

## EXPLORING THE POSSIBILITIES OF CITIZEN PREPARATION FOR EXTREME WEATHER EVENTS – AN INTERNATIONAL OUTLOOK

### A LAKOSSÁG SZÉLSŐSÉGES IDŐJÁRÁSI ESEMÉNYEKRE TÖRTÉNŐ FELKÉSZÍTÉSI LEHETŐSÉGEINEK VIZSGÁLATA – NEMZETKÖZI KITEKINTÉS

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#### Abstract

*Meteorological phenomena cause damage events and disasters worldwide that heavily burden the public administration, the tasks of the defence sector and the everyday life of the society. Responses to the consequences of extreme weather can only be effective if the population is actively involved in the struggle against the harmful effects and is well-prepared.*

*In this paper, the author makes an attempt to present, analyse and examine the meteorological and climatic impacts within some of the world's natural disasters, and explore some opportunities and methods for preparing the population for extreme weather events through some international examples.*

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**Keywords:** *Extreme weather, vulnerability, society, citizen preparation, adaptation*

#### Absztrakt

*A meteorológiai eredetű jelenségek világszerte okoznak káreseményeket, katasztrófákat, melyek jelentős mértékben terhelik meg a közigazgatást, a védelmi szektor feladatrendszerét, a társadalom mindennapjait. A szélsőséges időjárás következményeire adott válaszok csak akkor lehetnek eredményesek, ha a lakosság, a káros hatások elleni harcban aktívan közreműködik és megfelelő szinten felkészült. Szerző jelen publikációban kísérletet tesz arra, hogy a világ természeti katasztrófáin belül, a meteorológiai, klimatológiai eredetű hatásokat bemutassa, elemezze, továbbá vizsgálja néhány nemzetközi példán keresztül a lakosság szélsőséges időjárási eseményekre történő felkészítési lehetőségeket, módszereket.*

**Kulcsszavak:** *Szélsőséges időjárás, sérülékenység, társadalom, lakosság felkészítés, alkalmazkodás*

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## INTRODUCTION

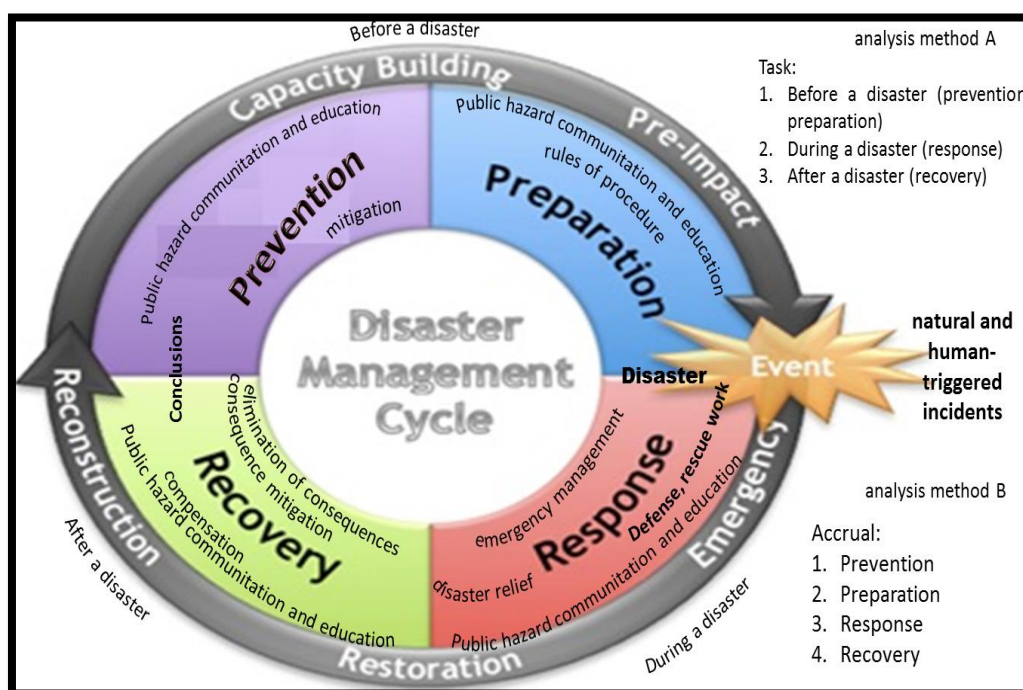
„Experts predict that certain types of extreme weather events are likely to become more frequent in the future as a result of climate change. 2017 therefore gave us a foretaste of what we can expect in the future”

Dr. Torsten Jeworrek [1]

Meteorological phenomena cause damage events and disasters worldwide that heavily burden the public administration, the tasks of the defense sector and the everyday life of the society. Responses to the consequences of extreme weather can only be effective if the population is actively involved in the struggle against the harmful effects and is well-prepared.

In this paper, the author makes an attempt to present, analyze and examine the meteorological and climatic impacts within some of the world's natural disasters, and explore some opportunities and methods for preparing the population for extreme weather events through some international examples.

## ABOUT CITIZEN PREPARATION IN GENERAL



**Figure 1** Citizen preparation in disaster management  
(Made by: László Teknős, 2018)

Figure 1 presents the place of citizen preparation in disaster management. Analysis of disaster management can be given in several ways. One analysis is based on the tasks, under which it is advisable to understand the pre-disaster (preventive), ongoing (defense), post-disaster (recovery) activities of the occurred incident. The other way is to switch to timing, when preventive, preparatory, defensive, recovery periods can be separated, regardless of whether the damage occurred. The prevention objective is to reduce the likelihood of emergence of disasters and to create the conditions for responses to potential damage. Activities during the prevention period have a great influence on the success of the other two periods. Protection can be quick and efficient where appropriate powers, equipment, and professional procedures have been formed; however, the success or failure of the rescue can

have a repercussion on the preparation of the next period as well as the process of restoration. During restoration, the sum of rescue experiences and the decisions made according to them will also influence both the preparation and the next rescue. Since the causes of natural and man-made disasters cannot be prevented, it is advisable to build social adaptation to these impacts, to create a self-defense preparation system, to update its content, and to develop proportionate preparedness to real threats. In terms of timeliness, damages may occur even during the preventive and normal period, but these do not reach the disaster level (pacing threshold) in the sense of harm in most of the cases. The difference between the two methods is that task determination (method A) is related to an incident, containing all the necessary activities that must be carried out before, during and after the occurrence. Timeliness (method B) is made of time-separated intervals, in which an event can occur anytime, but the event has a prevention, preparation, defense, recovery phase. Actually, it means cycles that occur regardless of the occurrence of the event, with the remark that the preparation, defense and restoration framework is being developed during the prevention phase.

Before any disaster occurs, it is necessary to take measures to mitigate the possible future impacts caused by the damage. It is better to prevent (as far as possible) trouble than to deal with, but prevention helps to reduce the impact of disasters in the area of life protection and property security. Prevention involves a preparation period. The main purpose of this cycle is to avoid the devastating effects of future or potential disasters, anomalies, major damages, or, if this is not possible, then the damages must be reduced to a minimum level for the fewest citizens to be exposed to danger and the least damage to be caused in material goods. It is an important task to create the conditions for protection against damages; the establishment and development of rescue organizations; the recurrent pursuit of defense methods and principles; the establishment and coordination of the population's self-defense skills and the enhancement of their survival skills. The preparation of population is a complex activity which, on one hand, is an activity system that contains preparation of the population for emergencies including exemplary rules of behaviour and action. The suitability to save themselves, others, and material goods; furthermore, the skills development of this knowledge by appropriate direct practice. On the other hand, raising awareness of self-induced emergencies by negligent behaviour or lack of necessary skills. The goal of this action is the foundation of security culture, formation of self-saving behaviour. The main goal of the disaster recovery preparation of the population is to introduce the behaviour rules to follow in case of specific local dangers or dangerous effects; and in case of alerts, as wide as possible. [1]

The proposed content of the preparation without the need for completeness:

- Profoundly familiarizing with the types and characteristics of the damages (developing a realistic danger scenario), the dangers and prevention task of the settlement, special phenomena (e.g.: extreme weather)
- Psychic and consciousness preparation
- The legal background, system and significance of disaster management (citizen protection); the responsibility of the citizen during the prevention, emergency management and restoration period, the importance and the need for more active involvement and participation in disaster management
- Knowledge of the signs of the alert and the means of the communication, the possible ways and tasks of complex defense, the emergency management tasks and means in the given settlement
- Tasks and means of recovery in the settlement, specialties, actualities, helping organizations, code of conduct, etc.

Dennis Mileti<sup>1</sup> wrote some important rules and recommendations in 2004 in connection with emergency communication, preparation and education: [3]

- Be Clear and Adapt Material to Locals: the population preparatory materials should be understandable, simple and clear for each target group of the society
- Tailor Information for Special Groups
- Use Multiple Languages
- Feature Specialists: experts should be involved in preparatory programs, whose specialty is emergency management and planning, but experienced spokespersons should liaise between society and information
- Use Varied Sources: population preparatory materials should derive from professionally relevant but different sources
- Render Information Consistent and Repeat It: Regular repetition of the information through different channels is important
- Use a Stream of Communications and Use Different Ways to Communicate (coloring books, obvious radio, TV spots etc.)
- Use a Good Mix of the Verbal and the Visual.
- Tell People What to Do
- Support People in Their Search for More Information
- Use Words and Great Graphics
- Position Additional Information in the Community
- Partnerships Work Best

According to the professor the citizens should gather information from multiple valid sources that come from organizations having proper population preparation education projects. For example on the Red Crosses<sup>2</sup> homepage content can be accessed in connection with preparation for different types of emergencies, chemical emergency, *drought*, earthquake, fire, flood, flu, food safety, *heat wave*, highway safety, hurricane, landslide, poisoning, power outage, terrorism, thunderstorm, tornado, tsunami, volcano, water safety, wildfire, *winter storm*. [4]

Taking into account 21st century technologies<sup>3</sup> and social relationships,<sup>4</sup> applications for smartphones emerged as a new method of emergency communication. Due to the rapid spread of smartphones and tablet PCs, organizations and other bodies<sup>5</sup> involved in disaster prevention have recognized that applications need to be created in order to inform the public on the basis of their own professional profiles and, as far as possible, to inform the most members of society. They have found that delivering emergency information and short-term weather forecasts to users can significantly increase the security of the population and citizens. Examples of such applications are:

- Hungary: Emergency Response Service (VÉSZ); Meteora, Hydroinfo, TAVIHAR Widget, Szív City

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<sup>1</sup> Director, Natural Hazards Research and Applications Information Center, Professor Emeritus of University of Colorado at Boulder

<sup>2</sup> The American Red Cross developed an application for smartphones that greatly helps the proper briefing of the population. Accessible: <http://www.redcross.org/mobile-apps/hurricane-app>

<sup>3</sup> Laptop, notebook, netbook, smart phone, tablet, wifi system, etc.

<sup>4</sup> Social media: Facebook, Instagram, Twitter, Google+, YouTube, Wikipédia, Reddit, LinkedIn, Tinder etc.

<sup>5</sup> Jointly involved in disaster prevention: Act CXXVIII. (1) of: those involved in disaster relief will provide the citizens with information, life, physical integrity, material goods and the environment.

- Germany: NINA - Die Warn-App, JUH RV Östl. Ruhrgebiet, WarnWetter, 6 DRK-App (DWD)
- USA: FEMA, Red Cross Mobile Apps, National Weather Service app etc.


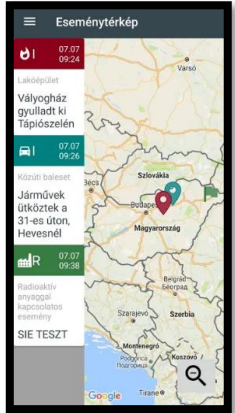



Meteora	VÉSZ	TAVIHAR Widget <sup>7</sup>	Hydroinfo	Szív City
National Meteorology Service	NDGDM, RSOE	RSOE	National Water Warning Service	National Ambulance Service
				

Table 1 Information-assisted programs installable on mobile tools in Hungary (Made by: László Teknős, 2018)

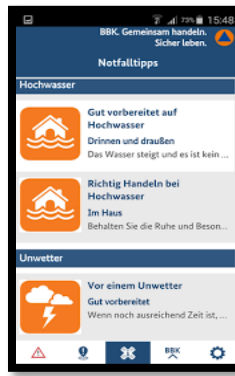


NINA - Die Warn-App des BBK <sup>8</sup>	JUH RV Östl. Ruhrgebiet <sup>9</sup>	WarnWetter	DRK-App - Rotkreuz-App des DRK <sup>10</sup>
			

Table 2 Information-assisted programs installable on mobile tools in Germany (Made by: László Teknős, 2018)

<sup>6</sup> Germany's National Meteorological Service (DWD)

<sup>7</sup> Tavihar is a program of information on the hikes of Hungary's navigable lakes, which can be run on mobile devices that can be continuously tracked.

<sup>8</sup> Federal Office of Civil Protection and Disaster Assistance (BBK)

<sup>9</sup> Johannita Segítő Szolgálat

<sup>10</sup> German Red Cross (DRK)



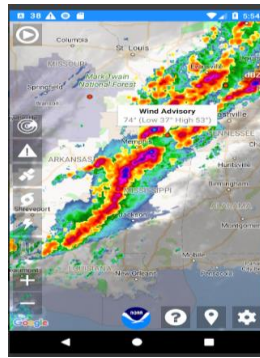
FEMA app	Red Cross Mobile Apps (12 pieces)	National Weather Service app
		

Table 3 Information-assisted programs installable on mobile tools in USA  
(Made by: László Teknős, 2018)

### Can social media be used as education and preparation tool?

In 2011, in the United States, the FEMA (Federal Emergency Response Agency) used the community media to inform the public during Hurricane Irene. In the year 2012, at Hurricane Sandy, government agencies and FEMA communicated preventive measures to the general public through communication with the community.

Since many organizations<sup>11</sup> use a Facebook<sup>12</sup> page, therefore, because of the nature of the task, within the tools of social media, Facebook can be the platform through which the population can be widely accessed. In the flood of June 2013, the official Facebook page of professional disaster management was visited by appr. 300,000 person, so it can be found out that, in the event of extraordinary catastrophes, the population is looking for disaster protection information, guidelines, etc. at the time of the event.<sup>13</sup>



Figure 2: Official website (left) and Facebook page (right) of the National Directorate General for Disaster Management, Ministry of the Interior in Hungary (Created by László Teknős, 2018)

<sup>11</sup> National Directorate General for Disaster Management, Ministry of the Interior (NDGDM), Hungarian Federation of Red Cross, Hungarian Defence Forces, RSOE, National Meteorology Service, etc.

<sup>12</sup> From the social media scene, only facebook (the most popular means of contact retrieving for home users in the internet) comes to the fore.

<sup>13</sup> On June 01, 2018, 25,060 people followed the NDGDM official facebook page.

Facebook is now available on mobile phones. This is helpful for public hazard communication. It can be expected that accessing Facebook via the phone will allow people to reach the required emergency information from anywhere, at any time, about road closures, about key data related to vulnerable areas, etc., which will help residents to get real-time information. This, in turn, requires that information security on Facebook should be kept in line with the situation. This information is something that affects also personal security, so tracking must be continuous for their own sake. For a citizen, collecting information on a continuous Facebook or website, he or she finds more information about his or her own security and less likely to be in trouble, so it does not affect the involved organization's work very significant. Additionally, if the citizen follows the information and behavioral norms on Facebook, it is more likely that he or she will not be in trouble or the problem will be easily solved. For example, the willingness of the community to engage in contact with the civil protection resources (races, lectures, exhibitions, events, etc.) addressing the traditional population is needed. Willingness to visit Facebook can be achieved through marketing and management. The goal is the continuous measurement and monitoring of the effectiveness of information transfer, preparation and information efficiency on the Facebook page. The possible measurements to be taken into account are: the number of fans, followers and comments, visiting ratios, the proportion of positive and negative ratings.

### THE EVOLUTION OF NATURAL DISASTERS IN THE WORLD

„Extreme weather and climate events, interacting with exposed and vulnerable human and natural systems, can lead to disasters.” [5]

IPCC Special Report, 2012

“The most immediate threats to humankind relate to increased variability in the intensity and frequency of storms and other extreme weather- and climate-related events such as floods and droughts, heat waves in major urban areas and the impact of sea-level rise on low-lying coastal regions”.

Professor G.O.P. Obasi, Former Secretary General, WMO, 23 March 2003. [6]

Why is it important to make people aware of natural hazards? The answer – among others – come from the existing and already occurred disasters in the world and the growing threats.

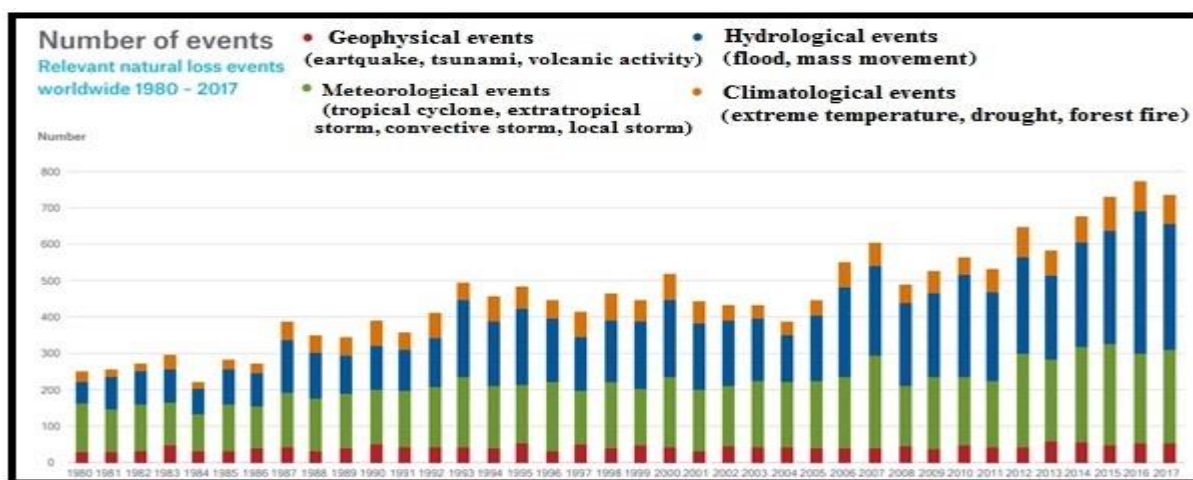


Figure 3 The evolution of natural disasters of the world between 1980 and 2017 [7]  
(Created by: László Teknős based on the data of Munich Re)

Munich Re<sup>14</sup> German Insurance Company examines the prevalence rates of worldwide disasters in its annual reports, which are published in a chart. *Figure 3* shows the evolution of natural disasters of the world between 1980 and 2017. We can separate four types of disasters amongst the examined ones: climatological, hydrological, meteorological and geophysical-originated. According to *figure 3*, we can state that in regard to climatological, hydrological, and meteorological originated dangers, the increase in quantity is clearly shown. The figure shows that climatological effects have to be considered the most in their occurrences. In 1980 approximately 250 events were registered. From 1987 that number grew over 300, after 2005 it grew over 400, after 2009 it was over 500 and after 2014 the number of global climatological events exceeded 600.

There is also an increase in hydrological events (flood, landslide). Examining in a linear trend, an increase can also be observed in case of meteorological events, even if it is not equal to the increase of hydrological and climatological events. One of the weaknesses of the figure is that it does not break the individual categories, so the finer analysis of dangers can only be interpreted in conjunction with other diagrams that can be found on the Munich Renatcatservice website.

	Geophysical events	Meteorological events	Hydrological events	Climatological events	Fatalities (fő/%)			
2017 <sup>23</sup>	7%	35%	47%	11%	10.000 fő			
					12	16	65	7
2016 <sup>24</sup>	7%	33%	50%	10%	9.200 fő			
					15	21	54	10
2015 <sup>25</sup>	6%	41%	42%	11%	23.000 fő			
					42	10	24	24
2014 <sup>26</sup>	8%	41%	42%	9%	7.700 fő			
					11	17	66	6
2013 <sup>27</sup>	10%	44%	37%	9%	20.500 fő			
					5	38	49	8
2012 <sup>28</sup>	7%	45%	36%	12%	9.600 fő			
					7	27	48	18
2011 <sup>29</sup>	9%	37%	37%	17%	27.000 fő			
					62	11	25	2
2010 <sup>30</sup>	9%	40%	39%	12%	295.000 fő			
					77	1	3	19
Átlag	7,88 %	39,50 %	41,25 %	11,37 %	28,88	17,62	41,75	11,75

**Table 4** Percentage distribution of natural events and associated deaths in the world between 2010-2017  
(Made by: László Teknős, 2018)

Table 4 shows natural events occurred in the world with associated death figures between 2010 and 2017. Based on the examined eight years, it can be stated that most of the damages is related to hydrological (41.25%) and meteorological (39.50%) type events. In terms of percentage distribution, the least number of disasters are caused by geologist type events, with the remark that this is the second largest risk category causing human casualties (28.88%) (see the right side of the table). It can be seen in the main geological related risk category that most deaths (207 thousand people out of 345 thousand) can be associated with this category in 2010, 2011 and 2015. Based on the data of the table, it can be concluded that the number of meteorological events shows a high number among the four examined types. In general, considering the probability of occurrence of the analyzed categories, it is almost 40%. Due to the theme of this publication the percentage distribution of the climatic effects should also be taken into account, since the climate means the average weather of a given area. People can

<sup>14</sup> Münchener Rückversicherungs-Gesellschaft (Munich Reinsurance Company)



affect the climate and can also alter it with their activities. However, they suffers its consequences through the weather.[8] [9] During the examined eight years 70834 persons lost their lives due to the direct effects of meteorological events and 47235 persons due to climatological effects.

The European Commission develops EU climate protection policies and strategies in the combat against climate change. Considering the execution of these policies and strategies it can be divided into two areas. One of them is the development and control of emission reduction measures<sup>15</sup>. The other one is the implementation of tasks to support adaptation to the effects of climate change. The European Commission's 'EU Strategy on Adaptation to Climate Change' addresses the issue of climate change, the current and expected European impacts and the adaptation measures. Based on the results of the "Climate change, its effects and the caused vulnerability in Europe 2012" report the strategy states that the consequences of climate change are becoming more and more perceptible in Europe and globally, which increases vulnerability and exposure to impacts. They create economic disturbances, generate agricultural problems, increase protective costs, cause more deaths to human health, etc. [10] Extreme weather events, heat waves, forest fires and droughts are increasing in Southern and Central Europe. In the Northern and North-Western areas heavier rainfalls and flooding can be expected, with increasing risk of water bursts and coastal erosion<sup>16</sup>. In May 2017, the European Commission issued a study on natural and man-made disaster risks. The executive summary states partially that these disasters are becoming more and more complex and expanded, and become more devastating due to the effects of climate change. [11] [12] EU pays particular attention to the common disaster risk management cooperation of the countries. Therefore several macro-regional strategies has been developed (for example the Danube, Baltic Sea, Alpine, Adriatic-Ionian Islands). In the framework of the SEERISK project, the Climate Adaptation and Risk Assessment Handbook was published in 2014, which analyses the ever more extreme climate impacts of the Danube macro-region, such as the heat waves in case of Arad (Romania), and the drought and vegetation fires in case of Magyarkanizsa (Serbia). The risk of forest fires in Velingrad (Bulgaria), floods in Senica (Slovakia) and Sarajevo-Ilidža (Bosnia and Herzegovina), while in Siofok (Hungary) wind storms were analysed, assessed and mapped. According to the Handbook, climate change contributes to the adverse impacts of floods, temperature extremes, storms and vegetation fires, which is associated with an increase in frequency and intensity. [13] SEERISK is a pioneer cross-border cooperation aimed at developing a common risk assessment methodology for disaster management organizations in the South-East European countries in order to prepare properly for natural disasters caused by climate change. According to the European Environment Agency (EEA) forest fires, floods and storms have an increasing impact on the environment with increasing damaging effects. The fight against extreme weather and climate events has become a priority for the European Union. Heat waves, storms, high precipitation events, floods, wind storms, landslides, droughts, forest fires, avalanches and hailstorms pose a major threat in Europe. The damage suffered by 33 member states of the European Environment Agency over the period 1980 and 2016 was over €450 billion. The largest damages were caused by floods (approximately 40%), storms (25%), droughts (about 10%) and heat waves (approximately 5%). [13] [14]

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<sup>15</sup> Energy efficiency, emission trade system (especially transportation and industrial facilities), agriculture, forestry and land use

<sup>16</sup> At the same place

According to the EU's strategy for adapting to climate change, the effects of climate change would be more and more perceptible in Europe, in the world. [15] Extreme weather events have become more and more common. In Europe flood losses are expected to increase. Models predict that snowfall in Northern Europe will be less, but more intense winter storms will have to be expected. Excessive weather events with more frequent and more severe effects may lead to a decrease in crop yield. The vulnerability of Belgium, Denmark, Germany, the Netherlands and the United Kingdom will increase as a result of sea level rise and storms. In Central and Eastern Europe, the amount of summer precipitation may reduce, droughts may occur, but winter rainfall may increase flood risk. [16]

In the executive summary of IFCR's "Preparedness for Climate Change", it is apparent that weather-related disasters are steadily increasing. Over the past decade, around 2.5 billion people have been affected, causing around \$400 billion in damages worldwide. Climate change as a global problem has local impacts, such as rising sea levels, droughts, heat waves, water shortages, flooding, health risks, challenges derived from the damage of assets. In order to mitigate the consequences, cooperation is needed among non-governmental organizations, citizens, economic actors, international and humanitarian organizations. The study suggests seven steps to tackle the effects of climate change:

- Preliminary climate risk assessment
- Assess priorities and plan follow-up
- Raise awareness
- Establish and enhance partnerships
- Highlight climate-related vulnerability with other actors
- Document and share experiences and information
- Advocacy: shape the global response to climate change (development of adaptation and citizens preparation related programs)

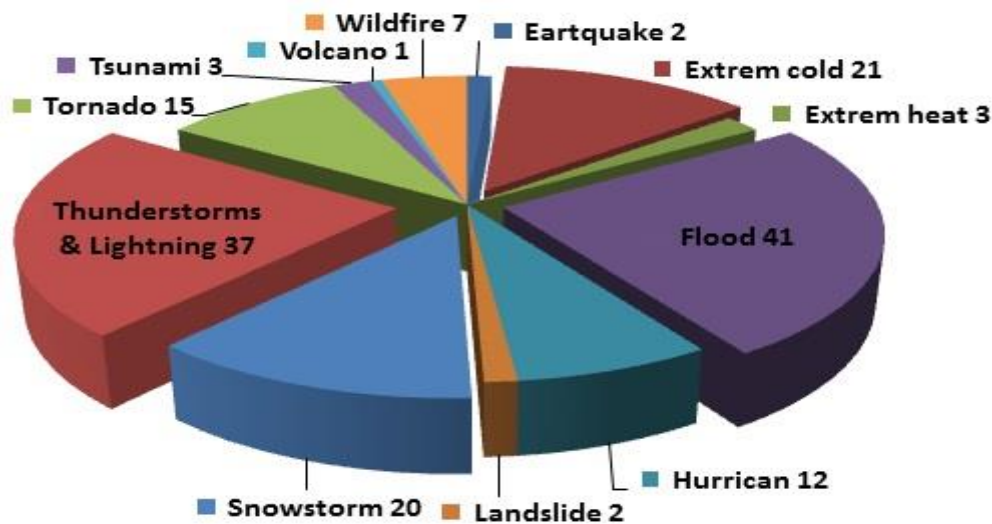
Weather- and climate-related disasters have social as well as physical dimensions. As a result, changes in the frequency and severity of the physical events affect disaster risk, but so do the spatially diverse and temporally dynamic patterns of exposure and vulnerability. [5] Due to the warmer and unstable climate, negative impacts are more intense, more severe and more common, increasing the vulnerability of society. However, every states must ensure the protection of the population and of the material goods. This obligation is supported by a number of organizations. It can be said that professional and voluntary forces play a significant part in this overall social task, tool and system of measures, even if it means a different way of implementation. This applies both in Germany, the United States and Hungary. [18]

### **CITIZEN PREPARATION ACTIVITY OF THE FEDERAL EMERGENCY MANAGEMENT AGENCY IN THE USA**

Severe weather can include hazardous conditions produced by thunderstorms, including damaging winds, tornadoes, large hail, flooding and flash flooding, and winter storms associated with freezing rain, sleet, snow and strong winds. Storms are weather phenomena that may be accompanied by gusts over 50 miles per hour<sup>17</sup> (80 km/h), hails, but they can cause flood and tornado as well. [19]

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<sup>17</sup> According to the Hungarian Risk Analysis System, if the expected strongest gusts exceeds 70 km / h, it is justified to release orange alert.



**Figure 4** The distribution of natural hazards between the member states of the United States of America [20]  
(Made by: László Teknós, 2018)

Figure 4 shows the distribution of major natural hazards related to the member states of the United States of America. Among the 13 most common types of species, the number of member states affected by floods is 41 out of 50 (see purple coloured article). 37 member states is endangered out of the 50 by storms and lightning strikes. In view of the concerned member states, extreme cold, winter storms, tornado and hurricane are the major threats.

According to the previously cited IFCR study, the decline in biodiversity in North America with certainty occur and the rise in sea levels has a moderate probability to occur, which will negatively affect the production activities of coastal settlements. [6] The increase of the coastal erosion also has a moderate probability to occur. Climate insurance costs are expected to increase, with increasing spending on defence costs. Vector-related diseases such as malaria, dengue fever and Lyme disease may appear in larger areas. Global climate change and extreme weather are the major challenge in the United States, for which the population must be prepared.

One of the key actors in the preparation and defence against disasters is the Federal Emergency Management Agency (FEMA). FEMA, as the US official disaster management organization, has several preparatory materials published on its website. The website distinguishes important preparatory materials that can be used before, during and after the disaster. FEMA coordinates the preparation of American citizens, which should include:

- Internet (websites, social media)
- Mobile phone (through Android, iOS applications)
- Brochures, flyers (for adults, children, youth and companies)
- Presentations, seminars, webinars (meaning online seminar)
- Educational movies (both at schools, in presentations and websites)
- Operation of youth and community associations (FEMA Corps, Citizen Corps)

In 2003 FEMA launched its "Ready" population preparation campaign, which has its website at [www.ready.gov](http://www.ready.gov). As a result of internet usage and population information needs, this web site contains population preparation materials, including preparation for emergencies, emergency planning, compilation of emergency toolkit, business support related information, youth education games, calls for proposals for voluntary activities, etc. Children can visit [www.kids.ready.gov](http://www.kids.ready.gov) as well or the website mentioned above. It is an advantage of the website to have the employing materials compiled for children and their parents by age

groups. Children can familiarize with disaster prevention activities with the game called "Disaster Master". Keeping pace with the social changes of the 21st century, FEMA also uses the various elements of the social media to prepare the citizens. Their mobile application, which is tuned to the GPS position, provides users with current information.

Based on the experience of Hurricane Katrina in 2005, the public information and warning system was further developed. As a result FEMA operates a complex public alert system since 2006 called Integrated Public Alert and Warning System (IPAWS). The essence of the system is that the president himself or the competent authorities can briefly send text and video messages to the population of the affected area (national, state, local, or even street level). In order to provide wider information, the system uses the Emergency Alert System (EAS), Commercial Mobile Alert System (CMAS) and CMAS and NOAA Weather Radio (NWR) alarm systems as well. With the IPAWS system, information and warnings with specific content can appear on TV, radio, mobile phones, highways and public transportation information panels.

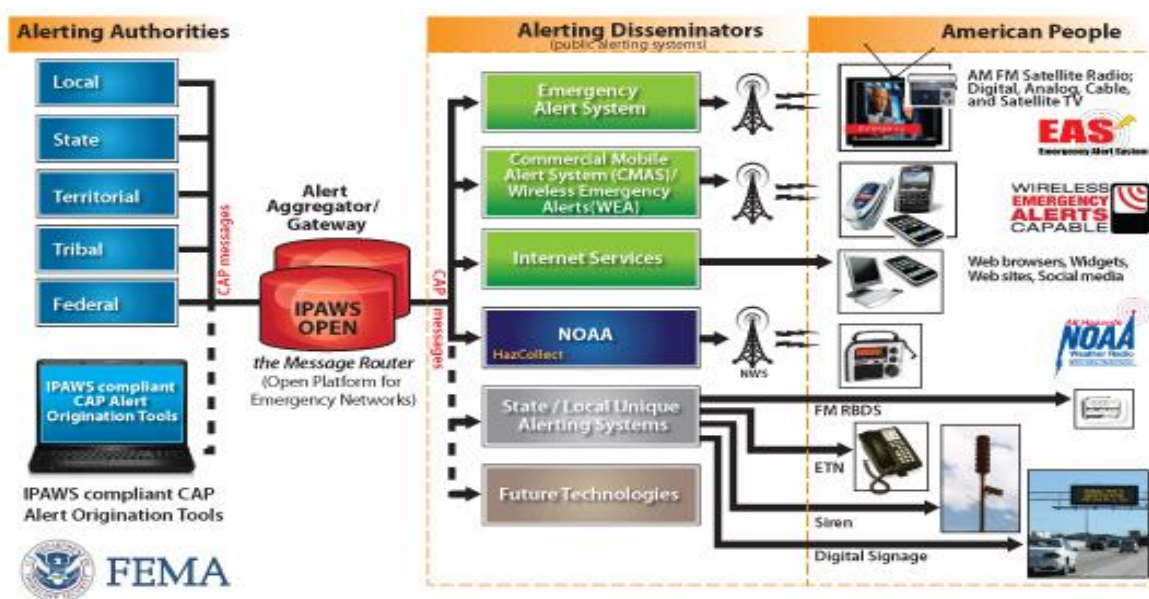
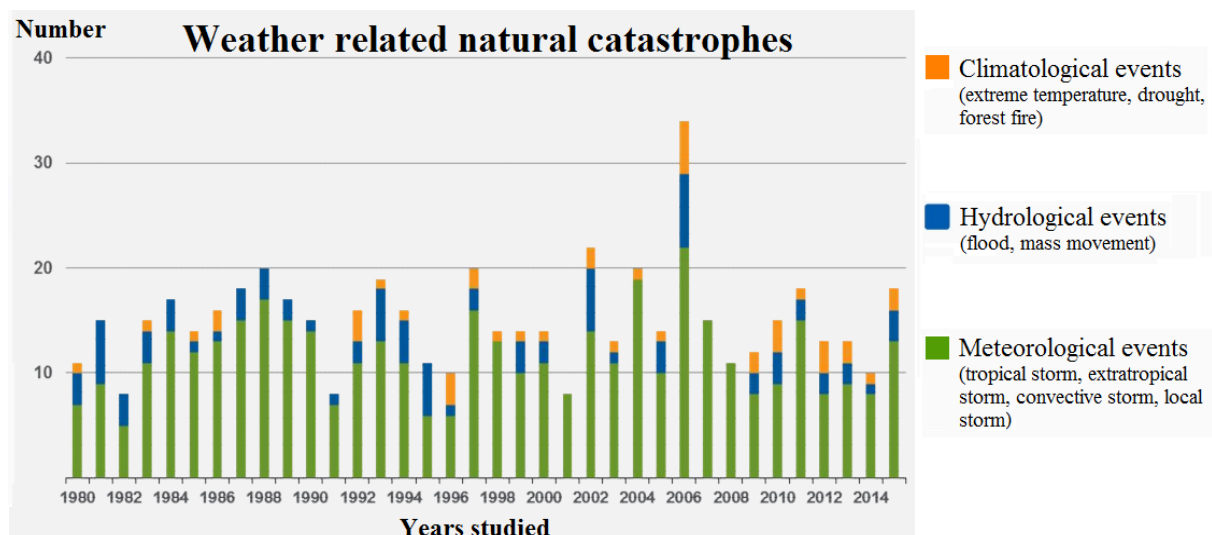


Figure 5 IPAWS Architectural Diagram  
(Made by: FEMA, 2015) [21]

Population preparation activity of the Federal Office of Civil Protection and Disaster Assistance (BBK) in Germany

„Höhere Durchschnittstemperaturen werden für mehr und intensivere Wetterextreme sorgen....“

Christoph Unger Präsident des BBK, Bonn, im Januar 2016 [22]



**Figure 6** Numbers of weather-related natural disasters in Germany between 1980-2015<sup>18</sup>[23]  
(Made by: László Teknós, 2018, based on Munich Re data)

UBA, DWD, THW and BBK have been working together at a federal level since 2007 in the "Climate Change and Civil Protection" working group, which, in addition to study the effects on the population, have sought to develop adaptation action plans. In December 2008, the Federal Government adopted the "Deutsche Anpassungsstrategie an den Klimawandel" (DAS) strategy, which provides guidelines, action plans and measures to adapt to the negative effects through a gradual assessment of the climate change risks. It describes in part 3.2.14. that the protection of the population is regulated at federal level, whose task is to analyze and evaluate the future occurrence and intensity of extreme events such as storms and floods, and assess the vulnerability of critical infrastructures. The natural origin events that have occurred over the past few years have demonstrated the need to develop civil protection at federal level, especially in the area of information transfer, in the communication between the organizations involved in civil protection, in the operative cooperation, clear and effective population alerts and information. [24]

The protection of the population and the material goods is regulated at federal level in Germany. Each province is responsible for ensuring the security, for which various organizations have been established and nominated. This is necessary because many natural and civilizational disasters may endanger life, wealth and security, the national economy, the operability and availability of critical infrastructures. At federal level, the civil protection (Bevölkerungsschutz) was divided between several bodies and organizations to avoid the interdisciplinary nature of the threats and the unilateral control of the Second World War. According to the Constitution (Grundgesetz für die Bundesrepublik Deutschland), federal, provincial and local authorities are responsible for the safety of people in Germany. Accordingly, a so called assistance system has been developed in which BBK, firefighters, aid organizations and THW are in close cooperation.

<sup>18</sup> 2016 Münchener Rückversicherungs-Gesellschaft, Geo Risks Research, NatCatSERVICE – Stand April 2016

## FEDERAL OFFICE OF CIVIL PROTECTION AND DISASTER ASSISTANCE (BBK)<sup>19</sup>

In Germany the Office carries out the tasks of population protection and disaster management, such as health defense measures, the protection of cultural goods, emergency drinking water supply, the existence of financial support for interventions, the coordination of crisis management, international cooperations, the planning of critical infrastructure protection, civil protection research (especially NBC threats), the identification and management of threats, the execution of trainings<sup>20</sup> and further trainings, the warning<sup>21</sup> and informing of the population, and the measures to improve the self-assistance ability of the society.<sup>22</sup> [25]

### Warning of the population

After the Cold War, the federal government assessed security as stable and decided to reduce its resources in the civil protection sector. According to federal regulations, the provincial authorities are responsible for warning the population. Sirens were almost entirely operated by local authorities as a warning device. Later on, it emerged as a problem that some cities and towns decided to install new electronic sirens, the consequence of which was that the municipalities did not apply a uniform system for the maintenance and development of the sirens. Today a residential alert can be carried out 1 minute, with 15,000 sirens nationwide. Due to the improper regulation of legislation today, the management of alarms and the use of warning signs are not uniform throughout the country. [26]

Even before the turn of the millennium it was recognized that there are still dangers that require great attention and require the development of residential alert systems. They were then looking for new techniques that could be used to replace existing warning devices (sirens and radio stations). With the help of commercial channels, a satellite-based warning system was built, enabling the federal government to notify the broadcasting organizations involved in the development within a maximum of one minute.

### Modular Warning System (MoWaS)

The modular alert system<sup>23</sup> developed by BBK, which is operational since 2013, is designed to alert to direct dangers. It warns citizens or calls them to follow the commands of the information broadcasting channels. The technical and editorial systems of broadcasters, media agencies and media service providers are not part of MoWaS, but the modular alert system sends them alerts, which, by means of pre-contracted contracts, send warning messages to the public.

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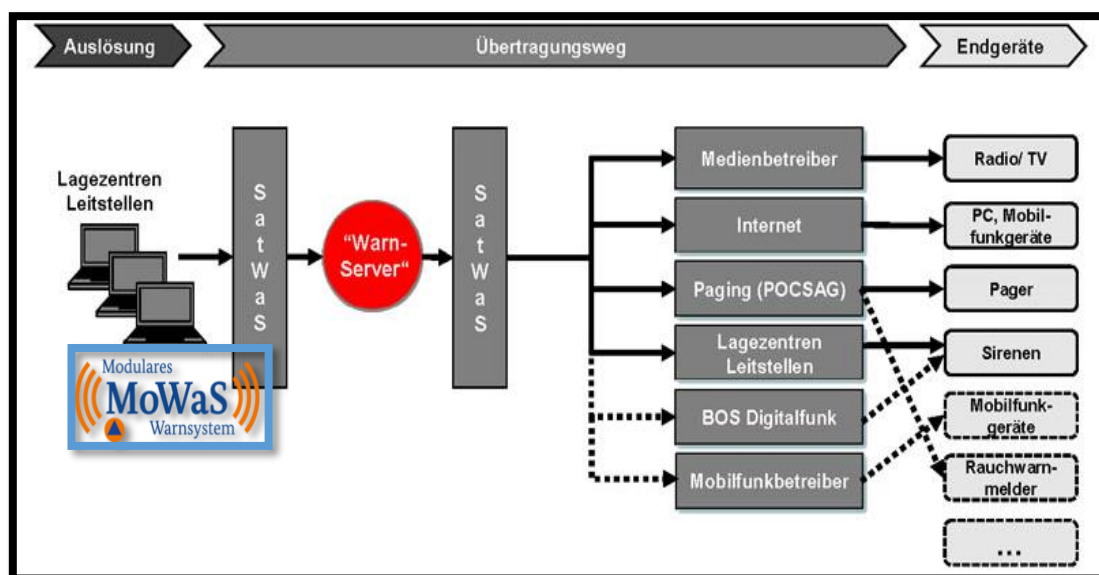
<sup>19</sup> Bundesamt für Bevölkerungsschutz und Katastrophenhilfe (BBK).

<sup>20</sup> Some 10 thousand persons participate in 400 education and training program at the BKK Academy annually (AKNZ).

<sup>21</sup> It forwards information through MoWaS warning system approximately 170 radio, television channel, media provider.

<sup>22</sup> 1.7 million volunteers carry out tasks in the German civil protection.

<sup>23</sup> Modulare Warning System (MoWaS)



**Figure 7** Modular alert system logo (MoWaS)  
(Made by BBK)

The technology and procedures have been continuously developed to meet the strategic requirements of a modern warning system. The satellite based warning system (SatWaS) is an improved result of the Modular Warning System (MoWaS). In addition to preserving existing features, the structure was complemented by a central rule set ("warning server"). Today, in Germany, a single system can be used to alert the population, linking all warning systems. The system is GIS-based. The warning area must be selected through a graphical user interface. The warning message must be entered in the warning signal to be activated and transmitted via the satellite to the warning server.

Central regulation takes into account MoWaS-related federal and provincial needs. The warning message is transmitted via satellite and without containing any new information it is transmitted to the central alert server. From there connected media service providers, location centres can be controlled. The Modular Warning (MoWaS) system is divided into three areas:

- The launching phase of the alert includes transmission and reception systems in the center stations of the federal government and the provinces and the interconnected control centers of counties and districts.
- The transmission phase then starts. This includes all components from trip to warning multipliers or terminal control systems.
- At the terminal equipment stage, alerting devices are available that are directly accessible to the population. The term "warning media" refers to terminals that can transmit individual content, e.g. confidence texts and behavioral forms. The wake-up effect can usually be accessed when one makes or sets up the device (e.g. radio, TV, internet, mobile application). The term "warning devices" refers to terminals that only emit a wake-up signal (e.g. siren) or additional standardized text content.

### Das Feuerwehr-Warnsystem FeWIS [27]

The German Meteorological Service, together with the fire brigades, developed the FeWIS online alert system in 2004 to support the interventions of professional fire brigades. As a result of innovation, research and development and special needs of fire brigades, this system became a disaster management portal.

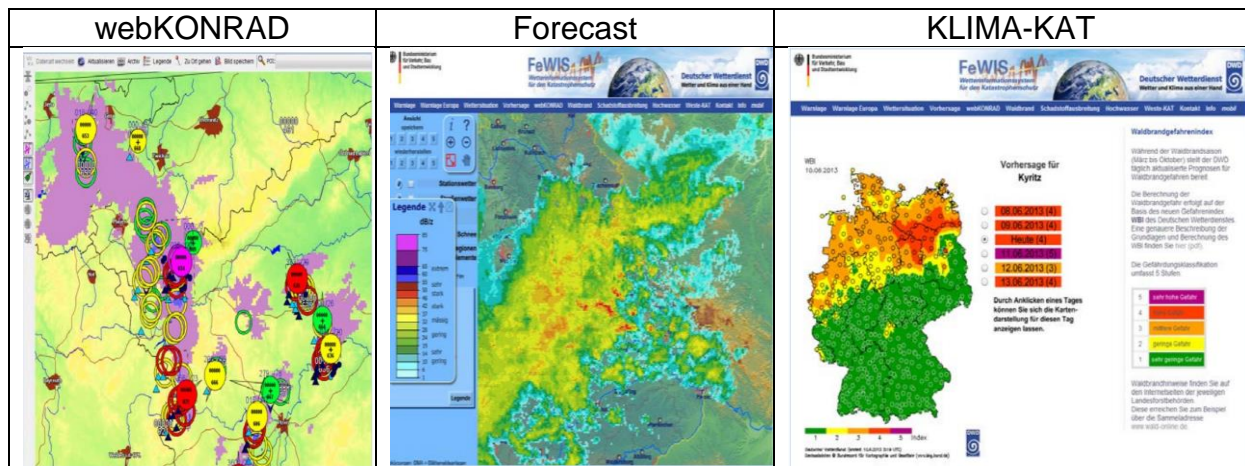


Figure 8 Information elements making up FEWIS [28]  
(Made by German Meteorological Service)

FeWIS contains and transmits several information that may provide assistance in the emergency decision making: [28]

- Actual warnings (gale, orkan, monsoon, Hagel,
- Warnings for Europe (Eumetnet- Meteoalarm, alerting Europe for extreme weather)
- Weather forecast
- Actual weather, radar, meteorological data, satellite image
- Lightning-storm monitor
- webKONRAD (provides information on the intensity and direction of the storms, it was introduced as part of the FEWIS in 2009)
- HEARTS: Modelling the spreading of pollutants
- Forest fire endangeredness index
- KLIMA-KAT (weather statistics, expert views, weather forecast)
- Direct contacts

FEWISmobil has been developed to support interventions, which displays radar images, movies, satellite images, thunderstorms, forecasts, warnings, and outer links from the FEWIS system installed on smartphones.

## SUMMARY, CONCLUSION

Hereby publication deals with population preparation, information and warning in general in connection with natural disasters and, in the narrow sense, in the context of extreme weather threats. Figure 1 shows disaster management cycles (see Figure 1), in two methodological divisions where population preparation as a time period and as a task is shown. It can be stated that the general goal of the countries is to reduce the probability of the development of damages or disaster. However, because of the inevitable threats, they must be prepared for future negative impacts. The preparation of the population also establishes and develops the technological-technical, administrative, social framework of emergency information and warning, which also means the method of self-rescue of society. The content of the preparation also covers the tasks to be carried out during multiple cycles, thus ensuring the communities' survival chances and the strengthening of coordinated, conscious personal self-defence opportunities.

In the publication the Hungarian, American and German population preparation, information and warning of the population is presented. Based on tables 1, 2 and 3, it can be stated that the organizations use the smartphone applications for the modern population,



information and alarm, taking advantage of the technological advances of the 21st century. It can be seen that a number of applications have been prepared directly for the weather hazards, which can be found in each of the examined countries. The reason for this is illustrated in Figure 3, which draws attention to the increasing climatic, meteorological and hydrological threats in the world. Table 4 shows natural events occurred in the world with the related mortality figures between 2010-2017. According to the table - in line with the research theme topic of this article - the number of meteorological events among the four examined types is high. This poses a serious challenge and risk, since - besides the increasing tendency - the number of deaths (and the affected persons) is high as well. All major international organizations address the dangers of climate change and extreme weather, all highlighting the significance, importance of the population preparation and information and the relevance of the adaptation to impacts.

Floods (hydrological origin), storms, extreme colds, and winter storms (meteorological) are also a problem in the United States, which endangeredness is presented in Table 4. One of the key actors in the preparation and defence against the impacts is the Federal Emergency Management Agency (FEMA), which brings together and coordinates the preparation of American citizens. In 2003, FEMA launched the "Ready" population preparatory campaign, which includes preparations for emergencies, emergency planning, compilation of necessary toolkit, business support, youth education, voluntary calls. It can be stated that FEMA has a well-developed population information and warning system, which is well-developed, informative and meets the present needs.

Figure 6 shows the event numbers of natural disasters related to the weather in Germany between 1980-2015. It can be said that threats with the greatest number of cases in Germany are caused by climatological threats. The strategy called Deutsche Anpassungsstrategie an den Klimawandel (DAS) poses a serious threat to the effects of climate change and extreme weather, for which management and adaptation it is necessary to be prepared. In Germany, the Federal Office of Civil Protection and Disaster Assistance (BBK) carries out tasks related to population protection and disaster management, among which the population preparation, warning, information and measures to improve the self-rescue ability of the society are highlighted. It can be stated that BBK has a well-developed population information and warning system, which is well-developed, informative and meets the present needs.

Taking into account the national preparedness, information, warning and alert systems of the countries presented in the publication, it can be stated that the preparation of the population, on one hand, represents its emergency education, information, the social realization of the security sensation and the development of the preventive culture. In the fight against weather and climate impacts, the goal is to create self-rescue ability, to carry out the rules of correct code of conduct with confidence, to build a civic, active contribution to the elimination of an emerged meteorological and hydrological event. Technological developments in recent years have provided new opportunities that are successfully used by the surveyed countries in order to prepare the population for extreme weather events.

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