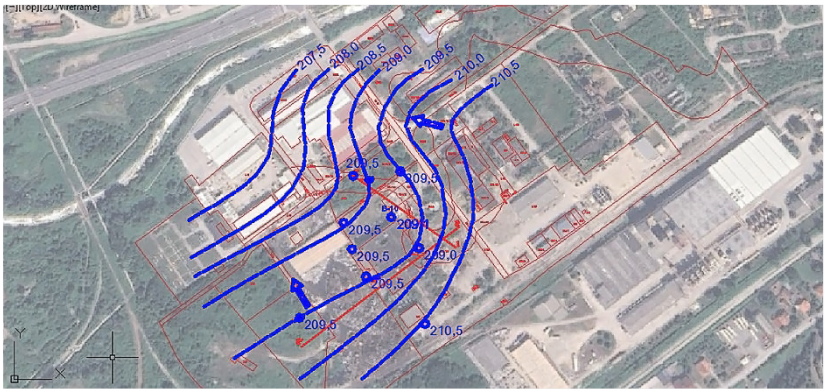

Figure 5 - Isoline map of groundwater levels

The water permeability of the alluvial aquifer, expressed by the filtration parameters **k** (filtration coefficient, m / s) and **T** (transmissivity, m^2/ s), has not been tested by exact methods of test pumping, but the results of laboratory tests of material samples obtained from the exploratory drilling may be used for a preliminary evaluation. An overview of the laboratory values for all samples is given in the following table.

Table 1 - Review of obtained laboratory test values

No.	Material description	Water permeability coefficient k (m/s)	Sample location	Mean value k_{sr}
1	GRAVEL	2.66×10^{-3}	B-3 (10.0-10.3)	3.51×10^{-3}
2		2.15×10^{-3}	B-3 (10.0-10.3)	
3		7.8×10^{-3}	B-10 (7.0-7.3)	
4		2.76×10^{-3}	B-13 (12.0-12.3)	
5		5.10×10^{-3}	B-10 (7.0-7.3)	
6	SAND	1.15×10^{-5}	B-3 (13.0-13.3)	5.53×10^{-5}
7		2.11×10^{-5}	B-5 (14.0-14.3)	
8		1.10×10^{-4}	B-10 (4.0-4.3)	
9		3.9×10^{-5}	B-3 (13.0-13.3)	
10		5.11×10^{-5}	B-13 (14.0-14.3)	
11		6.66×10^{-4}	B-19 (13.0-13.3)	
12	CLAY	5.15×10^{-7}	B-3 (7.0-7.3)	7.82×10^{-7}
13		1.05×10^{-6}	B-5 (5.0-5.3)	
14		3.71×10^{-7}	B-13 (4.0-4.3)	
15		8.9×10^{-6}	B-19 (4.0-4.3)	

Source: Karadžin et al, 2023

The transfer of pollutant occurs through groundwater filtration and surface runoff, among other things, where the dominant process is the dissociation of pollutants in water, transport by hydrodynamic dispersion and physicochemical interacting processes between pollutants, groundwater and rock. The research implies that the following important factors are determined and sufficiently analysed:

- source and generation of pollutants/pollutants (location, type, volume, intensity, duration, control, prevention and removal measures, etc.),
- hydrogeological conditions of infiltration and transfer (presence of aquifers, mutual spatial and structural relations of aquifers and HG insulators, natural vulnerability of aquifers, etc.),
- hydrodynamic conditions (hydrodynamic character of filtration, water permeability, filtration characteristics of aquifers, inflow and outflow, groundwater levels, directions and filtration rates of groundwater, etc.),
- hydrological conditions of transmission by surface runoff (climatological factors, development of the hydrographic network, morphology and drainage areas, etc.),
- physicochemical character of the interaction and transfer of pollution (molecular diffusion, advection, hydrodynamic dispersion and numerous other aspects),
- the presence of objects in the environment that need to be protected from pollution (sources and water sources, arable land, recreational, hydrotechnical facilities, protected ecological systems, etc.).

CHARACTERISTICS OF MERCURY (Hg) IN AQUATIC ECOSYSTEMS

Mercury is one of the most hazardous pollutants in aquatic ecosystems, and its ecological and toxicological effects depend on the type of mercury compounds in these environments, surface water or groundwater. The chemistry of mercury in aquatic ecosystems is very complex, and it is difficult to predict the effects of mercury in the natural environment. The sediments of aquatic ecosystems act as both sinks and potential sources of mercury, and once mercury is deposited in the sediment, it can pose a long-term threat to aquatic organisms. Depending on the prevailing physical, chemical and biological conditions, mercury compounds can interconvert, pass from the sediment into the water phase, enter the food chain, be emitted into the atmosphere or be transported by surface and underground flow to new, uncontaminated locations.

In aquatic ecosystems mercury occurs in three main forms: elemental mercury (Hg^0), complexes of mercury with various inorganic and organic ligands, and organic forms of mercury (methylmercury and dimethylmercury). In most aquatic ecosystems, about 10 to 30% of mercury is present in elemental form. Hg^0 in surface waters is mainly formed by the reduction of Hg^{2+} by aquatic microorganisms, as well as by abiotic decomposition of humus substances, the decomposition of organic forms of mercury, and by anthropogenic emissions, as in this case by the chlor-alkali industry. Elemental mercury is relatively unreactive and stable in water, but in the presence of chloride ions it can be reduced to Hg^{2+}. Most surface water is saturated with Hg in relation to the atmosphere, especially in summer. Due to its high volatility, elemental mercury evaporates easily at normal temperatures and is lost from aquatic ecosystems.

In water, Hg^{2+} has a strong tendency to form complexes, especially with soft ligands such as sulphur, and inorganic mercury can be converted into insoluble mercury sulphide (HgS), rendering it inactive. In the absence of sulphide, three uncharged complexes are formed during the speciation of inorganic mercury: $Hg(OH)_2$, HgOHCl and $HgCl_2$. However, inorganic mercury can also enter the food chain through the action of through Methanogenic bacteria, which are often the first link in the food networks of aquatic ecosystems, convert inorganic mercury into extremely toxic methylated mercury through their metabolic processes.The methylmercury cation (CH_3Hg+) has a high tendency towards complexity, with the most stable form being methylmercury hydroxide (CH_3HgOH). The transfer of mercury from water to the organic phase occurs mainly via neutral ion pairs: CH_3HgCl and CH_3HgOH. Methylmercury is the predominant organic mercury compound in water, on the surface and underground, while dimethylmercury is more common in marine ecosystems. Methylmercury is a very stable compound in water that is effectively degraded by microorganisms, and is also subject to photochemical degradation. Unlike methylmercury, dimethylmercury

readily volatilizes and is lost from freshwater ecosystems. It is not considered available for accumulation in aquatic organisms.

Methylated mercury has strong bioaccumulation properties in living organisms and properties of biotransformation and biomagnification in the food networks. As a result, mercury in water accumulates very quickly in fish tissue in concentrations that are hazardous to human health, and is an extremely dangerous pollutant. The toxicity of mercury in aquatic ecosystems is affected by temperature, salinity, dissolved oxygen and water hardness. For aquatic plants, inorganic mercury is toxic from a concentration of 1 mg/l, while its organic forms (methyl, butyl, propyl mercuric chloride) are toxic at much lower concentrations. Compared to other plants, mosses have a special ability to accumulate and bind mercury. Aquatic invertebrates are also more sensitive to organic forms of mercury, and are most sensitive at the larval stage. Some studies have shown that the concentration of methylated mercury in fish increases significantly with increasing water temperature. (Karadžin et al, 2023)

Source and generation of Hg pollutants

As previously discussed, mercury (Hg) played an important role in the entire technological process of the HAK1 electrolysis plant, as a cathode element of electrolysis. During the process, it changed its form from elemental mercury (Hg), through sodium amalgam (NaHg) back to elemental mercury (Hg) through chemical reactions. In theory, the mercury was not lost from the process, but circulated constantly in a closed cycle between the cell and the decomposer (Karadžin et al, 2023). In practise, however, some loss of mercury (~8%) occurred in the liquid licking from the cells and decomposers, most often with hydrogen, chlorine, caustic soda, electrolyte and graphic sludge from electrode wear. The water contaminated with inorganic salts was first treated to remove mercury, active chlorine, and other heavy metals. All water and sediments in this plant that could be contaminated with mercury were collected in collection tank by the internal operational sewage system and further sent to the mercury wastewater treatment plant.

After the closure of the HAK1 and the destruction of the facilities, uncontrolled processes of spreading mercury and other pollutants occurred into the immediate environment.

The tests carried out did not determine the form of mercury (elemental or methylated) in the analysed samples (Karadžin et al, 2023).

ANALYSIS OF THE SPREAD OF POLLUTION

As previously emphasized, the detailed hydrogeological research conducted in the research area of HAK1 and its surroundings has sufficiently clarified the hydrogeological relations in the narrower and broader area, as well as the hydrodynamic characteristics of the accumulation and movement of groundwater in space and time.

The character of groundwater filtration in an alluvial aquifer is unambiguously defined as filtration with free groundwater level, in a heterogeneous sand-gravel aquifer.

In terms of **water permeability**, the aquifer can be categorised as a "well-permeable environment" with defined mean values for the filtration parameters:

T = transmissivity coefficient = 1.62×10^{-2} m^2/s

k = filtration coefficient = 1.78×10^{-3} m/s

This characterisation of aquifer permeability favours the possibility of transfer and transport of contaminants by underground filtration (Karadžin et al, 2023).

The direction of the underground stream in the area of the deposits and exploitation works was determined on the basis of a short observation time of the level of groundwater on derived piezometers. The distribution of groundwater level and the directions of the subsurface flow are clearly defined by hydroisochips on the hydrogeological map. It is noticeable that the underground flow is directed to the north-northwest towards the Jala River and that the groundwater is diffusely discharged into the Jala watercourse (Karadžin et al, 2023).

The subsurface stream gradients (I=ΔH / ΔL in the area of the defined levels and directions of subsurface flow are relatively low values I = 0.006 and thus the mean subsurface velocities

(v = k x I) are low, with values around 1.067 x 10^{-5} M / s is 0.923 m / day.

Under such hydrodynamic conditions, it is realistic to assume a laminar regime of the subsurface stream, which reduces the possibility of transport of pollutants (Hg) by the process of advection of particles in the subsurface stream.

Vulnerability of the aquifer

The vulnerability of aquifer under the given hydrogeological conditions is a natural measure that shows how easily water penetrates and moves through the aquifer, introducing possible pollutants (in this case Hg). This is emphasized due to the character of the open aquifer and the filtration of the groundwater with a free level in it (Unconfined Aquifer). Numerous methods have been developed to quantitatively assess the degree of vulnerability of aquifers of various types. One of the most

commonly used methods is the GOD method (Foster & Hirata, 1988) as a simplified and patented version of the DRASTIC method (US-EPA, Aller 1985).

This method requires knowledge and indexing of the three basic factors of the aquifer: **G**roundwater occurrence – **O**verall lithology – **D**epth to groundwater (GOD). In the specific case of the aquifers in the HAK1 area, the indexing according to the GOD method (0.0-1.0) gives the output value: *Vulnerability to pollution = 0,7 - category high vulnerability*

GROUNDWATER POLLUTION

The migration of mercury through water is of a particular concern as elevated levels of mercury have been detected in all samples taken.

Table 2 Results of Hg tests of water

No.	Sample	The result of the Hg testing (µg/l)	Limit values (µg/l)	
			Target	Interventions
1	225/23 (Shaft 1)	**9.6**	0.01	0.3
2	226/23 (Shaft 2)	**2.3**	0.01	0.3
3	227/23 (Shaft 3)	**1.2**	0.01	0.3
4	228/23 (Channel 1)	**10.9**	0.01	0.3
5	229/23 (Channel 2)	**6.8**	0.01	0.3
6	230/23 (Separator)	**1.1**	0.01	0.3
7	231/23 (piezometer 1-old)	**0.85**	0.01	0.3
8	522/23 (upstream above the HAK)	**0,66***	0.01	0.3
9	523/23 (at the entrance to the HAK)	**0,68***	0.01	0.3
10	524/23 (downstream)	**0,69***	0.01	0.3
11	525/23 (Piezometer B10)	**3.3**	0.01	0.3
12	526/23 (Piezometer B19)	**178**	0.01	0.3
13	527/23 (Piezometer B13)	**5.84**	0.01	0.3
14	528/23 (Piezometer B3)	**0.50**	0.01	0.3
15	529/23 (Channel 3)	**2.81**	0.01	0.3
16	530/23 (Channel 4)	**3.58**	0.01	0.3
17	531/23 (Channel 5)	**4.26**	0.01	0.3
18	532/23 (Channel 6)	**1.46**	0.01	0.3

**Limit values are given on the basis of: - Decision on the characterisation of surface and underground waters, reference conditions and parameters for the assessment of water conditions and water monitoring "Official Gazette of the Federation of BiH No. 1/14"*

Source: Karadžin et al., 2023, Assessment on the contamination of soil and groundwater with mercury at the chemical industrial complex, HAK 1, Tuzla, Engineering Conference, Bečići, Crna Gora: 42.

All results show the presence of Hg in groundwater above the limits prescribed by *"Dutch Target and Intervention Values, 2000 (the new Dutch List)"*. This standard is used because there are no standards governing this issue in Bosnia and Herzegovina.

Pollution of the surface water

For the transfer of pollutants through surface water to occur, there must be a hydraulic connection (contact) of the groundwater from the area of pollutant generation to the surface flow in question. Surface flow can, in principle, be a carrier of pollution if there has been a direct discharge of pollutants into an open stream or the discharge of polluted groundwater into an open watercourse, of a concentrated or diffuse character. In the specific case of mercury (Hg) pollution in the HAK1 area, the Jala River is the main and only recipient of groundwater discharge from the alluvial aquifer.

The results of the analysis of the mercury (Hg) concentration show that the water samples taken from the Jale watercourse have the following values (Andrejaš et al, 2021):

Sample 522/23, (position upstream of the HAK) - 0.66 μg / l
Sample 523/23 (position at the entrance to the HAK) - 0.68 μg / l
Sample 524/23, (position upstream of the HAK) - 0.69 μg / l

The results presented show that the Jala watercourse is already contaminated with elevated levels of mercury (Hg) before the possible discharge of the pollutant from the HAK1 area, i.e., upstream of the location of the complex. It should be noted that mercury pollution of unknown or general origin occurs upstream in the area of the city of Tuzla in quantities exceeding the limit values.

A slight increase in the mercury concentration (+ 0.02 μg/l) was detected in the area of the drainage of the alluvial aquifer (carrier of the mercury pollution) into the Jala watercourse, and a slight increase (+ 0.02 μg/l) was also detected and further downstream of the HAK. With regard to the high concentrations in the HAK area (piezometer, 0.5-5.84 μg/l) and in particular the extreme concentrations at the electrolysis site (B-19.178 μg/l), these values indicate a slight transfer of pollutants takes place through the process of advection by underground filtration and uptake into the open watercourse. This suggests that mercury (Hg) in the alluvial aquifer may be predominantly present in the elemental state (Hg^0) and as such is difficult to move and non-reactive. Given that that the measurements were only taken over during a period of 40 days, and not during the different seasons these assumptions should be further investigated before remediation measures are determined.

Contamination of the soil

With regard to mercury contamination of the soil, the ranges for the limit values have been set, namely:

- target value 0.3 mg / kg and
- intervention value 10 mg / kg.

The volume of contaminated soil is defined on the basis of the known area and depth.

Table 4 - Area polluted and volume of polluted soil

Depth	Area (m^2)		Volume (m^3)	
	>10 (mg/kg)	>0,3 (mg/kg)	>10 (mg/kg)	>0,3 (mg/kg)
0.00-0.30 m	11.248	96.326	3.374	28.898
0.30-3.00 m	5.969	70.995	16.116	191.686
3.00-6.00 m	3.057	31.948	9.171	95.844
6.00-9.00 m	3.057	29.680	9.171	89.040
9.00-12.00 m	3.057	16.878	9.171	50.634
12.00-15.00 m	3.057	9.721	9.171	29.163
Total			56.174	485.265[3]

Source: Karadžin et al, 2023: 42.

One cubic metre of soil has an approximate mass of 2 t/m^3 which corresponds to 112.348 tonnes of contaminated soil with a contamination of over 10 mg/. This soil contains over 11 tonnes of mercury if we consider 10 mg / kg as the lowest expected value.

Based on the analysis, an approximate volume of 56,174 m^3 of soil is contaminated with more than 10 mg / kg of mercury.

Approximately, 485,000 m^3 is contaminated with more than 0.3 mg/kg of mercury.

3 Includes the amount of material of contamination more than 10 mg/kg

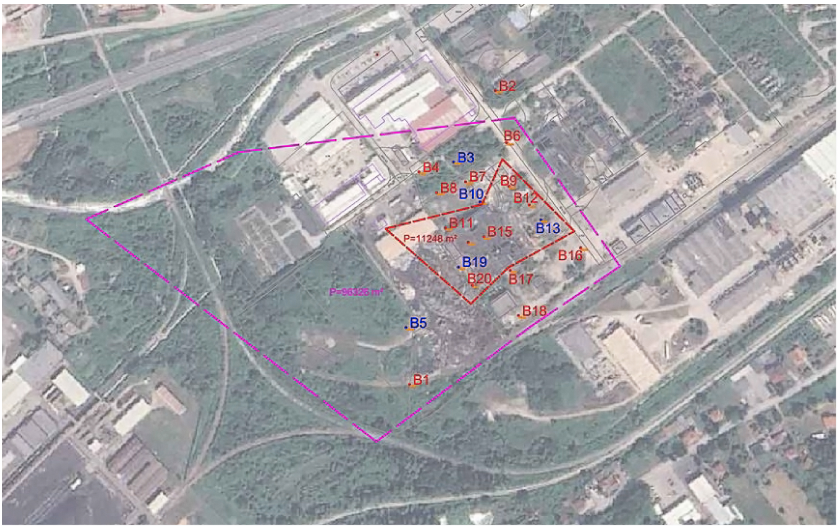

Figure 6. Contamination with mercury soil layer 0.00-0.30 m depth (Andrejaš et al, 2021).

The analysis carried out, clearly shows the limit of the area that needs to be treated depending on the depth of the examination.

Presence of mercury in the construction material of the electrolysis plant

Table 5. Results of the test of building materials for the presence of Hg

No.	Sample	The result of the Hg testing **(mg/kg)**	Limit values **(mg / kg)** dry substances	
			Target	Interventions
1	435/23 Concrete 2	**0.1825**	0.3	10
2	436/23 Concrete 1	**7.95**	0.3	10
3	521/23 Concrete 3 (B15)	**1240**	0.3	10
4	701/23 Concrete 4 (B14)	**430.6**	0.3	10
5	702/23 Concrete pillar 7	**1849**	0.3	10

Source: Karadžin et al, 2023: 41.

After scraping the floor and material from the concrete pillars to which the mercury cells in the electrolysis plant were attached, drops of elemental mercury were detected, including high mercury concentration in the concrete. It was therefore not possible to take samples for analysis due to concentration of Hg in liquid elemental form, which is mobile.

CONCLUSIONS

On the basis of the field research carried out and the laboratory analyses, it was determined that mercury is present in the soil and groundwater as well as in the building material of the electrolysis plant itself.

In addition, it was found that the level of groundwater in the area in question is high and that the clay layer lacks continuity, so that it is not a completely impermeable layer and therefore cannot prevent the spread of mercury.

In terms of water permeability, the aquifer in the research area can be categorised as a "well-permeable environment" with defined mean values for the filtration parameters. This characterisation of the water permeability of the aquifer favours the possibility of relocation and transport of contaminants by underground filtration.

The highest concentrations of total elemental mercury were found during the testing of building materials, indicating that a significant source of elemental mercury contamination is still present in the building itself and its surroundings, especially in boreholes B-15 and B-19, and continues to spread over a larger area, most likely through surface and underground runoff at the time of elevated groundwater levels.

This is particularly worrying when you consider that the HAK1 site is located in the alluvial plane of the Jala River, which flows into the Spreča river. This region is quite densely populated and there is agriculture land along the Spreča river.

Mercury, like many other heavy metals, cannot be degraded in the environment, and therefore, remediation must involve either removal or immobilisation.

Considering that this research was primarily aimed at determining the amount and spatial distribution of pollution in the soil, water and the plant itself, the next phase of solving the problem of mercury pollution at the research site would be the elaboration of an Environmentally Sound Management (ESM) plan for the disposal/remediation of mercury waste at HAK 1, Tuzla.

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CHANGE IN APPROACH TOWARDS FLOODS AND LEGAL CHALLENGES IN THE IMPLEMENTATION OF NATURE-BASED SOLUTIONS FOR FLOOD RISK MANAGEMENT IN SERBIA

Nikolić Popadić Sofija, PhD[1]
Research Associate, Institute of Social Sciences, Belgrade, Serbia

1 e-mail: snikolic@idn.org.rs

CHANGE IN APPROACH TOWARDS FLOODS AND LEGAL CHALLENGES OF THE IMPLEMENTATION OF NATURE-BASED SOLUTIONS FOR FLOOD RISK MANAGEMENT IN SERBIA[2*]

Summary: Predictions about the effects of climate change in Serbia in the coming period indicate an increase in the number of days with extreme amounts of precipitation that can cause flooding. The increased risk of flooding, as well as the extreme flood events that occurred in Serbia, indicate the need for change in this field. The research is dedicated to the change from the concept of flood protection to flood risk management, with a special focus on nature-based solutions. The results of the research have showed that nature-based solutions as one of the approaches to flood risk management in Serbia are neither recognised as a concept nor as a term in strategies, policies and legislation. Therefore, there may be problems with the implementation of measures in practise, especially on privately owned land. The research has identified the gaps in the system and in legislation, and provided indications of possible solutions.

Keywords: *floods, flood risk management, nature-based solutions, climate change, property rights*

CLIMATE CHANGE AND FLOODS

Climate change is one of the biggest global challenges of the 21st century. The world is already facing its consequences, and it is predicted that significant challenges are yet to come in the following decades. The impacts and effects of climate change can be very different, from pronounced periods of drought to very large amounts of precipitation that influence the occurrence of floods. Over a period of more than fifty years, the number of extreme precipitation events (exceeding the maximum daily precipitation amounts) has increased globally (Westra et al., 2013: 3904, 3910, 3914). Lehmann et al. found that the "number of record-breaking rainfall events" increased by 12% on a global scale between 1981 and 2010 (Lehmann et al., 2015: 501, 509, 512; Jia et al., 2019: 147). Intense precipitation events are also becoming more frequent in the Republic of Serbia. According to the research from 2018, there were "changes in the precipitation pattern, annual distribution and their intensity distribution, as well as an increased frequency of extreme weather events and periods with extreme climatic conditions" (Đurđević et al., 2018: 6). Compared to the climatological reference period (1961-1990), annual and seasonal precipitation has increased, especially in the southern part of Serbia, where the increase was over 10% (Đurđević et al., 2018: 10). The redistribution of precipitation was particularly noticeable in the summer

2 * This paper was written as part of the 2023 Research Programme of the Institute of Social Sciences with the support of the Ministry of Science, Technological Development and Innovation of the Republic of Serbia.

months, when significant less precipitation fell than on average.[3] In the last decade, the intensity of heavy precipitation has increased compared to the reference period (Đurđević et al, 2018: 12). The number of days with very heavy precipitation[4] has increased by 1-2-fold, and the number of days with extremely heavy precipitation[5] has "increased by more than 5-fold" (Đurđević et al., 2018: 12, 13). On the one hand, it is estimated that by the end of the 21st century, if the increase in greenhouse gas emissions continues, precipitation on the territory of Serbia will decrease by 20.5%, while in the southern regions the decrease will be up to 40% (Đurđević et al., 2018: 15, 17). On the other hand, predictions are that by the end of this century, around 60% of annual precipitation will fall during days with extremely high precipitation, if greenhouse gas emissions continue (Đurđević et al., 2018: 20). Periods of very heavy and extremely heavy precipitation pose a high risk that can lead to flooding. One example is the major flood event that hit Serbia in 2014 (see: Nikolić Popadić, 2021: 213-214). The long rainy period with considerable amounts of precipitation, began in the mid-April 2014 and lasted for twenty days. The extreme rainfall then fell between 12 and 19 May and caused major flooding (Prohaska et al., 2014: 15). Over 200 mm of rain fell in just one week, which is equivalent to the rainfall of three normal months (UN, EU, World Bank, 2014: 9). This excessive rainfall caused the increase in water levels in river basins with return periods of the flood wave from 100 years on the Zapadna Morava, the Sava, the Jadar and up to 1000 years in some parts of the Kolubara River (Babić Mladenović i Kolarov, 2015: 235-236; Nikolić Popadić, 2021: 214). The enormous rainfall also caused flash floods, followed by landslides, that caused severe damage behind (UN, EU, World Bank, 2014). This serious situation required the introduction of a state of emergency, which was declared by the Government on 15 May 2014, for the entire territory of Serbia (see: Gačić et al., 2015: 280). The floods led to evacuation of more than 30,000 people and 51 persons lost their lives. The floods affected different sectors. The total value of the damage and negative effects of the floods was estimated at EUR 1.7 billion (UN, EU, World Bank, 2014: 4, 11, 51).

In view of the climate change predictions outlined above and the increasing number of extreme weather events and days with very heavy and extremely heavy rainfall in the future, situations similar to 2014 are to be expected. Therefore, some changes need to be made with regard to flood protection and prevention, as the current approach has proven to be inadequate.

3 Deficit of precipitation is in the central and southern parts of the country was up to -20%, -30% negative change (Đurđević et al., 2018: 10).

4 Days during which accumulation is higher than 20 mm (Đurđević et al., 2018: 12, 13).

5 Days during which accumulation is higher than 40 mm (Đurđević et al., 2018: 13).

FROM FLOOD PROTECTION TO FLOOD RISK MANAGEMENT

The change in flood management in the European Union was influenced by Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks (Floods Directive). With this Directive, the European Union made a step "towards institutionalising an ongoing paradigm shift in dealing with floods, away from flood protection and towards flood risk management" (Hartmann and Spit, 2016: 361). The Floods Directive prescribes three stages for Member States, each of which forms the basis for the next: preliminary flood risk assessment[6], flood hazard maps and flood risk maps,[7] and flood risk management plans[8] as the final stage of the process. It is prescribed that flood risk management plans should cover different aspects of flood risk management such as prevention, protection and preparedness (Floods Directive, Art. 7(3)). The plans must be coordinated "at the level of the river basin district or management units" and be based on their characteristics (Floods Directive, Art. 7 (1) (3)). The objectives of the flood risk management plans should focus on reduction the likelihood of floods occurring and reduction the harmful effects of floods in different sectors (Floods Directive, Art. 7 (2)). They should include environmental objectives "soil and water management, spatial planning, land use, nature conservation" (Floods Directive, Art. 7 (3)). The change brought about by the Floods Directive also meant a change in approach to the role of nature-based solutions for flood risk management. According to Article 7, flood risk management plans should include potential water retention areas, and promote "sustainable land use practises, the improvement of water retention and the controlled flooding of certain areas in the case of a flood event" (Floods Directive, Art. 7 (3)). It is interesting that the view of "giving rivers more space" was incorporated in the Directive (Floods Directive, (14)), reflecting the change in approach to flood problem that began in the Netherlands when the government introduced "the concept of giving rivers space" - the new approach that emerged in response to the floods of the late 20th century (Hartmann, Slavíková, McCarthy, 2019: 4; van Ruiten and Hartmann, 2016: 698). This was the beginning of the shift from flood defence and "keeping the water out" to a different water management that would absorb water and "give water space" (Hartmann, Slavíková, McCarthy, 2019: 4; Hartmann and Spit, 2016: 361; Johnson & Priest, 2008: 513). The EU Member States transposed the Floods Directive into their legislation and complied with the three stages of implementation. However, there have been some

6 Preliminary flood risk assessment had to be finished by 22 December 2011. It should have been "reviewed, and if necessary updated, by 22 December 2018 and every six years thereafter." (Floods Directive, Art. 4, 14).

7 Flood hazard maps and flood risk maps had to be finished by 22 December 2013, and reviewed/updated by 22 December 2019, and then every six years (Floods Directive, Art. 6, 14).

8 Flood risk management plans had to be finished by 22 December 2015, reviewed/updated by 22 December 2021, and after that every six years (Floods Directive, Art. 7, 14).

difficulties along the way as outlined in the Special report of the European Court of Auditors from 2018,[9] and 5th (2019) and 6th (2021) Water Framework Directive and Floods Directive Implementation Report.[10]

The Law on Waters of the Republic of Serbia is largely harmonised with the Floods Directive (Nikolić Popadić, 2021: 215; Nikolić Popadić, 2020: 210-212). As in the Floods Directive, it is also necessary to carry out a preliminary flood risk assessment, prepare flood hazard maps and flood risk maps, and prepare and implement flood risk management plans (Law on Waters, Art. 47-51). The process of preparing and implementing these three phases was not easy and there were some delays. Namely, it was prescribed that the flood risk management plans had to be prepared by 2017 (Law on Waters, Art. 222), which means that all three phases should have been completed by this year, as the preliminary flood risk assessment, flood hazard maps and flood risk maps, form the basis for the preparation of the flood risk management plans. In practise, however, the situation was different. The preliminary flood risk assessment was completed in 2012. According to the Law on Waters, it should be reviewed/amended every six years, which was done in 2019. The preparation of flood hazard maps and flood risk maps was much slower. According to the data of the Public Water Management Company "Srbijavode", which is responsible for preparing the maps, the majority of flood hazard maps and flood risk maps were finalised for 101 areas with potentially significant flood risk identified in the Preliminary Flood Risk Assessment for the Territory of the Republic of Serbia (2019).[10] The Water Directorate of the Republic of Serbia, together with the Public Water Management Companies "Srbijavode" and "Vode Vojvodina", prepared a Proposal for a Flood Risk Management Plan for the Territory of the Republic of Serbia for the period from 2021 to 2027, in September 2022,[11] which represents a significant delay compared to the deadline initially prescribed by the Law on Waters. The implementation of the flood risk management plan is a process that will take place in Serbia in the coming years.

The harmonisation of Serbian legislation with the Floods Directive also represented a turning point in the approach to floods, but primarily in a formal term, while more significant changes in practise are yet to come in the following years. Traditional flood defence measures are primarily way of dealing with the flood problem issues in Serbia. Although there are over 3.550 kilometres of embankments and other types of traditional "line" protection, they have proved to be insufficient for flood protection in various places, especially in 2014 (Water Management Strategy of the Republic of Serbia, 2017; Babić Mladenović i Kolarov, 2015; Nikolić Popadić, 2021:

9 See: European Court of Auditors, Special Report no. 25/2018, Floods Directive: progress in assessing risks, while planning and implementation need to improve. https://op.europa.eu/webpub/eca/special-reports/floods-directive-25-2018/en/

10 As indicated on the website of the Srbijavode, preparation of maps for the six remaining areas with potentially significant flood risk is in progress. See: https://www.srbijavode.rs/karte-ugrozenosti-i-karte-rizika-od-poplava.html (11.01.2023)

11 The draft is available at: https://rdvode.gov.rs/lat/arhiva-2022-istorija-aktivnosti-u-2022.php

214). The Water Management Strategy of the Territory of the Republic of Serbia until 2034, which is supported by water management experts (Nikolić Popadić, 2021: 214), concludes that the current state of flood protection is unsatisfactory (Water Management Strategy of the Republic of Serbia, 2017). In view of the possible aggravation of the problem of the high-water regime due to climate change, it is necessary to promote and implement active flood protection measures (Water Management Strategy of the Republic of Serbia, 2017; Babić Mladenović i Kolarov, 2015; Stefanović et al., 2014; Babić Mladenović, 2018). In this regard, nature-based solutions can be one of the ways to help alleviate this problem.

NATURE-BASED SOLUTIONS

The analysis in the previous sections has shown that there are various ways of tackling the problem of flooding. In recent decades, the focus has been on flood risk management, which can be based on different aspects. One of them is nature-based solutions (European Commission, 2021: 4). In general, the concept of nature-based solutions was first mentioned in a 2008 World Bank publication (Sowińska-Świerkosz and García, 2022: 1; World Bank, 2008). Since then, there have been different definitions of nature-based solutions, all of which attempt to clarify this very broad concept (Sowińska-Świerkosz and García, 2022: 1). The official definition comes from the European Commission, and states that nature-based solutions are "actions inspired by, supported by or copied from nature. Nature-based solutions use the features and complex system processes of nature, such as its ability to store carbon and regulate water flows, in order to achieve desired outcomes, such as reduced disaster risk and an environment that improves human well-being and socially inclusive green growth" (European Commission, 2015: 24). The broad definitions of nature-based solutions have led to different interpretations of what can fall within their scope. It was therefore necessary to provide an additional specification. In 2020, the International Union for Conservation of Nature and Natural Resources (IUCN) published the Global Standard for Nature-based Solutions which consist of 8 criteria and 28 indicators (IUCN, 2020: 3). The criteria are that nature-based solutions: 1) effectively address societal challenges; 2) are at scale in their design; 3) result in a net gain in biodiversity and ecosystem integrity; 4) are economically viable; 5) are based on inclusive, transparent and empowering governance processes; 6) provide and equitable balance between achieving their primary goal(s) and the continued provision of multiple benefits; 7) are managed adaptively, and evidence-based; 8) are sustainable and embedded in an appropriate legal context (IUCN, 2020).[12] These

12 For more information about the content and application of each criterion see: Guidance for using the IUCN Global Standard for Nature-based Solutions, A user-friendly framework for the verification, design and scaling up of Nature-based Solutions, 2020 https://portals.iucn.org/library/sites/library/files/documents/2020-021-En.pdf

Global Standard for Nature-based Solutions aim "to provide users[13] with a robust framework for the design and verification of NbS that achieve the desired results in solving one or more societal challenge(s)" (IUCN, 2020: 2).

The importance of using nature-based solutions was emphasised in the EU Strategy on Adaptation to Climate Change form 2021. It states that nature-based solutions play an important role in climate change adaptation and can increase resilience to climate change (European Commission, 2021: 11). There is a need to promote nature-based solutions and their implementation in practise. Therefore, the Strategy suggests that benefits of nature-based solutions should be better quantified and communicated, especially to decision-makers and practitioners (European Commission, 2021: 11). According to the Strategy, one of the benefits of implementing nature-based solutions is the reduction of flood risk (European Commission, 2021: 11). Nature-based solutions could therefore be part of flood risk management.[14] Recently, there have been numerous studies looking at the possibility of applying nature-based solutions for flood risk management (Hartmann, Slavíková, McCarthy, 2019: 3, 9). The results have shown that different measures that fall under nature-based solutions can contribute to reducing the risk and/or consequences of flooding. Some of these include peatland restoration, nature-based solutions related forests (e.g., water retention in forests, afforestation of former pasturelands), changing agricultural practises (Bourke, Wilkinson and Srdjevic, 2022: 15-16, 18, 21-22; Albrecht and Nikolić Popadić, 2022: 33), reconnecting rivers with their floodplain, "planting native species to slow down the flow and stabilise river banks", etc. (European Commission, 2021: 125). In its 2019 report on implementation of the Water Framework Directive and the Floods Directive, the European Commission found that all Member States included nature-based solutions in all or some of their flood risk management plans and usually in the form of preparatory studies or projects (European Commission, 2019: 8). Although interest in the application of nature-based solutions for flood risk management has increasing in recent years, there are also certain limitations, i.e., problems when it comes to applying these measures in practise. This is because those measures may have to be implemented on privately owned land, and usually require more land than grey infrastructure (such as dikes) (Hartmann, Slavíková, McCarthy, 2019: 5). Encroachment on private property rights could pose a challenge. As significant areas of land are required, the instruments used to acquire land for the construction of traditional flood defence systems, such as expropriation, are not an appropriate solution in this case (Nikolić Popadić, 2021: 217). Countries are therefore faced with the challenge of how to regulate the implementation of

13 User can be „anyone working on the verification, design and scaling up of NbS. Users may include project managers in the public and private sector, landscape planners, development practitioners and conservationists, governments or representatives of the finance sector (donors and investors), policy makers and planners." Guidance for using the IUCN Global Standard for Nature-based Solutions, p. 11.

14 European Commission defines nature-based solutions in the context of flood risk management as "measures that work with natural processes to address flood risk management, while providing multiple benefits for both human well-being and biodiversity" (European Commission, 2021: 125).

nature-based solutions on privately owned land, in particular whether and how it is possible to oblige owners to allow/enable implementation. In most countries, the application of nature-based solutions is voluntary, while some countries have a system of incentives, compensation, etc. (see: Hartmann, Slavíková, McCarthy, 2019; Hartmann, Slavíková, Wilkinson, 2022).

Opportunities for the implementation of nature-based solutions for flood risk management in the Republic of Serbia

Nature-based solutions have not been in a particular focus of research in Serbia in the past decade, as has been the case in some other countries. Only recently, in 2019, the first comprehensive analysis on the importance and applicability of nature-based solutions in Serbia was conducted (see: UNDP, 2019). This study was focused on nature-based solutions to address the challenges of climate change. One part of this study was dedicated to the problem of flooding. But, the specific, comprehensive research on the possibilities of applying nature-based solutions for flood risk management in Serbia has not yet been conducted. The gap in the literature in this area and the lack of data on projects (especially small, local ones) that have been implemented or are in progress and relate to the application of nature-based solutions in general and flood risk management in particular pose a challenge in researching the possibility of implementing of nature-based solutions for flood risk management in Serbia.

Identifying appropriate nature-based solutions, assessing their impact and putting them into practise is a challenging process that requires cooperation and involvement of experts from different fields and stakeholders. The connection between different sectors for the appropriate application of nature-based solutions should be visible in policies and strategies, especially those dealing with broader issues such as climate change. It is also necessary to link strategies from different sectors such as, agriculture, forestry and water management, as the application of nature-based solutions for flood risk management requires the involvement of all these sectors and affects them simultaneously.

After the analysis conducted, we come to conclusion that nature-based solutions are generally not yet recognised as such in strategies and policies in Serbia. This does not mean that there are no nature-based solutions at all and that they are not applied in the practise, but that the term and concept as defined in the previous section have not yet found the place they should have in Serbia. Therefore, it is sometimes not easy to recognise the measures that may fall within the scope of nature-based solutions.

The Water Management Strategy does not include the term nature-based solutions, but after analysing it, we have come to the conclusion that certain measures can be subsumed under this term. One of the goals prescribed in the Strategy is the use of "active flood protection measures (existing and future reservoirs, retention basins, relief and perimeter channels) on smaller watercourses in order to reduce maximum flows" (Water Management Strategy of the Republic of Serbia, 2017). It

is necessary to create retention basins in less valuable areas, such as forestry and agriculture, in order to reduce the peaks of flood waves on international transit watercourses. Natural retention areas, such as wetlands and floodplains should be restored and expanded (Water Management Strategy of the Republic of Serbia, 2017). The maintenance and expansion of retention areas must be planned together with other relevant sectors. In general, watercourses should be designed in accordance with environmental conditions, and for smaller watercourses that are not located in settlements, hydromorphological changes should be minimal applying the principles of "natural regulation" as much as possible (Water Management Strategy of the Republic of Serbia, 2017). Another measure that should be applied is afforestation. This should help to prevent erosion in hills and mountains and flash floods. Green areas and parks in the settlements should be designed and planned in such a way that rainwater can seep into the ground in the best possible way (Water Management Strategy of the Republic of Serbia, 2017). As we can see, there are some nature-based solutions foreseen in the Water Management Strategy, but there is still space for improvement and for additional measures that should be part of flood risk management. Furthermore, the term and concept of nature-based solutions for flood risk management should find a place in this Strategy.

The draft Flood Risk Management Plan for the Territory of the Republic of Serbia for the period from 2021 to 2027, also does not contain a term for nature-based solutions as such, but certain nature-based solutions are envisaged. The measures envisaged in the Flood Risk Management Plan include the planning and implementation of measures for protection against erosion and natural water retention. These measures aim "to reduce inflows into natural or man-made drainage systems, e.g., by intercepting and/or accumulating surface inflows, improving infiltration, etc., including channel and inundation works and afforestation of riparian areas, thereby restoring natural systems that contribute to slowing down flow and water accumulation" (Flood risk management plan, 2022). This measure belongs to the group of measures related to the natural management of large bodies of water, runoff and the watershed management. Another measure from the same group is the implementation of biological and biotechnical protection works, especially in reservoir basins. A more detailed description of this measure within the Flood Risk Management Plan is identical to the previous one. The last measure, which may include nature-based solutions is planning for the preservation and expansion of existing and the creation of new retention areas (including necessary retentions). From this analysis we can conclude that nature-based solutions are recognised in the draft Flood Risk Management Plan, but not under this term and certainly not detailed and comprehensive enough. There is room for the inclusion of additional nature-based solutions for flood risk management. We can also recommend the introduction of the term nature-based solutions.

One of the examples of nature-based solutions for flood protection in Serbia is the Study on Bosut Forests' ecosystem services: How to achieve better flood protection,

income from wood production, and traditional animal husbandry. The results of the study show that "if environmental flooding of the forest complex and the expansion of traditional animal husbandry are implemented together with joint management and the establishment of protected areas, the value of the four ecosystem services selected as most important for the area (wood production, flood protection, meat production and biodiversity) is expected to increase" (Kiš et al., 2018: 1). For the perspective of flood risk management, it is important that retention area in the forest "can store 100 - 200 million cubic metres of water" (Kiš et al., 2018: 1)

There are also other potential nature-based solutions that could be used for flood risk management in Serbia. As suggested in the study Enhancing Nature-based Solutions in Serbia, there is the potential to enhance and transform special nature reserves Zasavica, Obedska Bara, Gornje Podunavlje and Karadjordjevo, so that they can be used more efficiently for flood protection (Popovicki, 2022: 52). Wetlands, which are also located within above-mentioned nature reserves, can play an important role in flood risk management. Serbia has great potential in this regard as there are 11 areas designated as Wetlands of International Importance (Ramsar Sites), with a surface area of 130,411 hectares (Ramsar Serbia). In addition to implementing nature-based solutions on the land that is publicly owned (as in previous examples) some measures, such as, water retention, land use change, etc., may also need to be implemented on the land that is privately owned. In this case, various challenges may arise.

Legal challenges in the implementation of nature-based solutions

The results of our research show that the term nature-based solutions has no place in Serbian legislation. We have analysed the Law on Waters of the Republic of Serbia, as a fundamental law governing the field of flood protection and water management. As in the Water Management Strategy, there are no nature-based solutions as such, but some measures that the Law prescribes can be subsumed under this term. The measures to be implemented that are aimed at flood protection include, for example, protection and improvement of natural retention areas (Law on Waters, Art. 52). Measures that should be taken to prevent and remove the harmful effects of erosion and flash floods include the use of agricultural and other land in accordance with the erosion control requirements. Other measures that should be implemented include biotechnical and biological protection measures such as afforestation, cultivation and maintenance of protective vegetation, weeding, planting of orchards and artificial meadows, melioration of pastures, cleaning of river beds and streams, etc. (the Law on Waters, Art. 62). The Law on Water obliges owners and users of land in the erosion area to carry out works and take measures to protect against erosion and flash floods (the Law on Waters, Art. 64). The previous measures can be categorised under the concept of nature-based solutions, but are not sufficiently developed, the Law only mentions them in general terms, while their concretisation and application in practise must be regulated more precisely by other laws. With the exception of land located in an erosion area, where the implementation of measures (which can be considered

nature-based solutions) by the owner and user is mandatory,[15] the application of nature-based solutions on privately owned in other areas is not regulated. It is therefore necessary to make appropriate amendments to the Law on Waters to allow the implementation of nature-based solutions on privately owned land that is not located in the above-mentioned areas.

Nature-based solutions for flood risk management can be applied to the agricultural land (Albrecht and Nikolić Popadić, 2022: 33, 44). Therefore, we analysed the Law on agricultural land to determine whether there is a legal basis for the introduction and implementation of nature-based solutions on agricultural privately owned land. Unfortunately, the term nature-based solutions does not exist in the Law. Based on the analysis of this Law, we have come to the conclusion that the introduction of nature-based solutions for flood risk management on agricultural land is possible to a certain extent, within the framework of this Law. The Law on Agricultural Land regulates the planning, protection, organisation and use of agricultural land as a good of general interest (Law on Agricultural Land, Art. 1). Since certain measures of nature-based solutions for flood risk management imply changes in the way land is managed, this means that it would be possible to regulate the way the agricultural land is used in this sense. Certain restrictions on the use of agricultural land are already prescribed in this Law, and additional changes that may contribute to reducing flood risk could be possible. As we can see, the Law prescribes some erosion control measures to protect agricultural land from the harmful effects of erosion and flash floods. Some of them are the "temporary or permanent prohibition of ploughing meadows and pastures and other land in order to turn them into arable land with annual crops; the introduction of crop rotation; the cultivation of perennial crops; the type of cultivation of agricultural land; the creation and maintenance of agricultural shelterbelts or the planting of perennial woody plants; the prohibition of clearing forests and forest plantations above vulnerable land; etc" (Law on Agricultural Land, Art. 18). Some of these measures can also be useful for water infiltration, which can help reduce flood risk. We propose decision-makers to include nature-based solutions for flood risk management, related to the way the agricultural land is used, in this Law, according to the same model. When it comes to nature-based solutions that cover larger areas of agricultural land and are intended to prevent the owner or user from cultivating agricultural land for a certain period of time or sometimes permanently, other solutions should be found. Some examples of such measures are temporary water retention on agricultural land, the conversion of agricultural land into natural areas for the purpose of water retention, the conversion of agricultural land into floodplain forests, the construction of small ponds on agricultural land, etc.

15 It should be emphasised that the Law prescribes the prohibition of the application of certain measures riparian land is involved, as well as the obligation to apply prescribed measures by the owner or user of riparian land, but all these measures do not fall under nature-based solutions (perhaps with the exception of the implementation of measures of conservation, improvement and presentation of natural values), see: the Law on Waters, Art. 133-135, but, this only applies to the implementation of measures in a well-defined area.

A model must be found that is suitable for both owners/users and the community. An appropriate system of subsidies and compensations for the loss of the possibility of using agricultural land must be created. In this context, a model that does not provide for expropriation must be considered, since, for example in the case of temporary water retention, the state would have no interest in becoming the owner and paying for large agricultural areas that may rarely be used for water retention.

When amending regulations or adopting new regulations that would enable the implementation of nature-based solutions for flood risk management, it should be noted that the Constitution of the Republic of Serbia and the Law on Foundations of Property Law Relations allow for the restriction of property rights. The Constitution of the Republic of Serbia prescribes that the property right may be restricted or revoked only in the public interest as defined by the Law, and the manner of use may be prescribed by the Law (Constitution of the Republic of Serbia, Art. 58). According to the Law on Foundations of Property Law Relations, the owner is entitled to possess, use and dispose of his/her property, but only within the limits set by the Law (Law on Foundations of Property Law Relations, Art. 3; Albrecht, Nikolić Popadić, 2022: 39). The way in which the land is used to enable nature-based solutions for flood risk management can therefore be determined by the Law on Waters and Law on Agricultural Land.

CONCLUSION

The change in dealing with floods in Serbia is a slow but necessary process. In addition to traditional flood protection measures, it is essential to implement more active flood protection measures. This change from flood protection towards flood risk management is particularly important considering the expected effects of climate change and the increasing number of days with extremely high rainfall that can cause flooding. Based on the research we conducted, we have concluded that nature-based solutions are not recognised as one of the approaches to flood risk management in Serbia, neither as a concept nor as a term in strategies, policies and laws. Certain measures that are prescribed can be brought under this concept, but further development and more detailed regulation of this field is necessary. We can propose a systemic approach in which nature-based solutions are first introduced into strategies and policies that define the goals and areas in which this concept must be applied, and one of these is certainly flood risk management. Detailed regulation is then necessary, eighter by amending existing regulations or by adopting new ones. For Law on Waters and the Law on Agricultural Land, we have made suggestions and recommendations as to which directions could be taken.

The definition and implementation of nature-based solutions requires cross-sectoral cooperation and the involvement of different stakeholders, professionals from different fields, decision-makers, but also people at local level who should be involved in the application of these measures, and who may be responsible for them (e.g., users of agricultural land). The role of lawyers in this process should also be recognised,

as they should propose appropriate solutions and regulatory changes based on the opinions of experts from different fields to enable the implementation of the measures in practise. The promotion of the concept of nature-based solutions to the general public is also necessary in this process, as the population is generally unfamiliar with it, and the implementation of measures requires community acceptance.
In this research, we have identified gaps in the system and in certain laws, and provide guidance on further changes that may be of benefit to decision-makers. We hope that this paper will help to fill the gap in the literature in this field, as the topic of nature-based solutions for flood risk management in Serbia has not yet been studied from a legal perspective by analysing the legislation in Serbia.

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FOREST FIRE MANAGEMENT IN GLOBAL CHANGE: THE PITFALLS OF CURRENT APPROACHES AND THE CHALLENGES OF DEVELOPING ALTERNATIVE SOLUTIONS

Gavriil Xanthopoulos, PhD[1]
Research Director, Hellenic Agricultural Organization - DIMITRA
Institute of Mediterranean Forest Ecosystems Athens

1 e-mail: gxnrtc@fria.gr

FOREST FIRE MANAGEMENT IN GLOBAL CHANGE: THE PITFALLS OF CURRENT APPROACHES AND THE CHALLENGES OF DEVELOPING ALTERNATIVE SOLUTIONS

Summary: As a result of global change, forest fires are becoming more destructive worldwide. Climate change is just one of the reasons behind this trend. The accumulation of fuel due to the abandonment of rural areas and limited forest management, changing people's attitudes, development of wildland urban interface (WUI) areas, inadequate fire prevention and sometimes firefighting deficiencies, are also important contributors. In the absence of a deep understanding of the dynamics of the problem, most governments resort continually reinforcing firefighting efforts by increasing firefighting personnel and resources. However, there are clear signs that this approach is not working. Fire behaviour is increasingly reaching mega-fire levels, and fire disasters, including fatalities, are also increasing in magnitude and frequency. An alternative approach to fire management is urgently needed. It should be based on a good understanding of the complexity of the forest fire problem, approach it holistically and devote more attention and financial resources to fire prevention, which should not be limited to technical solutions but should emphasise the cooperation with the local population and the development of resilient agricultural and forest landscapes and communities. The implementation challenges are manifold and will be discussed.

Keywords: *forest fire management, global change, fire prevention, resilient landscape*

INTRODUCTION

Forest fires are a natural phenomenon that plays an important role in most of the world's forest ecosystems, but they can also be a serious natural hazard that can lead to major disasters. Fire ecologists have extensively analysed their natural role, which differs significantly from forest ecosystem to forest ecosystem, while another branch of fire research has focused on their occurrence and significance as a natural disaster. Looking at the literature on the history of forest fires over time and other scientific literature on the characteristics of fires and the challenges they pose to management, it is immediately clear that the occurrence of fires changes over time. Indeed, in today's fast-changing world, there is clear evidence that forest fires are an ever-increasing problem around the world. This assertion is first discussed first, before focusing on an examination of current management approaches, their likely shortcomings and the alternative solutions available.

THE EVOLUTION OF THE FOREST FIRE PROBLEM

In recent decades, forest fires have taken up a great deal of space in the newspapers and mass media every summer, attracting the attention of the public. Reports of large, devastating fires are often accompanied by photos of burnt houses, cars and infrastructure, in addition to views of blackened forest landscapes. What is particularly worrying is that they are often accompanied by news of fatalities among citizens and firefighters. Although, as with other natural disasters, there is scepticism that the extensive and quick reporting we have nowadays is largely responsible for distorting the view of the true global trends, careful analysis supported by statistics and other evidence has shown that the forest fire problem is worsening around the globe, although the pace is not the same everywhere (Sullivan et al., 2022). The total area burnt is not necessarily increasing (Doerr & Santin, 2016, Turco et al. 2016, Jones et al., 2022, San-Miguel-Ayanz et al., 2023) but fire disasters are certainly increasing (Salguero et al. 2020, Buechi et al., 2021, Donovan et al., 2023) as a smaller number of extreme fire events cause devastation (Royé et al. 2020) and are often associated with numerous fatalities (Molina-Terrén, et al., 2019, Haynes et al., 2020, Xanthopoulos & Galloway, 2024). Citizens are worried or even angry, as they watch the news with awe, often feeling helpless, or they witness the threat first-hand in their vicinity, as evidenced by the corresponding content in the mass media and social media (Xanthopoulos, 2008). This is reflected in the urgency that politicians feel to "do something", which leads them into the so-called "firefighting trap" (Xanthopoulos et al., 2020a). Finally, there have been many cases where forest fire disasters have led to the resignation of ministers and possibly even contributed to the outcome of elections.

Another recent development of the forest fire problem has to do with the places where large fires occur. The European Mediterranean countries, as well as other regions of the world with a Mediterranean climate, such as California, parts of Australia, Chile and South Africa, used to be most often in the news. However, this has changed in recent years as severe fires have occurred in new areas, including parts of central Europe and Scandinavia, northern Canada and Alaska, Siberia, Indonesia and the Amazon region (Flannigan et al., 2009, Herawati & Santoso, 2011). In short, forest fires become a problem in places where they were relatively rare and harmless, while they become a major threat in countries where they have been present for a long time. Solving the problem is becoming a major challenge for policy makers and societies. In many countries this is reflected in significant changes in forest fire management in recent decades.

Past and present of forest fire management

As the problem of forest fires intensified significantly in the post II World War period, increased firefighting became the obvious answer and aerial firefighting rapidly increased. The surplus military aircraft used for aerial firefighting in the USA in the 1950s and 1960s, were soon followed by the Canadian-developed dedicated Canadair CL-215 amphibious water bombers, which were used in numerous countries around the world from the 1970s onwards (Mosov & Horskyi, 2022). Helicopters, which were used sparingly in the 1970s and 1980s due to high costs and limited availability, have been the most important tool for fighting fires from the air since the 1990s. In the late 1990s, a large and powerful ex-military helicopter, the Sikorsky S-64 "Skycrane" was converted into a very effective firefighting aircraft, the Erickson S-64 Aircrane, which can make a difference in firefighting but at a very high cost. The number of available S-64 Aircranes soon increased and they became part of the aerial firefighting fleet in many countries around the world. In the last three decades, some large well-known passenger aircraft (Boeing 747, McDonnell Douglas DC-10, McDonnell Douglas MD-87, Avro RJ85, Ilyushin Il-76, etc.) have also been converted to firefighting water or fire-retardant bombers, which carry huge loads and promise to extinguish large parts of fires with a single drop of water (Fojtík, 2019).

At the same time, firefighting on the ground became increasingly important. The number of firefighters grew, training improved, professionalism increased, and specialised units such as smokejumpers (Sowards, 2010), helicopters, and state-of-the-art "Type 1" crews were developed (Bramwell, 2008). Firetrucks became larger, more advanced and better equipped including provisions for self-protection. Tools at hand were improved and new tools were developed. Firefighter safety was recognised as extremely important, leading to the development of advanced clothing and other sophisticated personal protective equipment (Carballo-Leyenda, et al. 2021).

At the same time, technological developments were introduced at an ever-increasing pace. Forest fire spread models, developed through targeted research in the 1970s (Rothermel, 1972) were integrated into fire behaviour prediction systems in the 1980s (Burgan & Rothermel, 1984) and then, formed the basis for spatial fire spread simulation systems in the 1990s (Finney, 1998) that continue to evolve (Finney, 2006) and became useful tools for fire prevention and suppression. They soon became part of advanced computer-based systems that support the disposition of resources and the coordination of firefighting (Kalabokidis et al., 2012). Forest fire management tools were introduced in the 1950s, and have evolved over time to become another important tool in firefighting (Gimenez, 2004). Automatic fire detection cameras, and reconnaissance drones, are also among the important tools that have been introduced in many countries in recent years (Alkhatib, 2014; Yuan et al., 2015).

All these advancements in firefighting and technology promise to make fire

forest management more effective. Manufacturers promote their products with the promise that they can make a decisive difference in the effort to control all fires. Policy makers and other officials are eager to spend more money with the hope of preventing future disasters. Civil Protection is being strengthened everywhere, and the focus on firefighting is increasing year after year, especially after catastrophic fire seasons. As all of the tools and technologies mentioned above are associated with high cost, budgets for fire management are rising sharply in most countries. Unfortunately, in spite of the promises, the results are relatively poor and, in some cases, even marginal. Amazingly large fires occur nearly every year around the world. The average area burnt annually is not decreasing in most countries, and sometimes it is even increasing, in spite of the efforts, the equipment and the costs. The example of fire management statistics in the USA (1985-2018) is a proof of this (Fig 1): the number of fires is decreasing, the area burned is clearly increasing in spite of the sharp rise in the cost of firefighting.

Even more frustrating is the fact that every few years there is disturbing news about massive deaths among firefighters and citizens (Haynes et al., 2020; Xanthopoulos & Galloway, 2024). Entire countries are facing shocks they were not used to. It is clear that the approach taken to date is not producing the expected results and there is a strong demand for a solution to what has become a significant problem every fire season. Any such solution should be based on a good understanding of the problem, avoiding repeating the same measures as before, only on a larger scale. Policy makers should remember the saying attributed to Albert Einstein: "The significant problems we have cannot be solved at the same level of thinking with which we created them".

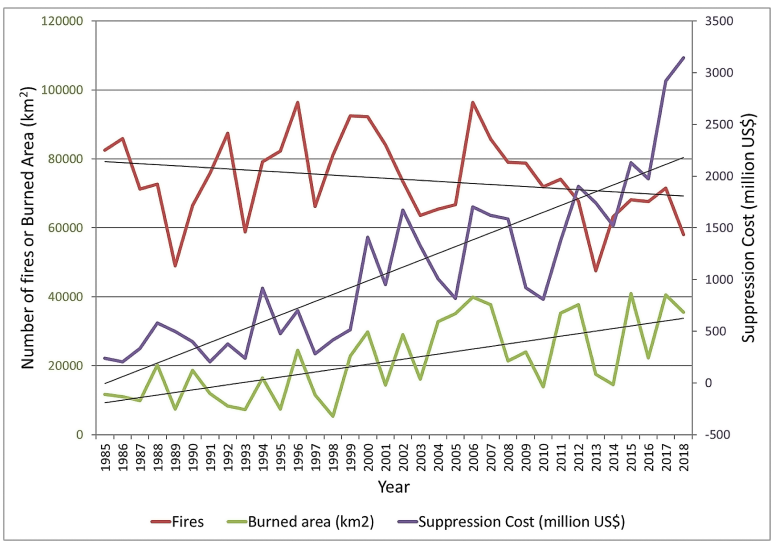

Figure 1. Evolution of the number of fires, the total areas burnt and the cost of suppression in the United States of America from 1985 to 2018 (Data source: National Interagency Fire Centre, Boise, ID, USA).

Why are forest fires getting worse?

In the face of ever-increasing strength of the firefighting mechanisms, their relatively poor results can only be attributed to the growing challenges associated with fire suppression (Calkin et al., 2015; Tedim et al., 2018). Scientific analyses concur with this and agree with numerous testimonies from citizens and firefighters. The main reasons cited for deterioration of the situation include:

1. Changes in climate and weather conditions
2. Failure to understand the dynamic evolution of forest vegetation and the natural role of fire:
   - Abandonment of rural areas, decline in rural population (Fig. 2), and reduced forest management leading to fuel accumulation (increase in fuel loads, horizontal and vertical continuity)
   - Fire suppression effectiveness increases future fuels! (Calkin et al., 2015, Kreider et al. 2024))
3. Changes in people's attitudes
4. Development of Wildland Urban Interface (WUI) areas
5. Inadequacies in fire prevention, including policies and regulations (Bouillon et al., 2020)
6. Potential inadequacies in fire suppression

As a rule, all of the above factors work together and increase challenges and risks for firefighters.

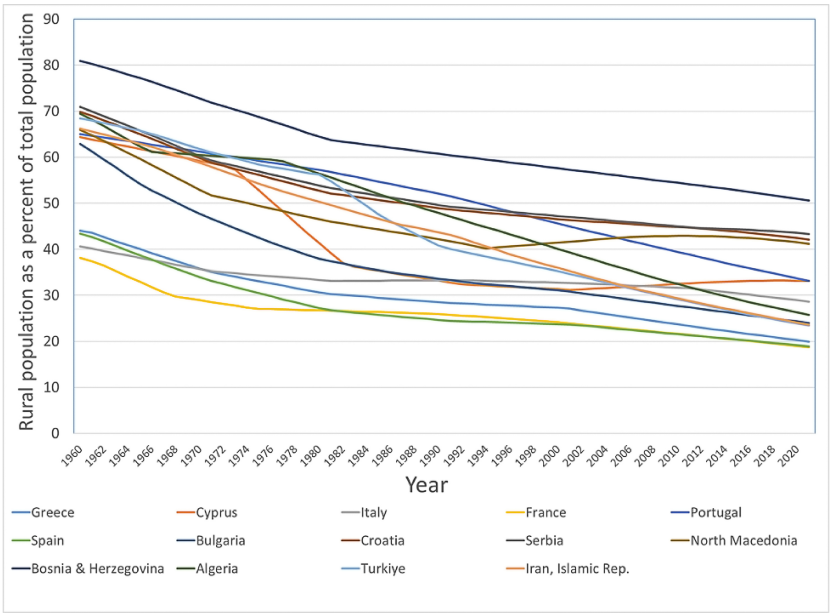

Figure 2. Rural population evolution as a percent (%) of the total population in fourteen countries in the Mediterranean, the Balkans and the Middle East.
(Data source: https://www.indexmundi.com/)

Climate change affects the weather in many ways, and not just through the observed rise in trend of the average temperatures. Changes in air, sea and land temperatures lead to changes in air circulation patterns, atmospheric profiles, the amount of water vapour in the air due to increased evaporation, etc. As a result, extreme weather conditions are becoming more frequent. The fire weather is affected accordingly, as periods of drought, heat waves with many consecutive days of very high temperature and low relative humidity, and days with extremely strong winds often coincide. The dryness of fuel combines with the wind. As a result, fires can easily start in the landscape, gain speed very fast, and the fire behaviour, both in terms of intensity and of rate of spread, becomes extreme very quickly (Jones et al., 2022). Extreme behaviour also includes phenomena such as fire whirls, profuse spotting (i.e., the creation of new fire starts outside the main perimeter of the fire by embers carried by the wind), the development of strong convection columns (Di Virgilio et al., 2019), etc. Under such conditions, firefighters can do very little and the result is large catastrophic forest fires. The term used to describe these fires, is megafire. It was coined in the 2000s (Williams et al., 2005) and refers to "fires that exhibit fire behaviour that exceeds all efforts to control, regardless of the type, kind or number of firefighting resources used".

How fires spread across the landscape also depends on the quantity and location of fuels. Fire suppression policies often tend to ignore the fact that forests, as

well as vegetation in rural landscapes, change dynamically as they grow through photosynthesis and eventually die. Dead biomass on the ground and in the tree crowns does not accumulate forever, but decomposes through the activity of invertebrates, such as worms and insects, fungi and bacteria. These microorganisms need a good combination of temperature and humidity to work effectively. If the climatic conditions in an area do not favour their activity and the rate of decomposition is slower than the growth of vegetation, fire is nature's way of accelerating the decomposition of dead biomass and maintaining long-term balance. The elimination of fire in forests adapted to frequent fire, leads to biomass accumulation (Stephens et al., 2018). In well-managed forests and rural areas, harvesting biomass as a product of the land (e.g., timber, agricultural products and animal grazing) helps to maintain balance and reduce the likelihood and intensity of fires.

In the last few decades, the rural population, as proportion of the total population has declined in most countries around the world. Rural areas are being abandoned while younger people are moving to large cities. At the same time, there is a general tendency to reduce forest management, as it is less profitable compared to other activities such as industry. This leads to an overall accumulation of biomass in the landscape in the form of increased fuel loads, which also have increased horizontal and vertical continuity, facilitating forest fire start and spread of large intensity forest fires that provid firefighting options. Increased firefighting capacity is an attempt to control the worsening fire problem. However, this leads to the so-called "fire paradox" phenomenon: successful fighting of landscape fires today, if not accompanied by effective forest management and agriculture to harvest biomass production, leads to further fuel accumulation, and more difficult fires in a few years' time (Kreider et al., 2024).

The population decline in rural areas is not only affecting the fuels in the landscape. As the average age increases, the ability of the local population to work on preventing and responding to forest fires, decreases. This includes, for example, lower maintenance of rural houses and insufficient control of the vegetation surrounding them to defend them in of the event of forest fire. This creates a rural-urban interface (RUI) problem, as many traditional villages become high fire-risk areas. On the other hand, the expansion of large cities to accommodate the growing population has led to the development of new suburbs where houses often come into contact or blend with vegetation. Furthermore, new tourist facilities, especially in the Mediterranean region, are often surrounded by flammable vegetation. In recent years, numerous and extensive "wildland-urban interface areas" (WUI) have been created. Fire risk there is very high. It is not surprising that devastating fires have occurred in many WUI settlements, sometimes resulting in fatalities.

All of the above factors contribute to the worsening situation with regard to fires in the landscape. Efforts to mitigate the problem should include actions aiming to address these factors as part of fire prevention. So far, however, this does not seem to be the

case, as shown by the funds earmarked for prevention in most countries compared to those spent on firefighting (Fernandes et al., 2020). Furthermore, prevention today is often seen as an activity that mainly involves technological means, from computers, maps and models to predict fire risks, to satellites, drones and surveillance cameras for rapid fire detection. The role of the people, the need to support them with policies that help them earn a decent living on the countryside, so that they can continue to live there, and the need to educate, mobilise and empower them to participate in fire prevention are often ignored. The importance of the existence of a strong and active forestry service is also overlooked due to the ignorance of decision-makers in some cases to the point of complete abolition, such as with the abolition of the Corpo Forestale dello Stato in Italy, in 2017 (Casinghini 2019).

Finally, there are many cases where firefighting authorities fall short of expectations (Fernandes et al. 2016). Although "the effectiveness of forest fire suppression is difficult to define, as it can be assessed against different objectives and at a range of scales" (Plucinski 2019), and generalisations can be unfair and ultimately invalid, there are a number of weaknesses that have been identified in many countries, especially where urban firefighters are involved in forest firefighting. Examples include: over-reliance on aerial resources to put-out the fires, while it is known that in most forest ecosystems final extinguishment has to be done by ground forces; aggressive firefighting tactics that do not take into consideration the temporal (diurnal) and spatial variations in fire intensity for safer, more effective and efficient fire control (Xanthopoulos et al., 2020b); use of larger diameter water hoses that are commonly used in urban firefighting but reduce agility in a forest environment where the fire spreads rapidly.

THE WAY FORWARD

With all the above pitfalls of the current approaches, the forest fire problem is likely to get worse if not properly addressed. Global change, which encompasses far more than just climate change, is likely to increase the current challenges. Existing policies to regulate forest fire, which are based on misguided approaches that are self-reinforcing, without considering or understanding the roots and dynamics of the problem, will only provide a short-term solution (Fernandes et al. 2020). Adapting forest fire management to the new reality is necessary, but it will not be easy. There are many challenges and barriers for the development of alternative solutions due to the complexity of the forest fire problem with its often conflicting environmental, technical, social, economic, and political aspects (Rego et al., 2018). Adaptations must address the public's ingrained belief in the currently prevailing fire suppression paradigm. They must overcome the influence and invested interests of industries that thrive under the ever-increasing paradigm of fire suppression. The social element of fire prevention should be promoted at least in par with the technological tools that can support fire detection, risk prediction, etc. The various actors should participate in

decision-making, including collaboration and coproduction of forest fire policies and initiatives at different levels, scales, and networks (Kirschner et al., 2023). The call of fire scientists and international organisations, such as the Food and Agriculture Organization of the UN, for integrated fire management (ECE & FAO, 2023), which includes a strong element of community involvement (Krah et al., 2020), should be adopted by public authority's leaders and politicians. This is a really difficult challenge, as they generally favour simple and clear "black-and-white" solutions, while fire management requires exactly the opposite. Furthermore, changes must not ignore the need of politicians to avoid major disasters during their relatively short term in the office, while fire prevention measures are likely to produce results in medium to-long term.

The pressure created by increasing fire disasters is influencing the way people think (Hartter et al., 2020) and is likely to be the motivation to address the above challenges and develop a new paradigm for landscape fire management that responds to the new conditions brought about by global change. There is no question that for such a complex multifaceted task it is necessary to use the knowledge and advice of science, always under the light of realism and practicability. One of these pieces of advice, focussing on the Mediterranean-type regions, is provided by Morreira et al. (2020) who proposed a change of paradigm. They suggested that extreme forest fires should be considered as unavoidable and more focus should be placed on minimising the damage they cause. They proposed to move away from using the area burnt to measure the impact of fire impacts on complex socio-ecological systems, and to use a more detailed multifactorial view for such an assessment.

The idea of minimising damage entails the need to create landscapes that are more resilient to the increasing risk of fire. Special emphasis should be placed on WUI and RUI areas in order to reduce the risk of damages there. The development of fire resilient landscapes and communities requires synergies between various state agencies and relevant stakeholders, working together and mobilising the local population (Xanthopoulos et al., 2023). In such landscapes:

- Maximum efforts are invested in minimising human caused fires (analysis and understanding of fires development, resolution of conflicts and technical problems, mobilisation of citizens, improvement of fire detection, maximisation of alertness according to predicted fire danger)
- Vegetation in agricultural and forestry areas is managed to minimise the risk of catastrophic forest fires, while achieving economic benefits to make the efforts sustainable and prevent rural population exodus
- Rural (and WUI) population is aware of the risk of fire and takes measures to protect themselves (e.g., preparing houses, planning action in case of fire). All relevant knowledge is made available to them
- Fire suppression is well organised, effective and efficient, and sufficient to protect

communities and the environment

- There is a fire prevention and protection plan in place, developed jointly with relevant local stakeholders, which sets out priorities and action protocols.

CONCLUSIONS

The need to approach the worsening forest fire problem under a different perspective, and to strike balance between efforts and funding for fire prevention and suppression is obvious. While the latter is quite straightforward, fire prevention is very complex and therefore a major challenge. To overcome the challenges, it is necessary to:

- Overcome ignorance about the true nature and complexity of the problem and promote prevention among the population in parallel to investments in technologies (e.g., fire danger forecasting, fire detection, technology-based training and dispatching, etc.)
- Inform and convince politicians, journalists, etc.
- Educate decision-makers in public authorities, who often follow the "business as usual" path
- Inform, sensitise and train the public; the majority are only interested for 2-3 years after a fire disaster
- Bravely stress not only effectiveness but also efficiency
- Limit the appetite of commercial companies to promote their products, by establishing criteria for actual need, and supporting decisions with objective cost-benefit analyses
- Empower those who need to apply the concepts (it is often forgotten that people are needed more than machines and that bureaucratic obstacles are often enough to null all good intentions)
- Foster cooperation at national and international level (sharing knowledge and experience, helping each other in difficult moments with firefighters, resources, and experts)

The alternative approach proposed above is more than likely to mitigate the current problems, improving people's resilience and safety while slowing down the continuous growth of the fire management budgets around the world.

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