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Disaster Vulnerability as a Key Concept in Civil Protection – A Theoretical Review for the National Organizations 6

Katasztrófa-sebezhetőség, mint kulcskoncepció a polgári védelem területén - Az elméleti felülvizsgálat a nemzeti szervezetek számára

Absztrakt

A katasztrófaveszélyeztetettség egy gyakran használt fogalom a katasztrófatudományban, mégis pontos jelentése mindmáig tisztázatlan. Mindazonáltal a kifejezés tartalmát szükséges standardizálni, ugyanis egységes terminusok nélkül a regionális együttműködésekben is problémák merülhetnek fel. Jelen tanulmány a katasztrófaveszélyeztetettség szemléltetésével foglalkozik, annak módszertani keretéhez nyújt segítséget. A kutatás metodikáját az irodalomelemzés alkotja: főként nemzetközi, angol nyelvű szakkönyvek és folyóiratcikkek analízisével kísérli meg a kapcsolódó fogalmak definiálását, illetve azon tartalmi elemek meghatározását, amelyek egy teljes veszélyeztetettségi körkép megalkotásához szükségesek. Az eredmények alapján a szerzők a veszélyeztetettség fogalmán belül az alábbi kategóriákat alkották meg: természetföldrajzi (kőzetek, tájegységek, vízrajzi jellemzők, meteorológia), társadalomföldrajzi (demográfia és gazdaság) és statisztikai (adatbázisokból kinyert katasztrófaadatok) jellemzők. Ezzel a konklúzióval a tanulmány a jelenlegi katasztrófatudományi kutatások módszertani megalapozásához kíván támpontot adni.

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Kulcsszavak: *katasztrófatudomány, veszélyeztetettség, földrajz, statisztika*

Abstract

Disaster vulnerability is a commonly used concept within disaster science, but its exact meaning is still unclear. However, the content of the term needs to be standardized, as the lack of unified terms my cause problems in regional cooperation as well. This study deals with the illustration of disaster vulnerability and provides a methodological framework for that. The applied methodology is literature review: it mainly attempts to define related concepts by analyzing international English-language books and journal articles, as well as to determine the content, which are necessary to create a complete vulnerability map. Based on the results, the authors classified the following categories within the concept of vulnerability: natural geographic (rock formation, landscape, hydrographic features, meteorology), socio-geographic (demography and economy) and statistical (disaster data extracted from databases) features. With this conclusion, the study seeks to provide a methodological framework for current disaster science research.

Keywords: *disaster science, vulnerability, geography, statistics*

INTRODUCTION

In 2018, one of the authors went to Bangladesh to make a fieldwork regarding South Asian disaster hazards.[7] As a preparation, he made some basic research where the country's disaster vulnerability was elaborated. Immediately at the beginning, some difficulties appeared; what should be included and excluded in a vulnerability map? What kind of statistical data has to be used? What are the components of the concept? There, the author had to realize that vulnerability itself is a too complex phenomenon and difficult to investigate.

[7] One of the research's outcome was published in Hungarian (Papp, 2019a).

Therefore, vulnerability is a key concept in disaster management and civil protection as well. In addition, as a key concept, its specification and determination are essential for the national organizations worldwide and in the Danube region as well. Terminological discussion does not only consist of a definition itself: it is a broader discussion of the topic. This paper tries to explore the related literature in order to conclude some basic trends about disaster vulnerability. In order to understand this term's complexity, one remark has to be made: one unified definition cannot be exhaustive. This paper offers a possible interpretation of the concept "disaster vulnerability" that can be used on all the three levels of disaster management: disaster science, political decision-making, and practitioner level.

This paper is structured as follows: Firstly, the concept of "disaster" is introduced: its definition, the basic criteria, etc. Afterwards, "vulnerability" itself is discussed and its most important interpretation points. The following two chapters are the geographical and statistical illustration of disaster vulnerability: theoretical empirics underpinning the methodological framework – it hopefully assists the methodological questions of disaster science. In the last chapter, some implications are drawn up for the development of the academic world of disaster science.

Every section is closed by examples from the Hungarian sphere of civil protection. As Hungary is part of the Danube region, the references could be useful for other national systems. Hopefully, these experiences might help in improving the practical level of disaster resilience in the region.

WHAT IS DISASTER?

The concept of disasters is difficult to define and has different interpretations depending on the context. Throughout the brief history of disaster science, a number of approaches (Etkin, 2016; Oliver-Smith and Hoffman, 1999; Perry, 2017; Quarantelli, 1985; Rodríguez et al., 2007) were applied to this basic term: according to the historical, political, professional, and cultural context, its research subject, "disaster" was defined in several ways. That is why a clear concept is difficult to establish.

This paper applies the theoretical school of problem-centred approach. This approach is now widely used, mostly by practitioners, and can be found in publications of international organizations (e.g. UNISDR, International Red Cross Society, EU) on disaster management. In UN's Sendai Framework, a disaster is referred to as "a major disruption in the life of a community that causes human, material, economic or environmental damage" (UN, 2015). The EU Civil Protection Mechanism is broadly defined as a "disaster" can be "any situation which has or may have a severe impact on people, the environment, or property, including cultural heritage" (European Parliament and Council, 2013). The approach of the Hungarian legal system is also problem-oriented, according to which:

"*A disaster is a condition or situation which is capable of triggering a state of danger, or a magnitude below, which endangers human life, health, material values, the basic supply of the population, the natural environment, natural values in such a way or to such an extent that damage, prevention, elimination of the consequences goes beyond the capabilities of the designated organizations to cooperate in the prescribed cooperation arrangements, and requires the application of specific measures and the continuous and closely coordinated cooperation of local and governmental authorities as well as the use of international assistance*." (Act 128/2011 on Disaster Management and amending certain related laws, 2011)

What is considered as a disaster can also be defined according to the objective, i.e. measurable, criteria. Disaster statistics and other professional documents also try to quantify each disaster incident, thereby defining the concept of disasters with specific variables. According to one of the largest international databases, the International Disaster Database, an event that meets any of the following criteria is considered a disaster: (i) Ten (10) or more people reported killed, (ii) Hundred (100) or more people reported affected, (iii) Declaration of a state of emergency, (iv) Call for international assistance (Guha-Sapir et al., n.d.). The Swiss Re

Institute's Sigma database, besides the number of victims, defines the concept of disasters based on insurance losses and other economic losses (Swiss Re Intitute, n.d.). This leads to several problems: no account is taken of the economic losses, or no distinction is made between some dying immediately or one month after the event (Etkin, 2016). However, some databases, such as DesInventar, which focuses mainly on Latin America (Corporación OSSO, n.d.), do not specify specific criteria for what is included in their database. From this, it can be seen that disaster statistics have certain theoretical problems, so, it is necessary to assign subjective, i.e. non-measurable criteria to the field of study. Exactly what these subjective criteria are and the criteria by which to distinguish disasters from other incidents greatly influences the research plan, implementation and even the results obtained (Etkin, 2016).

This definition and knowledge-sharing is essential for the successful cooperation between all three levels of disaster management (practitioners, political decision-making, academic community) (Poljanšek et al., 2017, pp. 518–520). The distinction between emergencies, disasters, and catastrophes might be mentioned here. Almost all researchers and a big number of policy-maker and operational personnel in emergency planning had to recognize that this distinction has to be drawn, namely a quantitative and qualitative difference between routine accidents, disasters, and huge catastrophes (Kuti and Papp, 2018). It is granted that a disaster is not simply a "bigger accident" than usual (Quarantelli, 2000, p. 2). What is crucial is that catastrophes mainly require different kinds of planning and managing than "ordinary" disasters or everyday emergencies do. This is true if the focus is on the planning for mitigation, preparedness, response and/or recovery measures. Many more differences can be surfaced and found by looking at the local community planning and asking what it assumes as being in place after the impact. (Quarantelli, 2000, p. 4). The Hungarian literature regarding disaster science has to be underlined. Hungarian authors mostly publish in Hungarian, especially in the field of disaster management. Their topics include fire protection (Bleszity, 1993; Bodnár and Komjáthy, 2018; Érces and Restás, 2016; Kuti, 2010, 2007), technical rescue (Kocsis et al., 2016; Kuti, 2006;

Pántya, 2017), civil protection (Ambrusz, 2015; Ambrusz and Muhoray, 2015; Endrődi, 2013a, 2015; Kirovné Rácz, 2019; Lóderer and Rácz, 2011; Teknős, 2018a, 2018b), and industrial safety (Bognár et al., 2013; Dobor, 2018; Dobor et al., 2017; Horváth et al., 2018; Takács and Kuti, 2017). Their common feature is that they all consider disasters problems, and that their research aims to prevent, eliminate and restore damages. The reason for this is that in Hungary, disaster science is represented by professionals who work in the field of disaster management themselves, so, their primary motivation is to improve organizational operations.There is a significant need for standardization in disaster terminology, as the problem of communication is essential regarding disaster management (Meltzer et al., 2018).

In the Hungarian professional organization of disaster management, the word *katasztrófa* is used for "disaster", and the word *veszélyhelyzet* is used for "emergency". However, their meaning is not correlating with their English terms. *Veszélyhelyzet* is a higher, more severe state of the country than *katasztrófa* itself. It can be seen, that despite the translatable versions, the national terms differ from the international ones (Figure 1). This problem might appear in international collaboration, so, the terminological education and mutual understanding is unavoidable in cooperation.

Severity of an incident

Translation: emergency=veszélyhelyzet disaster, catastrophe=katasztrófa

Figure 1: Differences in terms regarding disaster incidenst in English and in Hungarian. The arrow shows the increase of severity of incidents from left to right

VULNERABILITY AS A CONCEPT

The discussion of vulnerability is essential in any published materials on disaster management. However, one cannot find any consensus in the concept, furthermore, its translation has some barriers also. Vulnerability itself is not natural, it is rather the human dimension of disasters: the result of the entire range of economic, social, cultural, institutional, political and even psychological factors that shape people's lives, and create the environment around them. Academic literature over the past decades has drawn up that the weaker groups in society are the ones suffering worst from disasters: (especially) the poor, the very young, and the very old, women, persons with disability, and those who are marginalised by race or caste. Those who are already at an economic or social disadvantage tend to be more likely to suffer during disasters. In summary, the society's resilience and vulnerability is very important for understanding the impact of disasters, and making choices about how to eliminate them (Twigg et al., 2004, p. 16). This term is often discussed together with the words *risk* and *hazard*, so it is necessary to clarify them first.

The definition of *risk* is clear on the one hand, since not only disaster management uses the term. One of the most important theoretical works of risk research (Adams, 1995) uses the following interpretation: risk is a specific event or challenge that is likely to occur within a specified time. In one sentence, risk is nothing than the consequences of hazards (Bezek, 2002). According to Clarke (1999, p. 11), "risk is when you know the possible range of things that may happen following a choice; uncertainty is when you don't." Risk in its general form is when it is possible to estimate the likelihood that an event (or set of events) will occur; the specific forms of those estimates are the probabilities of adverse consequences.

Defining the word "hazard" is already a bit more difficult task, as the term is not determined uniformly in English. Hazard is usually understood as the probability of a type of disaster occurring in a certain context (Endrődi, 2013; Kuti, 2010; Kuti and Zólyomi, 2016). Thus, it is a predictive numerical category, value, or attribute that calculates and predicts future events based on various circumstances and effects (e.g., frequency, duration, extent, speed, etc. (Burton et al., 1978). According to an Internationally Agreed Glossary (UNDHA, 1992, p. 4), hazard is a "threatening event, or the probability of the occurrence of a potentially damaging phenomenon within a given time period and area."

The definition of *vulnerability* is complicated, while widely used in the international literature, as its content is not clarified. The works, despite their methodological differences, agree to analyse retrospective disaster tasks. International sources (Bankoff et al., 2004; Birkmann and Wisner, 2006; Etkin, 2016) mainly examine geographic, social, economic, mathematical, and cultural characteristics that influence the likelihood of disasters in some way. Vulnerability therefore encompasses all past or present factors that have an impact on disaster risk. Based on the problem-oriented approach model, the three concepts mentioned above relate to each other as following (Etkin, 2016):

Risk = Hazard x Vulnerability

The model therefore makes the following statement: disaster risk is the product of hazard and vulnerability. According to this, the occurrence of a catastrophe consists of (i) predictable probability and (ii) realized data (the natural and social factors influencing the catastrophes and the events that have occurred). Vulnerability is subdivided according to the realized data types described by the model: regional natural geography, socio-economic geography, (natural, built environment, demography) and available disaster statistics, namely the events that have occurred.

Depending on the context, *vulnerability* can be translated into Hungarian in three different ways (*sérülékenység*, *veszélyeztetettség*, *sebezhetőség*). Therefore, the Hungarian correspondence between the concepts of disaster management is unclear, as there is no English-Hungarian dictionary regarding disaster risk management, and there is no uniform academic or professional common understanding (Kuk, 2017). Accordingly, the Hungarian equivalents of English terms differ from author to author and even from publication to publication, so there is a huge need for standardization. However, most of the Hungarian literature regarding vulnerability (Endrődi and Zellei, 2018; Üveges, 2002) categorizes disasters and other events of great loss during history.

Detailed literature is available to illustrate natural geography. In addition to main volumes, other relevant professional books, book chapters and relevant papers should be used. All geographic features might not be covered due to the huge amount of data, only major geographic factors relevant to disaster risk have to be mentioned: rock formations, major landforms, hydrographic features (seas, major rivers and lakes), meteorology, as well as other geographic attributes which influence disaster vulnerability.

We divide the socio-economic geographic characteristics into five groups and separate the methodology of data collection accordingly. When analysing the demographic characteristics of the affected population, the focus should be mainly put on demography, population, population density and urbanization within the investigated region, which are essential for the civil protection. For demographic analysis, the data should be collected from the free, demographic-specific Worldometers database (Worldometers.info, 2018). The database is based on statistics from several global organisations, including the UN, WHO, FAO, IMF and World Bank. Because the data is derived from many different agencies, the methodology of collection has many potential errors that also call the accuracy of the data into question. However, Worldometers is still considered one of the most trusted databases: its system is used by thousands of peer-reviewed books, journals, Wikipedia, and even the American Library Association evaluated it as a “highly referenced website”.

Economic (development, agricultural and industrial) indicators are to be kept in mind for the interpretation of economic damage caused by disasters. Up-to-date figures were should be obtained by secondary analysis of the statistical results of regional relevant organisations, or the OECD (Organisation for Economic and Cooperation and Development, n.d.). General knowledge of settlement geography is essential for critical infrastructure protection and for intervention, and for food supply. Additionally for illustration, map visualisation programs might be used, such as QGIS (QGIS Development Team, n.d.). This set of software is practical for illustrating the main geographical features of the given area.

Referring to Hungary, there are plenty of volumes discussing geography (e. g. Glatz, 2002; Marosi and Somogyi, 1990). On the other hand, demographical and other relevant economic data can be retrieved from the Central Statistical Office, as it is a free, reliable database with a huge number of records. Figure 2 and 3 show some basic maps about disaster vulnerability in Hungary.

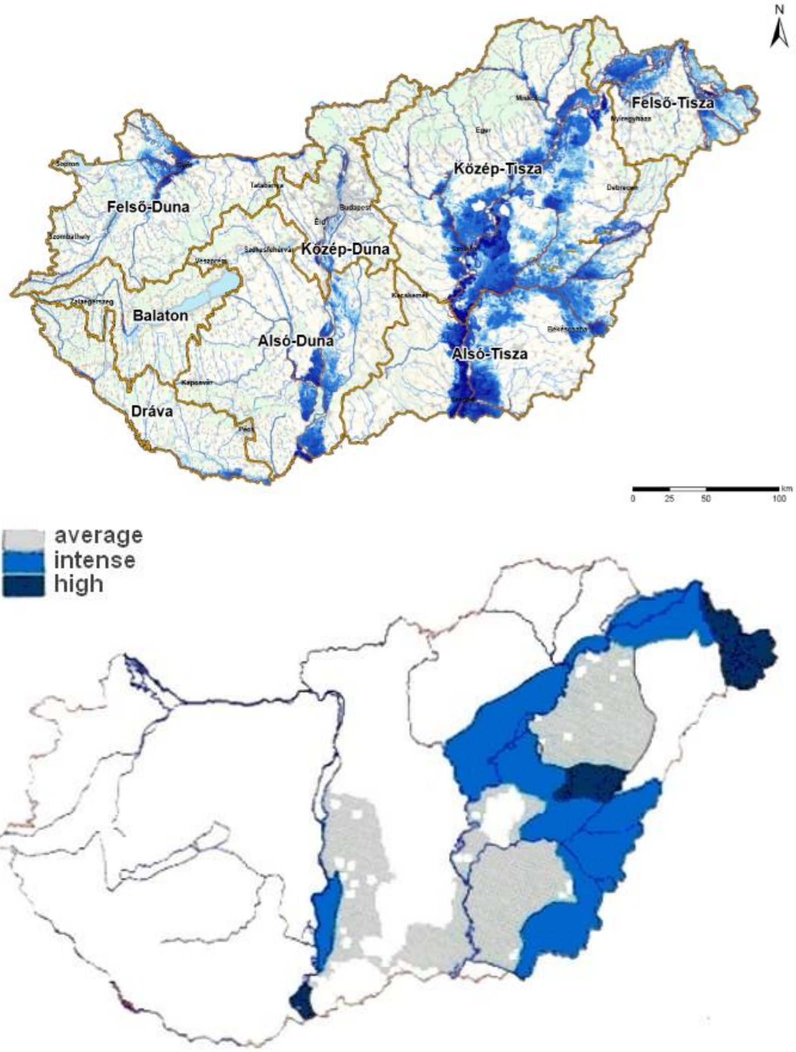

Figure 2 and 3: Flood vulnerability (OVF, 2018) and waterlogging vulnerability (NDGDM, n.d.) of Hungary

Disaster statistics are often used in disaster science and are one of the most widely used disaster risk analysis methods (Dilley, 2005; Kelman, 2006; Mileti, 1999; National Research Council, 1999; Nel and Righarts, 2008). Nevertheless, the effectiveness of the method has been questioned by many (Etkin, 2016; Guha-Sapir and Below, 2002, p.; Tschoegl et al., 2006), and since disaster statistics are in fact unreliable in many situations, there are obstacles to its use. A good example of this phenomenon: data extracted from the same area at a given time will cause completely different results depending on the applied database.

Another problem is the methodological diversity of disaster science data collection. Different organizations, by age and geographic region, collect data in different ways. Disaster risk data collection does not go back to history: insurance companies began to aggregate the results of their administrative tasks after accidents in the 1980s. Later, international organizations, government agencies, and the academic world did the same, so, reliable statistical information cannot be received on previous events.

In addition to the differences between data collectors, it is also difficult to compare data from different geographical areas. For example, Southeast Asia and Central Europe have different socio-economic geographic features, and disaster perceptions also greatly differ due to the cultural differences between the two continents (Jigyasu, 2005). As the Danube countries belong to a large region, this comparability is fairly proper, but caution is necessary in the case of regions that are far apart. Table 1 shows the different international disaster databases and their basic features.

Variable	EM-DAT (CRED)	NatCat (Munich Re)	Sigma (Swiss Re)
Period covered	1900 – present	1979 – present	1970 – present
Number of entries	12,000 (700 new entries/year)	15,000+ (approx. 700 new entries/year)	7,000 (300 entries/year)
Type	Natural (including epidemics) and man-made disasters + conflicts	Natural disasters (excluding drought and man-made, i.e. technical disasters)	Natural and man-made disasters (excluding drought)
Criteria	10 or > deaths and/or 100 or > affected and/or Declaration of a state of emergency/call for international assistance	Entry if any property damage, any person sincerely affected (injured, dead) Before 1980, only major	> 20 deaths and/or > 50 injured and/or > 2000 homeless and/or insured losses > US$14 M (Marine), > US$ 28 M (Aviation), > US$35 M (all other losses) and/or total losses in excess of US$ 70 M
Methodology	Country entry	Country and event entry, all disasters geocoded for GIS evaluation	Event entry
Sources	UN agencies, US Government Agencies, official governmental sources, IFRC, research centers, Lloyd's, Reinsurance sources, press, private	Insurance related media and publications, online databases and information systems from news agencies, governmental and nongovernmental organizations (REUTERS, IFRC, OCHA, USGS etc.), media reports, world wide network of scientific and insurance contacts, technical literature, Munich Re clients and branch offices	Daily newspapers, Lloyd's list, Primary insurance and reinsurance periodicals, internal reports, online databases
Priority source	Priority given to UN agencies	Priority given to Lloyd's list, Reuters, Reports from clients and branch offices, Insurance press	Not specified
Access	Public	Not public	Not public
Users	Research centers, governmental institutions, UN agencies, media, private, humanitarian agencies	Munich Re Underwriter, clients, governments, NGO's, scientific bodies, Universities, media etc.	Database not public. Annual sigma catastrophe publication available to whoever is involved in natural hazards issues, insurance companies, brokers, global companies, banks, media, scientific institutions
Web address	www.cred.be	www.munichre.com	www.swissre.com

Table 1: Different disaster databases. Source: (Guha-Sapir and Below, 2002)

Global statistics can be obtained from three major databases: Sigma (Swiss Re Intitute, n.d.), NatCat (Munich Re Institute, n.d.), and EM-DAT (Guha-Sapir et al., n.d.). Due to their different methodologies (Guha-Sapir and Below, 2002) and their applied basic concepts of disaster management (“dead”, “victim”, “affected”, “damage”) are also unclear (Quarantelli, 2001), data must be always extracted from the same database during a research. Sigma's database is not public, and its data can only be extracted from the organization's annual reports. In addition, it is the smallest of the three, with around 7,000 events, and its source is mainly the daily press and other databases. NatCat stores the most records of the three, with a total of 15,000 events, derived from insurance reports and from various media. The target audience for NatCat is clients of the Munich Re Institute, NGOs, governments, etc. Mostly used database is the International Disaster Database (EM-DAT) because, although it is not the largest database (12,000 items), the source of data collection is the UN and Red Cross reports, which are more reliable than insurance data.

In Hungary, statistics do not list disasters, as those do not happen frequently. The goal is rather to collect damage incidents, which is complicated because “damage” itself has rather a practitioner approach. Therefore, when Hungarian disaster vulnerability is discussed, the authors interpret different aspects of the concept. Figure 4 collects the damage incidents during the year 2016 and summarizes a number of approximately 55,000. Figure 5 discusses the deployments during several years, where the same year (2016) got more than 60,000 items. On the other hand, Table 2 covers the disasters during the recent years, and for 2016, only one event is shown as a disaster. Based on these differences, it can be concluded that disaster statistics and the statistical illustration of vulnerability highly depends on the methodology and data source (Papp, 2019b).

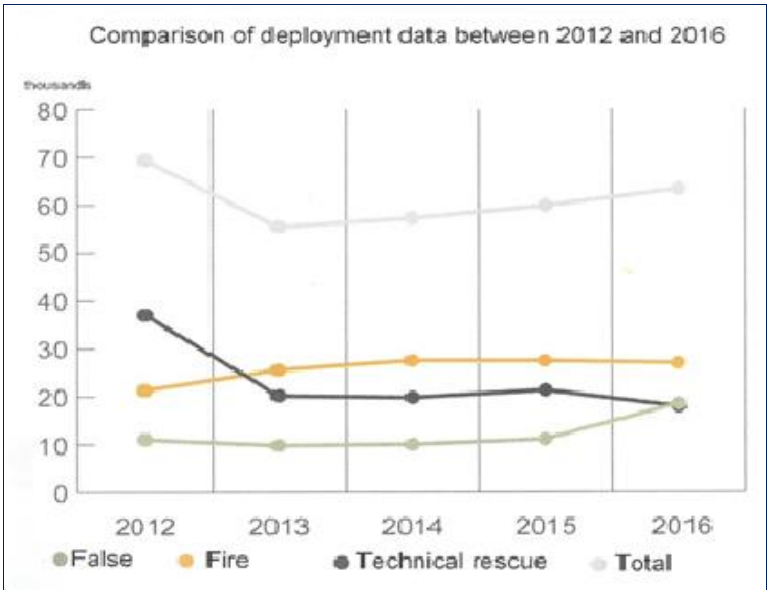

Figure 4: Damage events by month in Hungary, 2016. Source: (NDGDM, 2017, p. 41)

Year	Disaster type	Disaster subtype	Total deaths	Total affected	Total damage (US$)
2012	Extreme temperature	Cold wave	16	0	0
2013	Earthquake	Ground movement	0	1800	0
	Flood	Riverine flood	0	48565	0
	Storm	Convective storm	0	14000	0
2014	Flood	Riverine flood	0	6500	0
2016	Flood	--	0	2282	0

Table 2: Severe disaster incidents in Hungary between 2012 and 2016 according to the International Disaster Database (Guha-Sapir et al., n.d.).

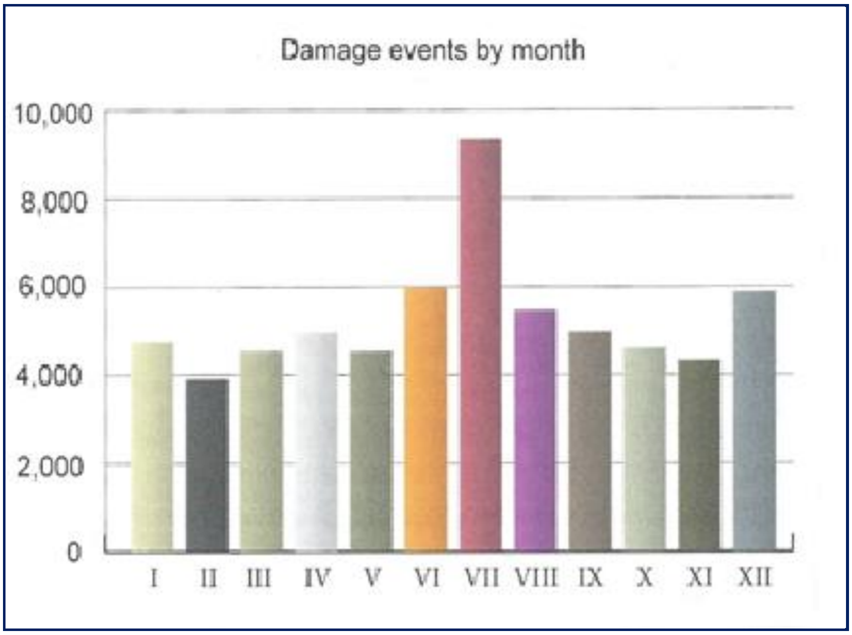

Figure 5: Comparison of deployment data between 2012 and 2016 in Hungary. Source: (NDGDM, 2017, p. 35)

HOW TO SUMMARIZE VULNERABILITY – AN IMPLICATION FOR DISASTER RESEARCH

Disaster vulnerability is a difficult and unclear concept, which varies in different sources. However, the term is a core keyword in disaster science. Therefore, its definition is necessary and significant. This paper tried to collect its basic tendencies and features that can support the academic life of disaster science. Furthermore, the illustration of vulnerability is a popular method in articles regarding disaster research. That is why the following implication can be made:

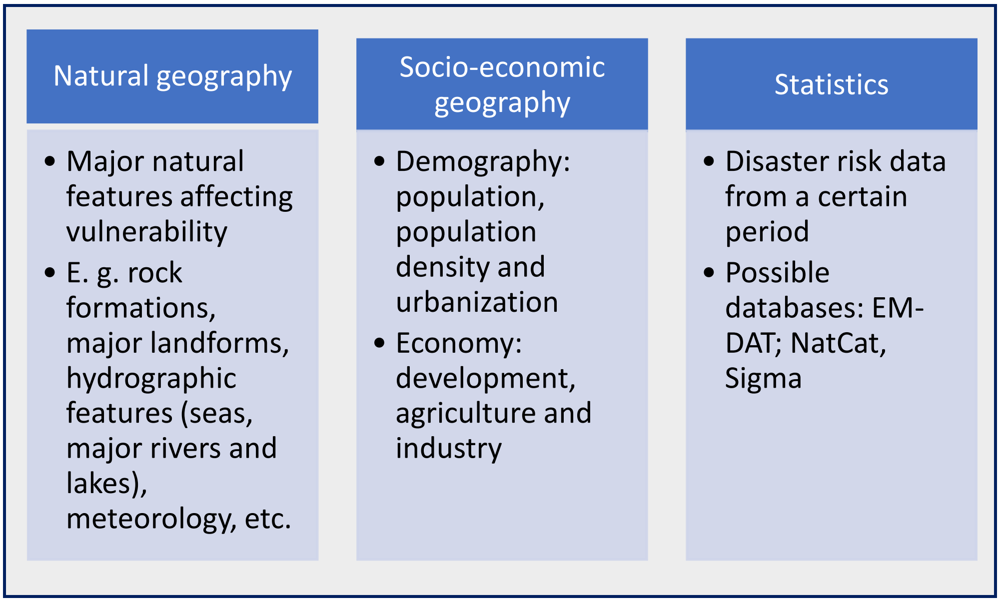

Figure 6: A possible illustration of disaster vulnerability. Edited by the authors.

A further message of this paper is the need for standardization among national disaster management organisations. As it was represented, there are differences in English and Hungarian terminology, so that we assume that in other Darenet state's language, this problem can be found as well. One of the Project's goal is to make a common standard information-sharing network within the Danube region. Nevertheless, without the standardization of basic concepts in disaster management, this network cannot fulfil its purpose.

REFERENCES

Act 128/2011 on Disaster Management and amending certain related acts, 2011.

Adams, J., 1995. Risk: The Policy Implications Of Risk Compensation And Plural. Routledge, London.

Ambrusz, József: A természeti csapásokat követő helyreállítás magyarországi rendszere, TÁRSADALOM ÉS HONVÉDELEM XIX: 2 pp. 73-82. , 10 p. (2015)

Ambrusz, J., Muhoray, Á., 2015. A vörösiszap-katasztrófa következményeinek felszámolása, a keletkezett károk helyreállítása. Bolyai Szemle 24, 67–85.

Bankoff, G., Frerks, G., Hilhorst, T. (Eds.), 2004. Mapping vulnerability: disasters, development, and people. Earthscan Publications, London ; Sterling, VA.

Bezek, B., 2002. Moderator Remarks, Session V: From Awareness to Action: How Do We Motivate Action?

Birkmann, J., Wisner, B., 2006. Measuring the un-measurable: the challenge of vulnerability ; report of the Second Meeting of the UNU-EHS Expert Working Group on Measuring Vulnerability, 12 - 14 October 2005, Bonn, Germany, Studies of the university: research, counsel, education. UNU-EHS, Bonn.

Bleszity, J., 1993. Tűzoltási és katasztrófavédelmi elhárítási ismeretek. BM Kiadó, Budapest.

BM OKF, 2017. 2016.

BM OKF, n.d. Belvízi veszélyeztetettség.

Bodnár, L., Komjáthy, L., 2018. Erdőtűzoltás támogatása műszaki megoldásokkal. Hadmérnök 13, 164–170.

Bognár, B., Kátai-Urbán, L., Kossa, G., Kozma, S., Szakál, B., Vass, G. (Eds.), 2013. Iparbiztonságtan I: Kézikönyv az iparbiztonsági üzemeltetői és hatósági feladatok ellátásához. Nemzeti Közszolgálati és Tankönyv Kiadó Zrt., Budapest.

Burton, I., Kates, R.W., White, G.F., 1978. The environment as hazard. Oxford University Press, New York.

Clarke, L.B., 1999. Mission improbable: using fantasy documents to tame disaster. University of Chicago Press, Chicago.

Corporación OSSO, n.d. DesInventar.

Dilley, M., 2005. Natural disaster hotspots: a global risk analysis, Disaster risk management series. World Bank, Washington, D.C.

Dobor, J., 2018. Veszélyes gázok felhasználási lehetőségei az iparban és a mezőgazdaságban, illetve e tevékenységek kockázatai. Hadmérnök 13, 28–42.

Dobor, J., Pátzay, G., Kossa, G., 2017. Atomerőművi balesetek és üzemzavarok tanulságai 1. Hadmérnök 12, 58–71.

Endrődi, I., 2015. Polgári Védelmi szakismeret 1. Nemzeti Közszolgálati és Tankönyv Kiadó Zrt., Budapest.

Endrődi, I., 2013a. A katasztrófavédelem feladat- és szervezetrendszere. Nemzeti Közszolgálati Egyetem Vezető- és Továbbképzési Intézet, Budapest.

Endrődi, I., 2013b. A közlekedési ágazat kritikus infrastruktúra elemei, kapcsolatuk a katasztrófavédelemmel, figyelemmel az Európai Unió Kritikus Infrastruktúrák Azonosításáról és Kijelöléséről szóló 2008. évi 2008/114/EK Tanácsi Irányelvében megfogalmazottakra, in: Horváth, A. (Ed.), Fejezetek a kritikus infrastruktúra védelemből: kiemelten a közlekedési alrendszer. Magyar Hadtudományi Társaság, Budapest, pp. 238–267.

Endrődi, I., Zellei, G., 2018. A légvédelemtől a légoltalomig: a Magyar Királyság veszélyeztetettsége és első intézkedései a hátország védelme érdekében 1914 - 1918-ig. Védelem Tudomány III, 154–168.

Érces, G., Restás, Á., 2016. Épületek tűzvédelmi életcikluselemzése, in: Restás, Á., Urbán, A. (Eds.), Tűzoltó Szakmai Nap 2016. BM OKF, Budapest, pp. 122–127.

Etkin, D., 2016. Disaster theory: an interdisciplinary approach to concepts and causes. Butterworth-Heinemann, Amsterdam ; Boston.

European Parliament and Council, 2013. DECISION No 1313/2013/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL.

Glatz, F. (Ed.), 2002. Magyar tudománytár, 1. magyar nyelvű kiad. ed. MTA Társadalomkutató Központ : Kossuth, Budapest.

Guha-Sapir, D., Below, R., 2002. The Quality and Accuracy Of Disaster Data - A Comparative Analyses Of Three Global Data Sets.

Guha-Sapir, D., Below, R., Hoyois, Ph., n.d. EM-DAT: The CRED/OFDA International Disaster Database.

Horváth, H., Kátai-Urbán, L., Kozma, S., Sárosi, G., Vass, G. (Eds.), 2018. Iparbiztonságtan II.: Kézikönyv a veszélyesáru-szállítmányokkal kapcsolatos feladatok ellátásához. Dialóg Campus Kiadó, Budapest.

Jigyasu, R., 2005. Disaster: A “Reality” Or Construct”? Perspective From The “East,” in: What Is a Disaster? Xlibris Corporation, Bloomington, pp. 49–59.

Kelman, I., 2006. Acting on disaster diplomacy. Journal of International Affairs 59, 215–240.

Kirovné Rácz, R., 2019. Az extrém csapadékhullás katasztrófavédelmi vonatkozásai. Védelem 26, 35–37.

Kocsis, I., Péntek, Attila, Fazekas, C., Kuti, R., 2016. Műszaki mentések hártyásszárnyúak okozta veszélyhelyzetekben. Védelem Tudomány I., 78–91.

Kuk, E., 2017. A katasztrófavédelmi terminológia azonosítása: a múlt eredményei és a jövő kihívásai. Műszaki Katonai Közlöny XXVII, 81–93.

Kuti, R., 2010. Extrém időjárási jelenségek kockázatai, a védekezéssel kapcsolatos önkormányzati feladatok. pp. 1–25.

Kuti, R., 2007. Terrorcselekmények kárfelszámolási lehetőségeinek vizsgálata tűzoltói aspektusból. Védelem 14, 34–35.

Kuti, R., 2006. A műszaki mentésekhez használható eszközök bemutatása, fejlődésük áttekintése. Védelem Online 2006, 1–12.

Kuti, R., Papp, B., 2018. Analysis of decision-making skills during disaster management operations. Hadmérnök XIII., 210–216.

Kuti, R., Zólyomi, G., 2016. Vegyes tüzelésű fűtőberendezések használatának kockázatai. VÉDELEM ONLINE: TŰZ- ÉS KATASZTRÓFAVÉDELMI SZAKKÖNYVTÁR 1–7.

Lóderer, B., Rácz, R.M., 2011. A klímaváltozás és annak következményeire való felkészülés lehetséges jövőbeni aspektusai. Hadtudományi Szemle 4, 91–98.

Marosi, S., Somogyi, S. (Eds.), 1990. Magyarország kistájainak katasztere. MTA Földrajztudományi Kutató Intézet, Budapest.

Meltzer, M., Ștefănescu, L., Ozunu, A., 2018. Keep Them Engaged: Romanian County Inspectorates for Emergency Situations’ Facebook Usage for Disaster Risk Communication and Beyond. Sustainability 10, 1411. https://doi.org/10.3390/su10051411

Mileti, D., 1999. Disasters by Design: A Reassessment of Natural Hazards in the United States. Joseph Henry Press, Washington, D.C. https://doi.org/10.17226/5782

Munich Re Institute, n.d. NatCat.

National Research Council, 1999. The Impacts of Natural Disasters: A Framework for Loss Estimation. National Academies Press, Washington, D.C. https://doi.org/10.17226/6425

Nel, P., Righarts, M., 2008. Natural Disasters and the Risk of Violent Civil Conflict. International Studies Quarterly 52, 159–185. https://doi.org/10.1111/j.1468-2478.2007.00495.x

Oliver-Smith, A., Hoffman, S.M. (Eds.), 1999. The angry earth: disaster in anthropological perspective. Routledge, New York.

Organisation for Economic, Co-operation and Development, n.d. OECD Data.

OVF, 2018. Magyarország 1‰-es valószínűségű árvízi elöntési térkép.

Pántya, P., 2017. A katasztrófavédelmi és tűzoltósági tevékenységek végzése és annak tanulságai nemzetközi szinten. Hadmérnök 12, 80–91.

Papp, B., 2019a. Banglades környezet okozta gazdasági problémái, in: Salát, G., Szakáli, M., Szilágyi, Z. (Eds.), Veszélyes Vizeken : Konfliktusok És Biztonsági Fenyegetések a Távol-Keleten. Typotex, Budapest, pp. 253–264.

Papp, B., 2019b. Disaster risk data and its terminological difficulties–A statistical review. Delta (In Press).

Perry, R.W., 2017. What Is a Disaster?, in: Rodríguez, H., Quarantelli, E.L., Dynes, R.R. (Eds.), Handbook of Disaster Research. Springer, New York, pp. 1–15.

Poljanšek, K., Marin Ferrer, M., De Groeve, T., Clark, I. (Eds.), 2017. Science for disaster risk management 2017 knowing better and losing less. European Commission, Luxembourg.

QGIS Development Team, n.d. QGIS Geographic Information System. Open Source Geospatial Foundation Project.

Quarantelli, E.L., 2001. Statistical and conceptual problems in the study of disasters. Disaster Prevention and Management: An International Journal 10, 325–338. https://doi.org/10.1108/09653560110416175

Quarantelli, E.L., 2000. Emergencies, Disasters and Catastrophes Are Different Phenomena.

Quarantelli, E.L., 1985. What Is Disaster? The Need For Clarification In Definition And Conceptualization In Research, in: Sowder, B. (Ed.), Disasters and Mental Health Selected Contemporary Perspectives. Government Printing Office, Washington, D.C, pp. 41–73.

Rodríguez, H., Quarantelli, E.L., Dynes, R.R. (Eds.), 2007. Handbook of disaster research, Handbooks of sociology and social research. Springer, New York.

Swiss Re Intitute, n.d. Sigma.

Takács, K., Kuti, R., 2017. Fenntartható vízellátás biztosításának aktuális kérdései. Védelem Tudomány 2, 304–317.

Teknős, L., 2018a. A klímaváltozás, mint új kihívás megjelenése az Európai Unió Polgári Védelmi Mechanizmus feladatrendszerében. Hadtudomány 28, 188–210. https://doi.org/10.17047/hadtud.2018.28.e.188

Teknős, L., 2018b. A lakosság védelmének időszerű kérdései, az önvédelmi képességek jelentősége a katasztrófák elleni védekezésben. Hadtudomány 28, 81–110.

Tschoegl, L., Below, R., Guha-Sapir, D., 2006. An Analytical Review of Selected Data Sets on Natural Disasters and Impacts.

Twigg, J., Overseas Development Institute (London, E., Humanitarian Practice Network, 2004. Disaster risk reduction: mitigation and preparedness in development and emergency programming. Humanitarian Practice Network, ODI, London.

UN, 2015. Sendai Framework for Disaster Risk Reduction 2015 - 2030.

UNDHA, 1992. Glossary: International Agreed Glossary of Basic Terms Related to Disaster Management (DHA/93/36).

Üveges, L., 2002. A Magyar Köztársaság katasztrófa-veszélyeztetettsége és az arra adandó válaszok (Ph.D. disszertáció). Zrínyi Miklós Nemzetvédelmi Egyetem, Budapest.

Worldometers.info, 2018. Worldometers [WWW Document]. URL http://www.worldometers.info/