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Improving resilience of settlements situated in plain areas in relation to inland excess water flood and drought risk

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Abstract

Hungary's vulnerability to water damage is significant, which is also evident in the classification process of municipalities into the disaster management classes. The settlements situated in plain area, the local water damage event generates from inland excess water flood, which protection activity is the responsibility of the municipalities. In the same time drought causes serious damage affecting these settlements. According to the climate change forecasts, water management extremes, including inland excess water flood and drought damage, are expected to increase in Hungary. In order to improve the resilience of the municipalities, we have examined the technical options which reduce the risk of inland excess water flooding and can also reduce the damage caused by drought in urban area, summarized it can improve the water management status of the municipalities. Modern GIS and hydrodynamic models help to develop these measures which greatly improve the resilience of the population in the settlements by providing information to the public. It is the responsibility of public organizations (water management and disaster management) to raise awareness of the vulnerabilities by the municipalities and give advice for possible solutions.

Keywords: inland water, drought hazard, urban water damage, resilience

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Introduction

Due to the morphological, hydrological, geological and soil characteristics of Carpathian Basin, in the lowland areas of Hungary often occurs flood in the rivers and inland excess water floods in wet periods and also drought in periods of water scarcity. Damage caused phenomena could arise significant sometimes, which is also significant for settlements in plain

areas. In this paper the lowlands (Hungarian Plain) have the main role which area is 45% of Hungary, that is about 45 000 km2. [1] [2]

In recent times, experts have identified two main lines for dealing with climate change extremes: avoidance / prevention with primary importance. And since that is often inadequate or insufficient, the main task besides and by parallel is the protection of effects and damage. In addition, it is important to reduce sensitivity, that is, to define the system of activities and tasks to be implemented in order to adapt. [3]

Climate change scenarios in Hungary are predicting the frequency of extreme water cycles. [4] [5] With regard to water damage, it is clear that the formation of inland excess water floods cannot be completely prevented [6], so we must emphasize on reducing its damage and increasing adaptability and resilience. This is a challenge for disaster management and also for water management in terms of defending settlements and preparing the population for protection and prevention in order to improve resilience of the settlements.

The interpretation of the resilience of the settlements can be interpreted from several aspects. This paper deals primarily with the interpretation of the increase of the technical adaptability of the settlements against water damage, which has already been applied in the examination of other technical issues. [7]

Hypothesis:

- In Hungary inland excess water flood is a significant risk factor for municipalities located in plain area, which accentual in classification in the disaster management class.

- Drought has been identified as another water hazard in lowland areas which typically affects the same settlements as the inland excess water flood hazard.

- According climate change scenarios, damage caused by inland excess water flood and drought should be taken into account which is also a major challenge for settlements in plain areas.

- In order to improve the resilience of settlements, for dry and wet periods interventions and protection activity should apply complex solutions which need to be determined taking into account the local conditions of the settlement.

During the research, we aimed to

- *present* the legal basis of the classification system of the settlements disaster management, *reviewing and evaluating* conditions of flood and inland excess water flood as a factor in classification of disaster management, and *introduce* relevant water management professional aspects for classification process,

- *analyze* the emphasis on exposure to water damage in the classification of settlements in plain area belongs to ATIVIZIG operating area, with particular reference to the inland excess water flood and drought situation,

- *exploring* the projections of the expected climate change for Hungary, with particular regard to forecasting damage with occurrence of water surpluses and water scarcity,

- *explore* opportunities for increasing the adaptability of settlements in water management and in protection of inland excess water flood, and *make recommendations* to improve the resilience of municipalities.

The studies and analyzes were performed in connection of competence area of ATIVIZIG[1] due to the available data (as a pilot area of lowland) and also there are data in national comparisons. Having regarded to the fact those municipalities, water management and disaster management organizations all operate in the same legal and economic environment in Hungary, so our results and conclusions can be generalized to the situation of lowland settlements.

Settlements classified in disaster risk classes, importance of inland excess water flood

In this chapter the legal basis of classification methodology of risk assessment will be introduced. We assumed in our first hypothesis that in case of plain area in Hungary the inland excess water flood is a significant risk factor in disaster classification process. At present, drought is not a relevant risk factor in classification in Hungary.

In order to prove this assumption, we analyze water damage hazard in Hungary according classification. We pay close attention to hazard of inland excess water flood which

[1] ATIVIZIG: (acronym of Alsó-Tisza Vízügyi Igazgatóság) Water Management Directorate of the Lower-Tisza District is a public administration organization which responsible for water management and protection of water damages.

is a special risk factor in lowlands of Hungary. The following section presents background of these classifications from the perspective of water management profession.

Classification process of the settlements is based on the law 2011. CXXVIII. law for disaster management and amendments to certain laws relating thereto and its implementing government regulation 234/2011. (10.XI.) and 61/2012. (11.XII.) order of the minister of the interior.[8] [9] [10]

The regularly review of the classifications is the responsibility of the county defense committees and civil protection. The water management directorates[2] which are also involved in the process due to the assessing and reviewing the risks of water damage.

The purpose of risk analysis is to determine with probability - with the help of scientifically based test methods: the size of the areas affected by each hazard and the number of inhabitants; the size of the national treasure and cultural heritage concerned; taking into account of preventive measures; the necessary organizations, resources and capacities needs to be involved in the defense; requirements and level of protection; principles and levels of defense planning. [9]

In Hungary in the 12 risk areas identified 72 risk scenarios have been prepared that take into account the short and medium term effects of climate change. [11]

For the different class of disaster the law provides a well-founded level of protection requirements, assigned set of protection devices for protection of vulnerable communities which includes state aid and co-financing of financial instruments.

Based on the risk assessment, the settlements should be classified as disaster classes: I., II., III. The risk assessment process consists of three steps: (a) risk identification (b) risk analysis (c) risk assessment. Based on the identified risks, measures can be planned to protect the population and property and to minimize the damage. [12]

Factors underlying the current risk classification, such as *elemental strikes, natural hazards* we will examine flood, inland excess water flood, local water damage in settlements, and drought in extreme weather conditions.

[2] There are 12 Water Management Directorates in Hungary which field activity was founded on river basin district

According to the legal[3] requirement, all known hazards must be taken into account in process of risk identification which features the local characteristics and characteristics of the area. In the case in lowland areas, which area is about 45% of Hungary, inland excess water risk appears as a risk factor in almost all settlements. This means 1000 of the 3200 settlements in Hungary. [1] We emphatically focus our analysis on this risk.

The Risk Classification Matrix, according to Government Decree [9], provides an opportunity to evaluate together the occurrence frequency and its threatening effect of each event. [11] [12] The characteristics examined in relation the risk of inland excess water flood events are described below. Statements are based on pilot area experiences of territorial area of ATIVIZIG[4].

Frequency of occurrence:

- Rare: It is unlikely to occur in the next few years (10 years) - whereas that an inland excess water flood situation can occur virtually any time in lowland areas, that category is scarcely used for this methodology.

- Uncommon: it may occur, but it is unlikely to occur within a few (5) years. - In the case of those settlements where were no any registered inland excess water flood phenomenon or protection activity in the last decades, or only one or two occasions, those settlements are ranked into this category.

- Common: it is likely to occur within a few (3-5) years. – According to experiences, this is one of the most commonly used categories in case of settlements located in plain area. In Hungary due to the characteristics of the lowland river basin; inland excess water flood phenomena and protection activity of water damage are very common situations. Literature data and local experience confirm that smaller inland excess water floods occur in every 2-3 years, and larger scale situations can occur in every 8-10 years. [13]

- Very common: It is very likely to occur at least once or more in a year. - In addition to the local conditions of the settlements, the formation of an inland excess water flood (local water damage) situation basically depends on the hydrological occasion. Therefore, even in lowland areas, the excess water flood situation does not occur in every year. Since periods of

[3] 234/2011. (XI.10.) governmental decree
[4] ATIVIZIG. Water Management Directorate of the Lower Tisza District. There are 12 water management directorate in Hungary which public institutions are responsible for water management in Hungary.

rainy weather and water scarcity alternate. By this time it is extremely rare for inland excess water damage situations related to storm events to occur more times in a year. For example in 2005-2006 and in 2010. that occurred at several settlements as we could see in the area of ATIVIZIG. We should draw attention that this situations are predicted by climate change may occur more extreme.

Hazardous effects are classified by the following levels:

- Very Serious: An incident that results in death or irreversible environmental damage, or it has serious financial consequences. – In Hungary inland excess water flood caused serious damage in 1940-42, 1966, 1970, 1999-2000 [14]. These events were followed by large-scale development of the canal-systems.

- Serious: An event that results in serious injury, irreversible environmental damage, or property damage. - In the case of a long-term and large-scale flooding events there is a significant risk of material damage: for example damage of buildings, damage in transport infrastructure, damage occurs in agricultural land. Following major incidents, the State Audit Office investigates the damages, and makes proposal to the state: fe. 2006, 2010-2011. [13]

- Not Serious: An event that results in minor injury, non-environmental damage or no important material damage. - In general, inland excess waters flood phenomena with a lower size of flooding area can be characterized by these parameters. It is often occurs in Hungary, in 2-3 years. [13] [14]

- Low degree: no injuries requiring medical attention or no important financial consequences. - In wintertime, we do not necessarily protect against inland excess water flooding in the agricultural areas, as long as this situation does not endanger damage to other facilities. It is a common situation in lowland areas.

In determining the level of hazard exposure, the worst case scenario should be considered. [11] [12]

As we measured in the area of ATIVIZIG: in the period of a smaller inland excess water flood events the size of flooded area was 80-150 km^2, in serious situations even 400-800 km^2 area was flooded. The ATIVIZIG territory is 86400 km^2, the area with maximum flooding was 1080 km^2 in year 2000. [13]

The water damage protection situations in the last 20 years were accrued in 1999-2000, 2005-2006, 2010-2011. During this period at ATIVIZIG area many municipalities had protection activities against water damage (Summarized 114 municipalities are situated in ATIVIZIG area) is shown in Table 1:

year	number of municipalities in activity of defense damage of inland excess water flood at ATIVIZIG area
2000	64
2005	30
2006	51
2009	56
2010	64
2011	53

1. Table: Number of settlements in activity of defense (ATIVIZIG).

In those years at the same time ATIVIZIG engaged a significant defense activities against the flood of rivers and besides of it inland excess water flood in its operation area.[13]

Based on the risk assessment introduced above, we have investigated the hazard of inland excess water flood at the ATIVIZIG operating area. The following figure summarize the 114 municipalities on the basis of cumulative risk, flood risk and inland excess water flood risk assessment. Table 1 shows the results of the classification of the settlements classification according to the order of the government [9] in the area of territory of ATIVIZIG .

Disaster Risk Class/	Disaster Risk based on a cumulative risk assessment		Elemental strikes, hazards of natural origin		Elemental strikes, hazards of natural origin	
			flood protection		**inland excess water flood protection**	
Settlements Nr./%	Nr	%	Nr	%	**Nr**	**%**
I. Disaster risk class	9	7,9	1	0,9	3	2,6
II. Disaster risk class	38	33,3	28	24,6	37	32,5
III. Disaster risk class	67	58,8	9	7,9	58	50,9
No risk	0	-	76	66,7	16	14
Summarized	**114**	**100**	**114**	**100**	**114**	**100**

2. Table: The results of the classification of the settlements classification according to the Order of the Government 234/2011. (XI. 10.) at the area of territory of ATIVIZIG (made by the authors)

Based on the analysis, we can see the two identified water hazard risk elements that flood risk is identified in 38 settlements (33%) and in 76 settlements there is no flood risk. While there is identified the inland excess water flood risk in 98 settlements (86%) and in 16 cities there is no risk. According accumulated disaster risk classes and inland excess water risk classes we have found that 3 settlements in class I., 37 settlements in class II. and 58 settlements in class III. have been classified.

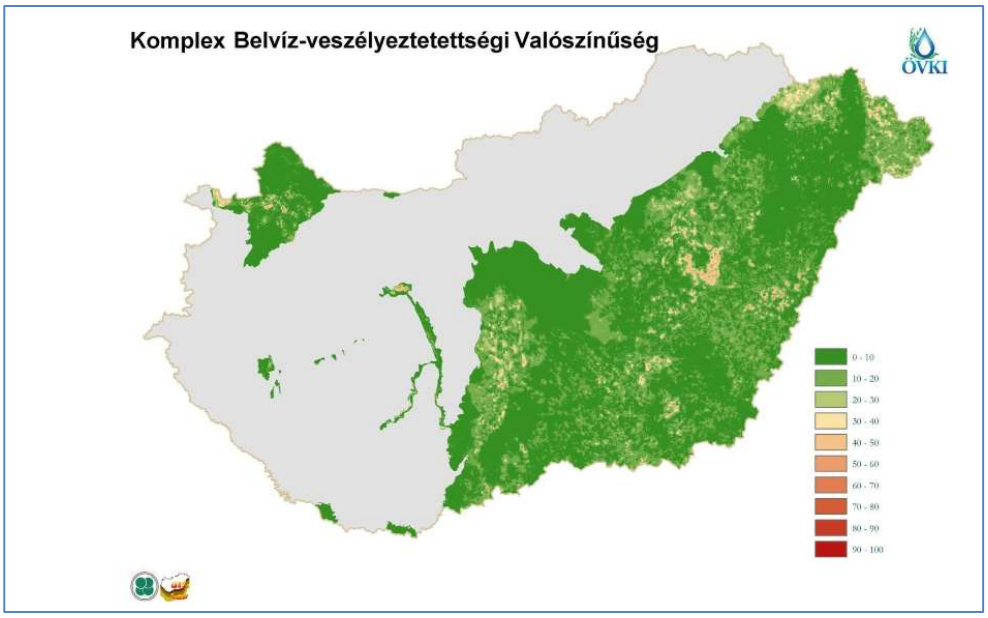
Summarized it comes out in case of settlements are in plain areas, the risk of inland excess water flood is a significant hazard, so attention should be paid to the municipalities activities in preparation and protection against inland excess water flood risk and improving resilience of settlements to this hazard.

The professional background of inland excess water flood hazard and risk

In this chapter we examine in detail what kind of considerations have been used to base the water risk assessment which used for risk assessment needs for the Disaster Management Act.

Directive 2007/60/EC of the European Parliament and of the Council on the assessment and management of flood risks, the legislation requires Member States to develop preliminary risk assessments, flood hazard and risk maps and measures to manage and reduce flood risks.

National implementation tasks in Hungary are set out in Government Decree 178/2010. Regulation. In Hungary, with the coordination of the National General Directorate for Water Management, this work began in 2010. [13] [15] Due to the specific features of the country, the work included managing inland excess water flood risks in addition to flooding. Complex Inland Excess Water Flood Hazard Probability Map of Hungary was prepared in the risk mapping work (Figure 1).



1. Figure: Complex Inland Excess Water Flood Hazard Probability Map of Hungary [15]

The definition of vulnerability caused by inland excess water flood for different areas has been a constant professional and social demand also for earlier decades. There were elaborated professional considerations, which came out as legislations and mapping. It served as an up-to-date background for the water management service's task for estimating disaster management risks.

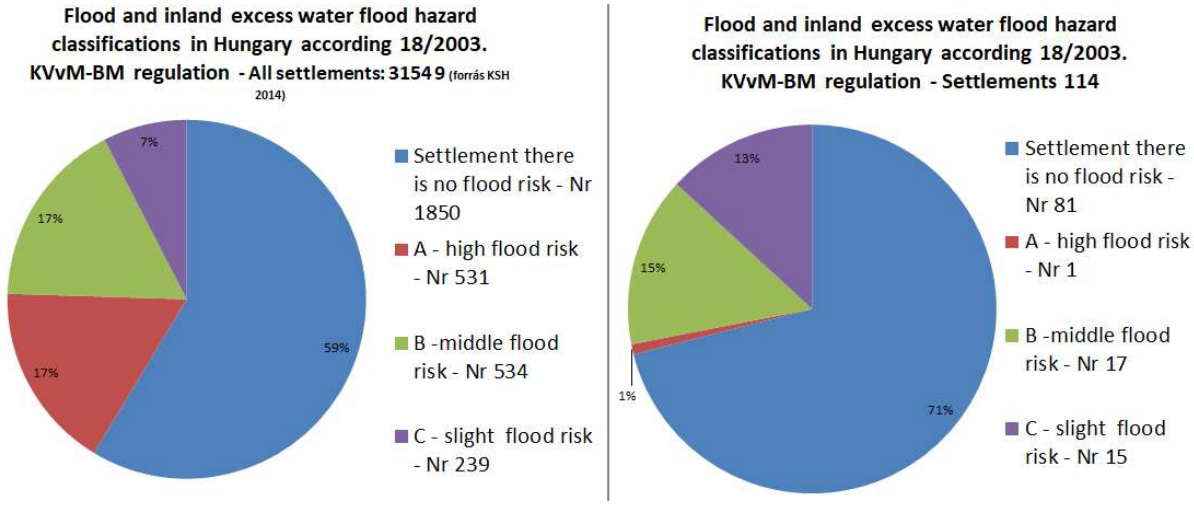
These professional considerations are going to be introduced below. It is also emphasized that in addition to the inland excess water flood hazard, the water management governance has already considered the risks of water scarcity. [14] We show that areas exposed to inland excess water flood risk are similar to drought hazards in periods of water scarcity.

First of all we examine the legislation background. Flood and inland excess water flood hazard classifications of the municipalities were issued by Decree 18/2003. KvVM-BM. [16] It gives a 3 classes for the hazard degree. From the point of view of inland excess water flood hazard is need to mention that during a long term flood[5] waters leaking under the dike that can cause high groundwater level in protected side. These phenomena can cause inland excess water flood in wet periods.

[5] In Hungary there are dikes along the rivers. In case of flood means a high water level which flows down between the dikes and there is no inundation in the protected side.

There are 3154[6] settlements in Hungary, 1850 of those settlements are not endangered (59 %) and 1305 (41 %) of those settlements have flood vulnerability.

Of the 114 settlements in the area of operation by ATIVIZIG, there are 81 settlements which are non-endangered (71%), and there are 33 settlements endangered (29%). We can determine there are less settlements threatened by flood risk at ATIVIZIG area, than the national rate. But we have to emphasize that at the lower Tisza district the flood periods could take a long time (from some week to two-three months) and the water level could rise slowly but keeps on high level for a long. This is the deepest part of Hungary and there are the highest dikes in the country. Those 33 settlements at ATIVIZIG area are highly threatened also by inland excess water flood than those which are farther from the rivers. The vulnerability is shown graphically in Figure 2, both nationally scale and for the ATIVIZIG operating area.



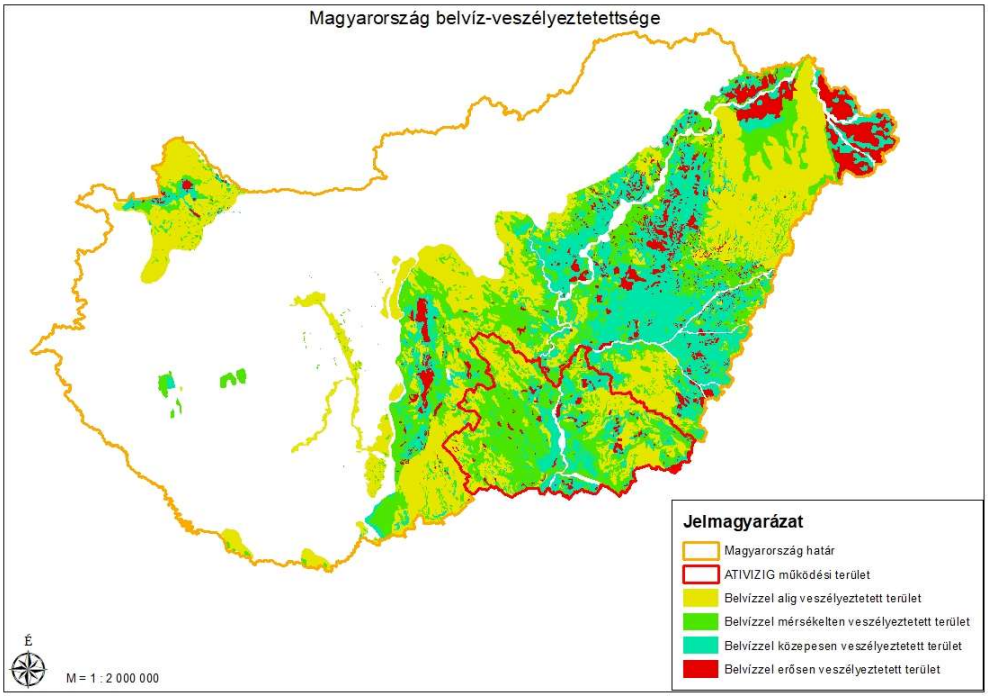
2. Figure: Flood and inland excess water flood hazard classifications in Hungary and at ATIVIZIG according 18/2003. KVvM-BM regulation (made by authors)

The professional need for estimation of the territorial vulnerability due to the extreme hydrological situation and its numerical indices (mapping) resulted development the map of the inland excess water flood hazard and map of the drought-zones for Hungary.

In the 1980' period was developed the Pálfai's Inland Excess Water Hazard Map for the water sector which took into account the spatial characteristics (hydrometeorology, topography, soil, geology, groundwater, land use and the results of earlier territorial floods) and based on

[6] KSH (Central Statistical Office of Hungary) Data of Hungarian settlements http://www.ksh.hu/docs/hun/xftp/idoszaki/mo_telepuleshalozata/varosok_falvak.pdf

the data collected by water management directorates about the earlier event of inland excess water flood. [14]



3. Figure: Pálfai's Map of Inland Excess Water Flood hazard in Hungary with ATIVIZIG operational area (degree of inland excess water hazard: yellow:slightly, blue: moderated, red: highly) [14]

It is important to note that Pálfai's hazard map can only be interpreted in relation to the periphery because applied considerations! However, the characteristics and the vulnerability of inland excess water flood of the surrounding areas naturally has affect to inner area of the settlements, so vulnerability has to be taken into consideration in any case during examination of the susceptibility genes of the settlements.

According the Pálfai's hazard map there is inland excess water flood in the surroundings of the 114 settlements at ATIVIZIG area, rate of hazard by settlements is given in Table 3.

The environment of the settlements is characterized by the Pálfai's inland excess water flood hazard at ATIVIZIG area	Settlements No.	Settlements %
no hazard	3	3
slightly endangered	58	51
moderately endangered	48	42
highly endangered	5	4
Summarized at ATIVIZIG	**114**	**100**

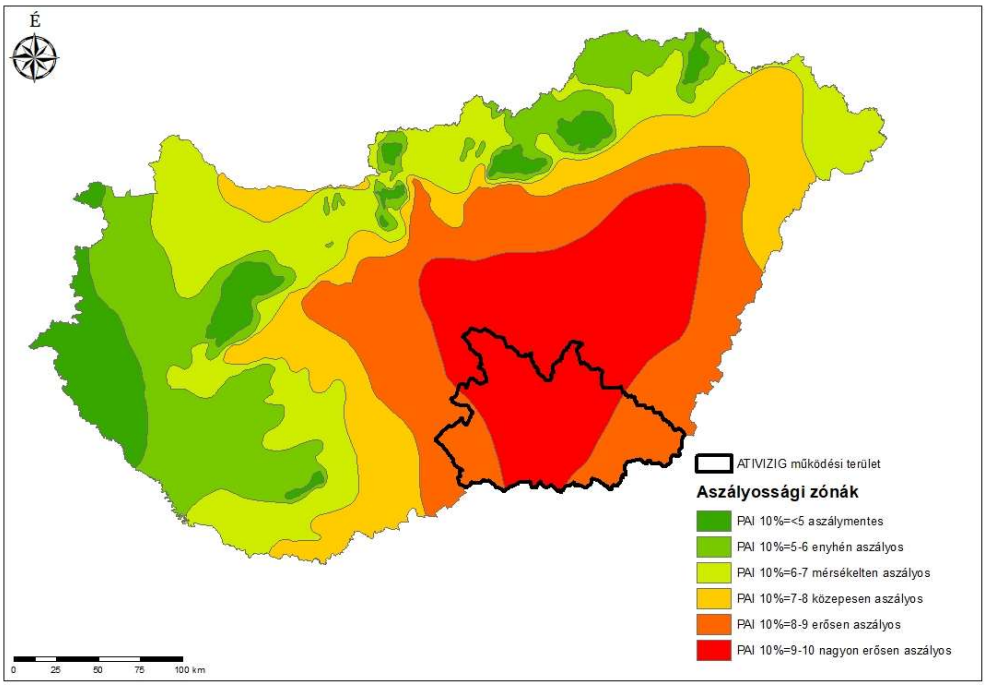
3. Table: Surrounding of settlements by Inland excess water flood hazard at ATIVIZIG area

In summary it can be stated that in the case of the assessment and evaluation of the professional background of water management and the disaster management risks, the inland excess water flood presents a significant risk in the case of settlements in plain areas, while the risk is higher in the settlements along the river.

In the previous chapters, we have presented and evaluated the inland excess water flood considerations on the disaster management class in respect of the Hungarian settlements. Our research and analysis support the emphasis of inland excess water flood hazard in Hungary, thus confirming the hypothesis that it a significant risk factor for the classification of the disaster management of settlements.

With regard to the vulnerability and resilience of the settlements, we need to examine not only the vulnerability to floods, but also to the drought vulnerability of water scarcity periods. For this purpose we use the Pálfai's Zonal Drought Map for Hungary in Figure 4. (Green shows area with no risk, red shows very strong risk of drouht.) [14]

The map shows that Hungary's exposure to water scarcity periods is still significant. The areas (the Great Plain, especially the area of ATIVIZIG) where we analyzed inland excess water flood hazard there are also classified as intense (very strong and strong) drought zones. At present, drought as an incident does not fall directly under the responsibility of disaster management, but indirectly, such as more frequent forest fires are definitely included.



4. Figure: Pálfai's Drought Zones Map of Hungary with ATIVIZIG area [14]

PAI 10%	<5	no drought risk	PAI 10%	7-8	medium drought
PAI 10%	5-6	mild drought	PAI 10%	8-9	strong drought
PAI 10%	6-7	moderate drought	PAI 10%	9-10	very strong drought

The map shows that Hungary's exposure to water scarcity periods is still significant. The areas (the Great Plain, especially the area of ATIVIZIG) where we analyzed the present of inland excess water flood (see Figure 1 and Figure 3) there are registered drought zones too.

At present, drought as an “incident” does not belongs to directly responsibility of disaster management, but indirectly, such as more frequent forest fires are definitely included.

"Combating extreme water management conditions (flood protection, inland excess water flood protection, drought protection) requires significant cooperation in Hungary, but it is particularly important in the Great Plain and in the Tisza Basin." [17, 214]

To sum it up the settlements are endangered both by inland excess water flood and by droughts, especially in the Southern part of Hungary (Hungarian Plain) and at the ATIVIZIG area. The examination of the resilience of settlements requires consideration of these factors.

Let's look at how these two major risk factors evolve in relation to climate change.

Expected impact of climate change on water management in response to water surges and water scarcity: floods, inland excess water floods and drought

Studies related to the National Climate Change Strategy show that extreme weather events will be more frequent and intense. [5]

Most of the climate forecasts and different scenarios indicate an increase in temperature and a dehydration of the climate in Hungary and in the Carpathian Basin for the 21st century With seasonal variations, significant spatial variations can be expected in all seasons with increasing temperature, especially in the Great Plain. And similarly, there will be a seasonal variation in annual rainfall, which will, with significant seasonal shifts, decrease overall (with an increase in rainfall during the winter period). " [17]

The urban environment would be mainly affected by the sudden intensive rainfall in a short term which means problem for the urban sewerage system, because it is not able to take the increased load. In addition, paved surfaces accelerate assembly, which also requires greater drainage capacity. Climate change is expected to increase the incidence of these heavy rain and besides in recent decades paved surface areas has been significant increased, it is also predicted that water-systems capacity will be insufficient which will cause more floods. [4] [7] [17]

The appearance of water also will change in time: longer dry seasons are expected. The amount of summer precipitation is going to decrease significantly, which also leads to the disappearance of smaller streams. The amount of rainfall and its intensity shifts seasonally. The infiltration of the intense precipitation is limited, which increase the amount of drainage water, which can cause an inadequate drainage capacity. Evaporation will increase due to higher air temperatures. Vegetation period change would increase drought. [4] [18]

The formation of inland excess water floods depends on significantly from the groundwater level. Climate change also will affect the quantity and quality of groundwater. During the dry periods, groundwater is expected to decrease mainly in the Great Plain, due to both a lack of rainfall and an increase in irrigation water demand based on groundwater resources. This also has a negative impact on water-dependent ecosystems. In the central areas of the Great Plain drought is going to appear in nearly one third of the next 100 years. [17]

Researchers agree that the risk of flooding and inland excess water flood is increasing with water cycles extremes, and droughts are expected to intensify. Loss and harm caused by water damage will increase. [4] [7] [17]

From the point of view of increasing the resilience of the population to water damages, it has to be figured out joint management systems for damage caused by water scarcity and damage caused by inland excess water flood in the context of current and future extreme water cycles. Damage only can be minimized with complex and flexible water management solutions.

Examination of other factors in urban areas affecting the resilience of settlements concerning water damages

According to our hypothesis, interventions promoting resilience can be defined by considering the conditions of the settlement. In this chapter we examine what factors influence the inland excess water flood and drought situations in the settlements.

In Hungary the local governments has the right and responsibility [7]to control water damage in the territory of the city so it is extremely important for municipal decision-makers to be aware of the vulnerability of downtown. Also they must know the identified of the potential impacts on urban area water management conditions that may also affect the extent of damage.

First of all the condition of surroundings of settlements has to be examined. The Pálfai's Inland Excess Water Hazard Map (see Figure 3), the map of Hungary's Complex Inland Water Hazard Probability Map (see Figure 1) and the Pálfai's Drought Zone Map of Hungary, which maps shows primarily considerations for outer areas (agricultural fields) but summarize very well the natural factors in a very illustrative way.

In urban areas anthropogenic factors overwrite natural processes! There are many anthropogenic factor in urban areas: infrastructure, covered/paved areas, structure of the city, land uses, density of installation, etc. One of the most characteristic anthropogenic influences on the state of water management in urban areas is the water utilities: state of development and condition Effects of these facilities were investigated in terms of effect on inland excess water hazard and on drought hazard. Our analysis is set out in the table 4.

[7] 1995. LVII. act , 232/1996. (26. XII.) Government Regulation, 10/1997. (17.VII.) KHVM regulation

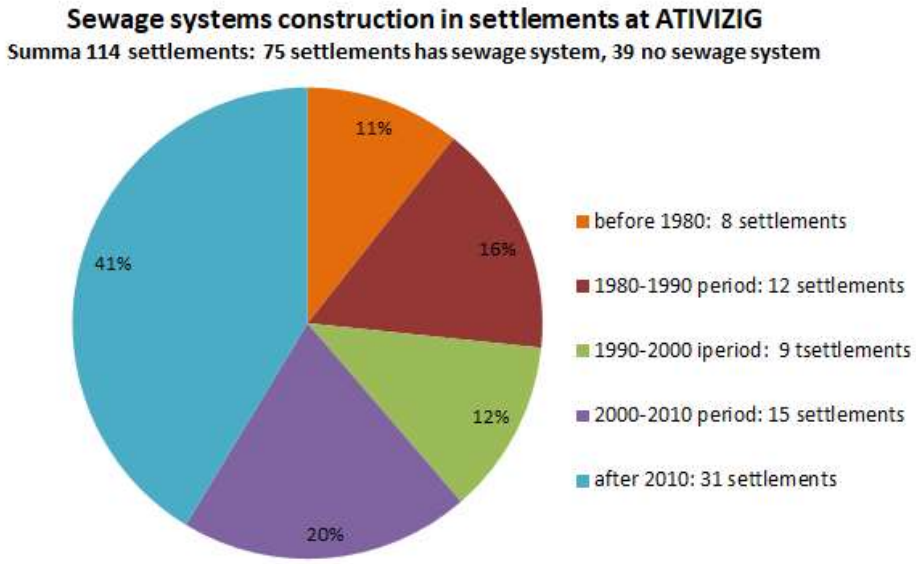
Anthropogenic effects (technical installations)	Effect on damage caused by inland excess water flood		Effect on damage caused by drought	
	Effect	**Explanation**	**Effect**	**Explanation**
Drinking water supply	Good technical conditions - *no effect*	No infiltration or exfiltration.	Good technical conditions - *no effect*	No infiltration or exfiltration.
	Bad technical conditions - *increasing effect*	Drinking water can discharge into the soil causes a high groundwater level in urban areas. It reduces the free capacity of the soil, no place for infiltration.	Bad technical conditions - *decreasing effect*	Systems in bad condition can have significant infiltrations that can increase the groundwater level. It is a very expensive method supply groundwater resources.
Rainwater drainage system	Good technical conditions - *decreasing effect*	A canal system in good technical condition drains rainwater and reduces the risk of flooding.	good technical conditions - *increasing effect*	Canal system in good technical condition drains all rainwater (not only that cause damage). It will increase drying process.
	Bad technical conditions - *increasing effect*	Insufficient capacity of drainage system can cause flood.	bad technical conditions - *no relevant effect*	Protection activity will concentrate to eliminate floods in a short time, so no relevant effect those floods on drought.
Sewerage system	Good technical conditions - *decreasing effect*	Wastewater discharges into the soil causes a high groundwater level in urban areas (wastewater slope). It reduces free capacity of the soil infiltration. The sewerage system collects waste water and drains.	Good technical conditions - *no effect*	No direct effect on drought.
	Bad technical conditions - *increasing effect*	Systems in bad condition can have significant infiltrations that can cause groundwater growth.	Bad technical conditions - *decreasing effect*	Systems in bad condition can have significant infiltrations that can cause groundwater growth *but it pollutes groundwater resources.*
Concentrated discharges of wastewater treatment plants into temporary water-systems	Discharge - *increasing effect*	Discharge means overload the canal-capacity and the nutrient load causes overloads vegetation in canals.	Discharge - *decreasing effect*	Treated /cleaned waste water means water supply possibility.

4. Table: Anthropogenic Factors Affecting the Inland Excess Water Flood Hazards and the Drought Damage Risk in the Urban Environment (Created by authors)

Generally it comes out that most of the situations mentioned above which decrease the inland excess water flood risk that would increase the drought damage, and opposite, which

decrease drought damage will rise inland excess water flood hazard. So from the point of urban area resilience it must be consider all that situation for planning measures in water management system.

In the lowland urban areas one of the most important factor on formation inland excess water flood is the wastewater infiltrations into the soil, which causes high groundwater levels. [14] For this reason we examined the development of construction of municipal sewage systems by periods in ATIVIZIG area which is introduced in *Figure 6*. A large extent (41%) become after 2010, thanks to the National Sewage Program. It was based on measures of the River Basin Management Plan of Hungary prepared on the Water Framework Directive. [18] [19] By implementation of sewage program in urban area, all settlements which larger than 2000 population equivalent are supplied by sewerage, so the infiltration comes from sewage load has decreased.



5. Figure: Sewage system development in ATIVIZIG area (Edited by authors)

Based on the above, in ATIVIZIG area there is significant improvement in sewerage situation in the settlements. The harmful infiltrations which caused high groundwater level in the urban area have decreased which also decreases the possibility of formation of inland excess water flood.

Changed land use in settlements has very important effect on origin of inland excess water flood and drought hazard. Important factor of it is the ratio of paved surfaces which does not allow local infiltration but increases the capacity of rainwater drainage by runoff. Increased paved areas have led to increased flooding and damage in many places. [7] [20] Another

important factor is losing green area in urban area, manly those deep areas which become often water-covered as natural basins in wet periods. Our examination of the main anthropogenic effect is summarized in Table 5.

Anthropogenic effect	Effect on damage caused by inland excess water flood		Effect on damage caused by drought	
	Effect	**Explanation**	**Effect**	**Explanation**
Lowlands are built into (loosing natural storage area)	Increasing	There is no space for temporary storage of water, and the area suitable for infiltration is reduced increase the amount of water collected.	Increasing	There is no space for temporary storage of water, the area of infiltration is reduced, the water is drained, enhances the drying process.
Paved surface increasing	Increasing	No rainfall infiltration, the amount of water discharged increases, the collection of water accelerates, which results insufficient capacity in the existing water system.	Increasing	The infiltration area is reduced significantly increases the drying process.

5. Table: Anthropogenic effects in urban areas on inland excess water flood and drought damage (edited by authors)

It can be stated, that the factors affecting the water hazard situation in urban areas are unique due to the anthropogenic effects even with similar natural conditions: some settlements have a sewage network, while the other ones does not have, also a built-up deep-lying area can fundamentally change the hazard in urban area.

We can confirm our hypothesis that interventions promoting the resilience of municipalities can be determined on the basis of their vulnerability, which is, after individual consideration, taking into account the characteristics of the settlements.

Improving the resilience of municipalities based on water management considerations

There are many interpretations of *resilience* in the literature. [21] Resilience is fashionable particularly with scientist, administrators and international authorities in charge of preventing disasters. [7]

In this article, we interpret the resilience of settlements as “to face devastating event reducing damage at minimum” [22] which we apply for water damages. That means, that their

reactive ability to successfully adapt to strong, renewable, or even shock-like external influences.

The theme is important in connection with the activities of NGOs. We draw attention in this regard to the Red Cross Community Resilience in Urban Areas (CRUA) project, which aims to develop methodologies for preparing flood-prone populations in cities, to internationally compare population resilience activities, and to identify good practices because uncertainty causes the most stress. [23]

In the context of water resilience of settlements which is expressly stated climate adaptation options which has a wide publication background by know. [20] This is closely related to the topic we are discussing, adaptability and resilience are mutually reinforcing.

Climate scenarios reinforce the appearance of inland excess water flood hazard and drought hazard, what's more as we introduced lowland areas are most vulnerable from both effects, so improving resilience requires common solutions. Concerning flood hazards, resilience concepts are comprised of individual preventive and emergency measures at building scale and a land use policy to adapt building activities to floods. [7]

Let us examine what kind of flexible tool system and solution in water management are available for settlements implementing to handle anthropogenic effects outlined in Table 5. mentioned above.

In Table 6. there are given possible measures for different anthropogenic factor and beside of it is shown the impact on the resilience of settlements. The leaders of the settlements must know what kind of effect has their decision in different situations because *uncertainty causes the most stress.*

Anthropogenic factors in urban areas affecting the risk of inland excess water flood and drought	Possible measures	Impact on the resilience of the settlement
Rainwater drain/canal-system	Transform (reconstruct) rainwater drainage systems should primarily ensure the discharge of harmful water, and smaller rainfall need to keep in place and maintain to absorb.	Drainage of harmful water prevents flooding of inland water. For drought period local water resources remain which reduces the drying process.
	It is necessary to maintain good technical condition of canals. It should manage intended floods into a planned area for water retention purpose.	At planned flooding sites, there rainwater has time for infiltration without or with less damage. Reduces the drying process.
The municipal sewage system.	Efforts should be made to collect and treat untreated wastewater in larger settlements (bigger than 2000 inhabitants) and it is economical.	Cleaned wastewater is available and recoverable local water resource.
	Cleaned sewage can be infiltrated in small settlements depending on local conditions and economical.	During periods of drought, the water resource remain in place so the drying process can be slowed down.
Drinking water supply	Due to the principle of sustainable development, the use of drinking water should also be speared.	The good technical condition of drinking water networks serves sustainable development.
Concentrated discharges of wastewater treatment plants into water (canal) systems	Well-cleaned municipal wastewater appears as recoverable water. The municipal utilization of this is gaining in importance due to the decrease of water resources.	Separate and divide from canal system and keep water in place. The availability purpose of water resources depends on local characteristics. Slows down the drying process.

6. Table: Possible measures and impact on the resilience in connection of anthropogenic factors (edited by authors)

Possible measures are negotiated above can be performed in the settlements water management systems, all those are technical solutions.

We have examined the possible measures and their impact on the resilience of the settlements from the point of land uses which is the most powerful activity for urban areas, it is detailed in Table 7.

Anthropogenic factors – land use in urban areas affecting the risk of inland excess water flood and drought	Possible measures	Specific proposals for intervention Impact on the resilience of the settlement
Built-in of deep (low) areas	Loosing previous natural reservoirs new places necessary to store water. Establishment of water retention and infiltration fields (reservoirs) to reduce inland excess water flood and drought damage in urban areas.	At controlled flooding fields, rainwater has time to infiltrate with no or minor damage. Reduces the drying process. Development of areas suitable for flooding: e.g. among other functions playground, football field, parking - in rainy weather could play as a water reservoir
Increased covered areas	For decreasing inland excess water flood and drought damages important to develop floodplain areas and runoff should be slowing down to reduce peaks. We have to avoid prevent system from overloads.	Application of permeable pavements, demolition of existing pavements, development of parks, green surfaces. Establishment of residential individual reservoirs.

7. Table: Possible measures and specific proposals for intervention according land use in urban areas for improving resilience of settlements (edited by authors)

Summary

In Hungary, inland excess water flood presents a significant risk for the settlements situated in plain area. At the same time, the damage caused by periods of water scarcity afflicts almost the same cities. According to climate change forecasts, periods of water abundance and water scarcity will increase further extremes, so in the future risk and damages of inland excess water floods and drought would increase in Hungary.

During planning and developing the resilience of settlements for water damages, complex solutions should be applied that reduces both damage caused by periods of water scarcity and flooding. The major challenge is preserving the water amount of water-rich periods without causing damage for drought periods. We summarized those proposed technical solutions for municipalities in this paper which can help improve settlements resilience in water management. These solution proposals are in harmony with the EU Water Frame Directives guidelines and with the measures and recommendations of Hungarian River Basin Management Plan. [19]

It is very important to emphasize that the adaptability and resilience of a settlement depends on the local characteristics and environmental conditions. Therefore for optimal and effective solutions have to be determined by examining the conditions of surroundings and inside the

settlements. The municipalities need to be aware of these features in order to feel the problems themselves and to play an active role in the solution.

Hydrodynamic models based on IT and GIS systems provide an extremely good opportunity to develop optimal solutions which, combined with meteorological forecasting systems, can greatly help improve the resilience of communities to water damage. [7] [24]

Professional organizations, as water management and disaster management directorates play an important role in providing necessary information. In this paper we attended to draw attention to the need for a complex approaches to water management issues: inland excess water flood and drought.

We close our paper with the thought of Jenő Kvassay[8]: "Do not allow life-giving water to flow unavailingly out of your household, out of your land, because it is a gift of God."

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Hazards and occupational safety of firefighting interventions

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Abstract

Some hazards of the civilian work, the firefighting interventions and the consequences of the work accidents are similar. The biggest difference is in the formation of the work environment. There are many aspects of occupational safety in the formation of work environment in case of civilian activities, while there is little opportunity for this at the site of firefighting interventions. In the paper, the authors present the general hazards of work, the effects and predictability of the work accidents, and examine how firefighters can prepare to prevent them.

Keywords: occupational safety, source of danger, accident, increasing safety

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1.Introduction

Most sources of danger arising during firefighting operations are the same with the possible dangers of specialized fields. Of course, during firefighting interventions, unlike civilian workplaces, not all work processes can be pre-planned and executed. In this article, we analyze the general sources of danger with which are most frequently faced by firefighters - similarly to civil workplaces – which are fire incidents and technical rescues. In addition, we will examine various threats and some options on how we may provide protection against them.

1.1 The emergence of dangerous work environment

Unlike civilian activities, during firefighting interventions, we do not create the environment for the task to be performed, but the interveners adapt to the work to be performed, during which there is little opportunity to change the environment to a substantial extent. The other factor is forced decision-making under the pressure of time, during which the greatest effort of the leader of the intervention is to make such decisions that may ignore the classic occupational safety rules, so that the rescue team may have a larger percentage of having a successful operation [1].

1.2 Occupational safety responsibility

The professional fire department is the local body of the professional disaster prevention agency. Based on this, the professional fire department is a law enforcement agency, so those who choose the profession know that they must risk their physical health or even their lives while performing their duties [2]. This clearly indicates that both the state (the Parliament as a legislator) and those practicing the profession are aware that the working conditions, in terms of occupational safety, differ from the ideal state [3].

However, it is important to note that a distinction must be made between necessary and unnecessary risk taking in all cases. Both parties should try to minimize the danger as much as possible, in order to avoid accidents with even serious injuries.

2. Occupational accidents and occupational safety

Before presenting the topic in more detail, it is advisable to explain the basic concepts. Accordingly, below we provide a brief interpretation and systematization of the necessary concepts. The definitions, sources of danger, tasks related to occupational health and safety are regulated at the legal level [4], on the basis of which our concepts can be defined.

2.1 The definition of accident

An external impact that occurs suddenly or within a brief period of time, outside of the victim's will, which can cause injury(s) or death. It should be noted that the injury may not only be physical. These include various poisonings, psychological effects, in fact any factors resulting in health damage.

2.2 An accident that occurred during or in connection with the work, regardless of the location and time, as well as the influencing factor of the injured (employee).

Since the accident mustn't necessarily take place at the workplace, this also includes accidents that occur during the performance of work-related tasks (transportation, material handling, etc.).

2.3. Sources of danger

All factors that pose a danger during work or related tasks, i.e., the root causes of accidents and work accidents.

Physical hazards: work tools; imbalance of structures, slippery surfaces; sharp, burred surfaces, edges, corners; temperature of objects; level difference; weightlessness; lighting; electricity; aerosols, dusts in the air; air flow, pressure, temperature; air humidity, ionization; noise, vibration; infrared and ultrasound; particle radiation; electromagnetic radiation.

Hazardous substances: hazardous substances and mixtures.

Biological hazard sources: microorganisms; macroorganisms.

Psychic sources of danger: physiological dangers; excessive stress on the nervous system and psychological stress.

2.4. Occupational safety

Occupational safety is a complex preventive, constantly actively present and control system. Its purpose is to create appropriate working conditions and to regulate work in order to avoid accidents. It investigates work accidents that have occurred, which gives an opportunity to prevent them from happening in the future, and also collects information to achieve more effective protection against individual sources of danger [5].

3. Effects of work accidents

Work accidents have an impact on society as a whole, not only on the individual, but on his/her workplace as well. We can arrange the impacts into three, clearly separable, but still intertwined groups.

The first is the affected person. After the accident, you find yourself in an unexpected physical and/or psychological condition that may extend beyond the duration of medical care. It can be stated that any accident brings with it changed circumstances for the person who suffers it.

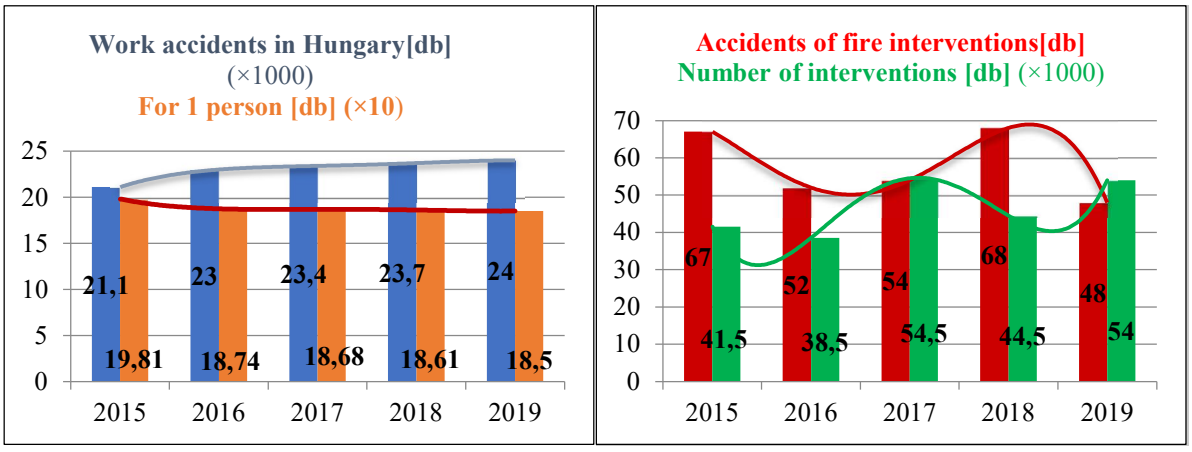
During his inability to earn, in addition to the difficulties of recovery, his financial resources will also become scarcer, and the burden of possible care at home will also be extended to his family members.

The second is the workplace. The employing organization must temporarily replace its employee for the duration of the medical leave. This is especially critical if the task requires specifically trained, specialized knowledge.

The third is society. The costs of medical interventions and medical treatments after the accident are paid by the state, i.e. society. In addition to the financial expenditure, the use of the health system - its entire personnel and material resources - increases during care [6].

3.1. Number of work accidents in recent years

Based on the data concerning the entire country, we conclude that, unfortunately, the number of work accidents shows an increasing trend every year. Of course, this is also greatly influenced by the number of employees. In 2015, looking at the average of the quarters, the number of economically active people was approximately 4.2 million, which rose to 4.4 million in 2019. Knowing these data, analyzing the extreme columns and values of the examined period read from Figure 1, it can be concluded that the number of work accidents per person decreased from 198.1 to 185 in 5 years. The prognosis that can be deduced from the data is that the annual number of work accidents is directly proportional to the number of employed persons, which shows an improving tendency over time, albeit to a small extent, compared to the number of employed persons per person.



1. Figure: Work accidents and fire interventions in Hungary. source: [7] [8] [9].

Compared to the national situation, the number of accidents that occurred during firefighting interventions shows a fluctuating trend line. To analyze this, it is not appropriate to examine the regularized number of professional disaster protection agencies, because its number is stagnant, i.e., from the point of view of statistical analysis, there is no significant change. For this, it would be reasonable to consider the number of interventions, however, there is no mathematical relationship between the number of accidents and the injuries that occurred, which is excellently represented by the trend lines (Figure 1). The nature and type of the interventions could be further investigated in order to find the connection points, but this is not the purpose of our analysis.

On the basis of the above, from the comparison of the number of firefighting interventions and the number of accidents that occurred, we draw the conclusion that the avoidance of occupational accidents requires a different, more thorough and stricter attitude than in the civilian fields, both from the employer and from the workers at the site of the accident, since even that hypothesis cannot be established that conclusions can be drawn from simple statistical indicators. The reason for this is that in order to avoid work accidents, the general occupational safety mechanism cannot provide a comprehensive solution for the protection of firefighters.

4. Possible measures of enchancing security

Based on the previous two chapters, it is logical that findings concerning work safety are related to firefighting interventions. On one hand, the work environment cannot be adapted - only to a small extent - to carry out firefighting and technical rescue tasks in accordance with the classic work safety requirements. On the other hand, the direction of the number of accidents that have occurred is random, and it is not possible to create a simple vision of the future from the events of the past.

During the workplace risk assessment - which is regulated by Act XCII of 1993 on occupational safety - is determined by law [4] and it is the employer's duty to prepare it - special attention must be paid to the assessment of unavoidable hazards and a solution must be found that provides the safest solution for the most frequently occurring situations [10]. The BM National Directorate General for Disaster Prevention (hereinafter: BM OKF) fulfills its obligations in its Human Regulations, in which it defines, among other things, the BM OKF's Occupational Safety Regulations, for which bodies with territorial status prepare their own regulations and risk assessments as well [11]. However, it is important to note that this basically applies to structures and work tools used by disaster management agencies.

It follows that a great deal of emphasis must be placed on increasing work safety, including non-identifiable hazards. In the field of firefighting, this critical point is difficult to record in regulations, but this does not mean that it is not possible to prepare for their elimination.

The possibilities of increasing safety during the performance of the fire protection tasks of the rescue can be divided into five large groups, which together can serve the set goal, i.e. accident-free work. These basic subjects are protective equipment, training and exercises, avoiding the harm of a dangerous environment using modern technologies [12], workplace preparation for psychological stress; development of appropriate procedures [13].

4.1. Personal protective equipment

The function of personal protective equipment is to protect its user from one or more sources of danger. If the technically designed protection (covering, railing, etc.) does not provide comprehensive safety, it is possible to supplement it with these. The general grouping of personal protective equipment is adapted to the parts of the body to be protected: head protection devices, face protection devices, eye protection devices, hearing protection devices, protective gloves, foot protection devices, protective clothing, respiratory protection devices.

Personal protective equipment issued to individuals used by the fire department is as follows:

- protective gloves (for fire),
- protective gloves (for technical rescue),
- protective clothing (jacket and trousers),
- protective helmet (with face shield and helmet),
- protective hood,
- protective boots,
- climbing belt (with demolition ax and hose rope);

Personal protective equipment designed for car syringes:

- breathing apparatus (breathing mask),
- rescue mask or rescue hood,
- chest pants (fisherman's boots),
- electrically insulating protective gloves,
- oil- and acid-resistant rubber gloves,

- rescue rope,
- noise protection earplugs,
- dust mask [14].

It is clear from the systemized protective equipment that they provide protection against a significant number of sources of danger. However, it is possible to achieve the best efficiency during their use if the user has the appropriate knowledge. To do so, a firefighter should know which device provides protection against exactly which threat, and he should also know the limitations of the devices.

The employer is obliged to take care of the possibility of acquiring the necessary knowledge (within the framework of occupational safety training), and the employee is obliged to attend these trainings.

4.2. Training and exercises

In the training of firefighters, a lot of emphasis is placed on exercises. This can be seen in Firefighter II. also, in the professional and exam requirements of subspecialty qualifications, according to which practical make up 65% of the training [15]. The reason for this is that the firefighting profession is a particularly practical profession. The sub-actions of the performed tasks are linked to a practiced, routine methodology. This is realized in a complex system of tasks, which includes, among other things, assembly tasks (e.g.: tasks corresponding to the rehearsed schedule based on the assembly regulations; bindings, rope technology; assembling ladders, etc.) and the use of technical tools (e.g.: motorized chain saw, high-speed chopper, tensioner-cutter, fan, etc.) [16].

In accordance with this, the General Director's Order on the practice system of the BM OKF was issued, which distinguishes the following types of practice: driving practice, assembly practice, fire extinguishing technique operator practice, local knowledge training, situational practice, firefighting practice, other practice. All of these are built on each other, which ensures the acquisition of a routine within a controlled framework [17].

In parallel with the complex training system - based on the provisions of the same measure - daily training is also held in the firefighting barracks. These include the basics of acquiring theoretical and practical knowledge, as well as maintaining them at an appropriate level. Then a specific, typified intervention will be taught, as well as the critical points, rules of use, and

occupational safety regulations of the protective equipment, technical equipment, and other equipment used during the exercises.

Since the training and exercises take place daily, the continuous training of the intervention staff can almost be regarded as schooling. Based on this, as well as the experiences gained during interventions - which leave a deeper impression for psychological reasons - they ensure that the members of the standby staff can meet the different solution patterns in order to recognize the patterns with possible solutions in the partially unknown (every damage is different) work environment the fastest and safest form of intervention possible.

4.3. Modern technological application

All devices that are currently being developed or expanded so that the sources of danger in the environment can be mapped and more visible during firefighting operations can be classified here [18], or those new materials that provide greater protection against external influences. For example: thermal camera and communication devices integrated on the mask of respirators; new materials for making protective clothing; firefighting robots etc.

4.4. Workplace preparation for psychological stress

The importance of the psychological state is not yet fully accepted in the public mind today. In many cases, society associates these problems with some serious illness affecting the mind. Despite this, unfortunately, mundane things such as pressure to conform, sleep disorders, stress, anxiety, or burnout play a role.

A milder course of these can also be observed during normal organizational operations (also for personal reasons), but "combat stress" and its prolongation during a damage event involving more serious or serious injuries or death occur more often, even if they are rarely discussed in the firefighting community. [19].

The defense against them and their management are at least as important as the elements discussed in the previous chapters, because they form a determining dimension in performance.

4.5. Development of procedures

The regulation of firefighting interventions can also be found at the legislative level. Based on the Fire Protection Act [2], the leader of the firefighting task force is the individual responsible for extinguishing the fire, whose detailed duties are defined in the 39/2011. (XI. 15.) BM decree

(hereinafter: Decree) is prescribed [21]. In addition, many organizational regulations define the tasks to be performed, many of which deal with occupational safety [22]. They designate the corner points that are intended to serve the safe execution of firefighting interventions. By systematizing the rules that must be observed by the fire-fighting manager - adjusted to the circumstances of the given fire-fighting and technical rescue task - the following grouping can be formed:

- use of protective equipment,
- thorough reconnaissance of the firefighting area in order to search for sources of danger,
- personal reserve formation prepared for the rescue of the participants in the intervention,
- creation of defined positions in the organization of firefighting.

Of these, the last point should be highlighted, in relation to which the regulation-level rules specify that the duty of the security officer is to observe the deployment conditions of the participants in the intervention, check the distribution of public utilities, supervise the proper use of personal protective equipment, check shifts according to personal use, and in the case of intervention in the presence of a dangerous substance, to make a proposal for the adoption of special rules after consultation with a suitably qualified specialist to the fire chief. In addition to these, in order to intervene as safely as possible in accordance with the given circumstances, you can make suggestions to the fire chief for appropriate tactics [22]. On the basis of the above, it can be concluded that the fire chief can, in certain cases, organize a schedule that specifically deals with occupational safety, in order to ensure safe work.

5. Summary

From the introduction, we were able to learn how the working environment of firefighting operations differs from civilian activities. Due to the determined increased dangers resulting from this, the responsibility for occupational safety can be determined by legislation. This already makes it clear to the legislator - in this case the Parliament - and to those who choose the profession of firefighter. After getting to know the conceptual system of accidents and work accidents and the sources of danger, we reviewed the negative effects of work accidents, from which it can be concluded that they represent a complex social problem in addition to the personal and family difficulties of the affected individual. It has been proven that it is difficult to make a prognosis of accidents that occurred during rescue fire protection tasks, many factors different from civil areas must be taken into account, which probably does not guarantee a high chance of success.

After that, we explained the options, methods, and techniques that ensure the reduction or complete exclusion of hazardous effects, thereby ensuring the avoidance of as many accidents as possible.

We found that the universal work protection and work safety field developed the grouping of hazard sources related to the topic, which were integrated and further expanded by the firefighting profession in accordance with the special work environment and task system. All the presented areas of complex work and accident protection involving rescue fire protection are equally important - they are built on each other - together with the regulators that record the tasks to be performed.

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DISASTER MANAGEMENT ON THE MARGIN OF MILITARY SCIENCE AND THE SCIENCE OF LAW ENFORCEMENT

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Abstract

Hungary has undergone fundamental changes in the global security environment, and the new processes particularly enhance the necessity to take into account security and to identify scientific responses to the new challenges. At present, disaster theory cannot be discussed in a scientific way within a single discipline, because the common content of different disciplines, not yet available, would have to be used to interpret disaster research.

Keywords: disaster, disaster research, law enforcement, military science

1. Introduction

Hungary has gone through fundamental changes in terms of the global security environment, and these processes especially value the need for security-related thinking and the identification of responses to new challenges. It can be observed that in terms of risks, challenges and threats affecting security, previously undefined and often immature social responses, new methods and tools are gaining strength. In the course of history, the State's consciously organized and regulated system of the prevention of, the response to disasters and the recovery of the aftermaths, as well as its management system, developed in different ways for each age and society.[1]

In recent decades, disasters of high magnitude occurred in many parts of the world, the consequences of which still have an impact to this day. Therefore, the almost simultaneous

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interpretation of the political, internal affairs, military, economic, financial, social and environmental dimensions of security, or the search for solutions beyond the sectors concerned, has become essential. This simultaneity is further strengthened in 2020 by the epidemic and crisis situation caused by the virus affecting almost the entire world.

In the international literature, the concepts of disaster and disaster management are not uniformly defined, but several international trends explicitly focus on the scientific investigations of disasters and their possible prevention, the protection against their impacts and consequence management, often the changes of, impacts on and responses to health, economic, social and built environment and nature are placed.[2]

In addition to technical scientific solutions, social impact assessments are also ongoing, looking for well-founded and verified research nodes, advocating solutions based on consensus.[3]

The Hungarian disaster management organizational and activity processes can be understood as a structured, specific integration in their development and method.

2. Systems approach to disaster management

Uncovering the scientific values of disaster management as an organization and activity system, promoting and advocating the application of scientific results in practice, and strengthening the systematic place and role of disaster management scientific activity are highly important scientific tasks. The technical and engineering disciplines connected to the specialized fields of disaster management can be identified as a priority when analyzing the activities, in addition to the existence of authoritative and specialized authoritative procedures.[4]

Researches are published in the development of a disaster risk assessment system, in the analysis of the quantification of given risk factors, in construction fire protection, in other areas closely related to fire safety, in the determination, evaluation and analysis of the fire hazard characteristics and risk factors of industrial materials and technologies, but also in the field of effective fire investigation. However, in addition to this, the role of disaster management is to maintain safe living and working conditions, which is carried out in a unified system of prevention, response and recovery, integrating it into the country's security system, in close cooperation with all actors in society.[5]

The authoritative and industrial safety specialized areas of disaster management as an organization ensure the protection of human lives and property, the continuous functionality of vital systems by carrying out prevention and risk reduction tasks, as well as support investments that are prioritized from a national economic point of view, acting in the authoritative powers

of fire prevention, water and water protection complete the procedures of public administration authorities and specialized authorities. The water and water protection authority performs its tasks for the utilization of water, preservation of its utilization possibilities, licensing of water facilities and water works, as well as water damage prevention, water quality protection, damage prevention, and protection of water as an environmental element. It acts as a tax authority in relation to the water resource contribution. It supervises the safe operation of plants dealing with hazardous materials and lower tier plants by performing the authoritative licensing, supervision, and control tasks related to hazardous plants, and ensures a high degree of protection for citizens and the environment. It supports the safety of road, rail, water and air transport and the minimization of risks arising during transport by continuously checking the vehicles and premises involved in the transport of hazardous materials (road, rail, water and air).[6]

It is typical for tasks related to the protection of critical infrastructures that the professional disaster management participates in all stages of the identification and designation of vital system elements, thus ensuring law enforcement and internal security aspects. Within the framework of activities related to nuclear emergency prevention, it participates as a specialized authority in the authoritative procedures of the Hungarian Atomic Energy Authority related to nuclear facilities and radioactive waste storage facilities.

3. Study starting point

The starting point of the authors of this study is that currently the theories related to disasters cannot be discussed in a scientific manner within the framework of a single discipline, because for the interpretation of disaster, the affected areas, e.g. in relation to its technical content, and for their management, the common content part of the disciplines should be used, which, however, are not yet available. In addition to this finding, the most important challenge of each scientific field is precisely the provision of answers to disasters or the risk thereof, so it has a functional impact. It is important to choose research methods, which must be able to be projected onto methods used by other sciences, to examine how well the methods complement each other, and how they ensure each other's control. The methodology of this is, in a general sense, the methodologies of the different scientific fields and disciplines, they encompass the totality of the methods of the scientific field, and during the study, they indicate the science that is the subject of the research itself. In addition to the clarification of the theoretical connections, the mechanism of their practical application and the definition of possible indicators are an important additional aspect in the choice of methods.

The decade dedicated to this topic was characterized by very active international professional, political and research activity in the field of natural disasters and related environmental and technological disasters. The Sendai Framework demonstrates the types of disasters in a segmented manner and, in terms of their consequences, determines their impacts on human physical, mental and social well-being in terms of deaths, injuries, illnesses, which aims to fundamentally reduce the risk of disasters, the loss of life and livelihoods, the protection of economic, social, cultural and environmental factors.

4. Request for EU, UN, NATO assistance, regional relations

By now, it has become clear that security is not simply a technical, but a complex social issue, not simply a local one involving one profession, but a global issue, and we have to face protracted, long-term challenges. The central body of the professional disaster management organization performs the coordination of international disaster relief and requests for assistance between the relevant ministries, as well as organizing the activities of the bodies participating in the disaster relief and requests for assistance and other operational tasks. Within this framework, it acts as a national contact point in the EU, NATO, UN and other regional and bilateral disaster management cooperation systems.

Hungary's activities related to the provision and request for international disaster assistance are regulated in Act CXXVIII of 2011 on disaster management and the amendments to certain related laws, as well as Act CXCII of 2013 on amendments related to increasing the effectiveness of disaster management. The head of the central body of the professional disaster management organization organizes the practical implementation of international disaster relief in cooperation with the minister responsible for foreign policy. In the event of a request for international assistance, it ensures the reception of international assistance. The legislative environment is in line with the European Parliament and Council Decision on the Civil Protection Mechanism of the European Union. In December 1991, the UN General Assembly adopted Resolution No. 46/182, which was intended to strengthen the UN's response to natural disasters and complex emergencies. The UN Secretary-General subsequently approved the establishment of the Department of Humanitarian Affairs, which was renamed the Office for the Coordination of Humanitarian Affairs (OCHA) during the transformation in 1998. The Field Coordination Support Section (FCSS) of the Emergency Services Branch (ESB) operating within OCHA acts as the Secretariat of the International Search and Rescue Advisory Group (INSARAG) in Geneva. INSARAG's operating rules are collected in the INSARAG Guidelines document.

The National Directorate General for Disaster Management (NDGDM) is also the contact point for EADRCC (Euro-Atlantic Disaster Response Coordination Center), which deals with international disaster relief within the framework of NATO. EADRCC is NATO's operational body, which coordinates relief from partner countries in the event of disasters occurring in the territory of member countries.

One of the common features of international programs is that, with regard to the elimination of the impacts of disasters, e.g. on the residential environment, they do not provide a more uniform opportunity for the comprehensive interpretation and methodology of the elimination of the consequences. In order to deal with environmental, economic, and social problems, it is necessary to apply the global and local approach together, as well as the coherence of short- and long-term planning.[7]

5. Security priorities in the field of disaster management in Hungary

The organization of disaster management in Hungary, and within it the development of fire protection, civil protection and industrial safety as its main areas of expertise, is in line with international, European Union and Hungarian legal regulations based on them, government strategies and concepts.[8]

The new National Security Strategy states that special attention must be paid to the comprehensive reduction of disaster risk, that Hungary must have capabilities that form a complex prevention and disaster risk reduction system, and in the event of natural or industrial disasters, as well as health crises and attacks involving mass injuries and destruction, they effectively respond in order to protect the life, health, and property of the population and to minimize damages.[9]

The scientific support of the integrated system of disaster management is structured, one of the main pillars of which is the Scientific Council of the Governmental Coordination Committee, created to support the activities of the Interdepartmental Coordination Committee for Disaster Management, for the purpose of preparing scientifically based decisions. The Scientific Council consists of leading experts from renowned Hungarian research institutes and organizations, the need for cooperation is supported by the several disasters that have occurred in Hungary, the involvement of representatives of several scientific fields was necessary in relation to the management of its harmful effects and the implementation of exemption options. The scientific fields basically concern natural sciences, the humanities and social sciences, the living natural sciences, as well as economic and legal sciences.

6. Connections to the science of law enforcement

The science of law enforcement as an expression has been present in professional public life in Hungary since the second half of the 19th century. Rédey, Tomcsányi, Szamel, Finszter all used and still use this term.[10]

The science of law enforcement is an independent discipline belonging to the social sciences, recognized by the Hungarian Academy of Sciences and the Hungarian Accreditation Commission, which has a specific thematic relationship with political and legal science. It shows a connection with the science of public administration, which also has the quality of an independent discipline, but it is also connected to other disciplines. Examples include management and organizational science, sociology, psychology, history, economics, education, statistics or technical sciences (e.g. material sciences and technologies, transport science, IT science, chemical and electrical engineering, etc.), and military science.[11]

The internal thematic structure of the science of law enforcement primarily reflects the main functions of law enforcement and the types of law enforcement activities. The general part of the discipline deals with the common characteristics of law enforcement functions and types of activities. The main functions include community policing, force policing, intelligence gathering policing and policing discretion. A special part of policing studies focuses on the characteristics of individual types of policing activities and functions. This can happen if the given law enforcement activity is legal, administrative, sociological, etc. by examining its context, but it can also be realized in substantive areas.[12]

Regarding the tasks of law enforcement agencies and the powers of the participants, they are primarily connected in the scope of tasks and organizational system of public administration. In terms of their function, they are integrally connected to the period of the special legal order and the declared disaster risk, but also in the period of prevention, in relation to their tasks of disaster management and national defense. Law enforcement can be connected to a scientific research in at least two ways. On the one hand, law enforcement is the user of scientific results, on the other hand, it can also be a subject. Consequently, law enforcement is also about law enforcement agencies.[13]

Instead of questions of state organization, the theoretical works on policing began to examine an activity-oriented professional administration system, focusing on authoritative functions such as the prevention of law violations, the removal of threats to social order, and the elimination of harmful consequences.[14]

The authors' conclusion is that the analogy of the above statement is also the starting point and border of the temporal activities and functions of the professional disaster management organization.

Police administration is basically implemented through four functions. [15]

The functions of disaster management administration can be defined in a broader sense, but they differ in their subject matter. Differentiation is provided by coordination, so, it is shown by the possibility of involving bodies assigned to disaster prevention. The law enforcement relationship is also based on the history of the legal predecessor organizations, as it can be seen more clearly in the development of fire protection and the evolution of Hungarian fire policing if examined in a historical context. In an organized form, only in the second half of the 19th century, did voluntary fire brigades began to be established, and the task of preventing fires appeared as a primary goal, which had to be made mandatory for everyone. Starting from this, we can talk about the development of Hungarian fire policing, because from that time on, firefighting as an activity and fire policing as an administrative and law enforcement activity separated from each other.[16]

In the field of civil protection, the current situation can only be understood in a strict context, since it is a well-known fact that civil protection as an organization, has always had a strict legal definition of its tasks and management system. The Act of 1939 on national defense put Hungarian active and passive air defense on a new foundation, declaring that all citizens are obliged to participate in national defense, which also included passive and active air defense obligation in person and in kind. The organization and management of civil protection/defense was a state administrative task, which was carried out by the state administration, local government bodies and professional civil protection/defense bodies, but the armed forces and law enforcement bodies, as well as citizens, participated as collaborators in the implementation of the tasks. In order to perform these duties, citizens and non-military entities were charged with civil protection obligation in person and in kind. The law specifically regulated that even during a declared state of emergency, civil protection/defense organizations could only carry out their philanthropic tasks defined in the Act, and could not be used to prevent armed acts or serious acts of violence.[17]

7. Researches in military science

The central core of military science is the art of war, since tactics, operations and strategy deal with combat and operations, which could not do without good leaders, so the theory of military leadership has always been and still is an important part of military science.

Operations require a number of additional conditions that are inextricably linked to theories, so they are closely related to logistics, military engineering, force organization and military training, as well as preparation. These disciplines make up the second layer, which belong to military science.[18]

With regard to the disciplines belonging to the next stratum, they are already explicitly connected to individual civil sciences, during which disaster management also emerges as a field. It is a matter of approach and organization of science, to what extent they can be considered sub-branches of individual civil disciplines, and how strongly and with what specific characteristics they are connected to military science. After all, military science and the armed forces use all civilian scientific results in order to successfully fight wars, participate in armed conflicts, or successfully solve peace-making tasks.

In recent years, the examination of research directions in military science can be regarded as particularly significant. The Military Science Board of the University Research Council summarized in a study the most important military science research directions, priorities and topics that are necessary to achieve and implement the goals defined in the Institutional Development Plan and the Research, Development and Innovation Strategy of the National University of Public Service. The Board considers the research of military theory and warfare the "core" of military science to become one of the most important research directions and priorities.

The organizational development of the protection against disasters has been very intensive in recent years, as part of which the national defense/protection administration system was also transformed, and the special technical capabilities of the Hungarian Defense Forces were enhanced. The military's involvement in disaster management goes back more than a hundred years. Military science research has also been investigating this area for decades. The researchers of the field consider it particularly important to examine the issues of international military cooperation, since the impact mechanism of disasters is often not exclusively a national issue. Military research should deal with the investigation of the branch of disaster management closest to the armed forces: civil protection.[19]

8. Study of the research area of military technical sciences and disaster management

Military technical sciences include all other technical disciplines belonging to the field of technical sciences (such as civil engineering, electrical engineering, architectural engineering, material sciences and technologies, mechanical engineering, transport engineering, chemical engineering, IT engineering, agricultural engineering and

multidisciplinary technical sciences), a discipline dealing specifically with basic, applied, experimental development, technological, technology transfer and technical innovation research related to military application. The place of the new branch of science is determined based on the situation of the related military sciences and technical sciences. Accordingly, we can basically speak of military sciences as a branch of science that satisfies the needs of applied military users and creates new scientific research results - with the procedure and tools of the technical sciences. Its research results are adapted in the modern, new procedures and system of tools of military technology and the defense/protection sphere in the broadest sense (including disaster management, critical infrastructure protection, energy security, safety technology, defense/protection administration) and related fields of science and application. [20]

The environmental safety and disaster management research area deals with the research of environmental hazard sources, which are an important part of our safety and security within the military engineering sciences, the prevention and elimination of possible disasters and accidents, and the mitigation of damages, as well as the research of technical issues related to rehabilitation.

9. The main points of intersection between disaster management and the science of law enforcement, conclusions

Due to their multidisciplinary nature, disaster management and law enforcement apply the results of other basic and applied sciences. The disciplines that can be linked to various incidents have now become proactive with regard to the prevention period, but they maintain the discipline of the post factum, i.e. they focus on the response and consequence management following an emergency. At the same time, the function and scope of the application of individual knowledge represents an area of demarcation, because of which the institutional system providing and adapting scientific results is differentiated.

In relation to certain related disciplines (e.g. psychology), disaster management also plays a significant role in crisis intervention in addition to work psychology, the aim of which is to provide psychological first aid, resolve crises, resolve ineffective problem-solving tools, promote adaptation, restore emotional balance, and prevent possible future crises, in other words, it forms a network closely connected not only with the organization, but also with the organization's environment and the object of activity.

A common point of intersection in the light of the conceptual definition of disaster management is also its law enforcement environment, since, on the one hand, the concept presupposes the state when, in accordance with the provisions of the Fundamental Law, the Government declares a state of emergency in the event of a natural disaster or industrial accident that threatens the safety of life and property, and in order to prevent their consequences, who may introduce extraordinary measures defined in a pivotal law and how. On the other hand, it also refers to cases of limitation and suspension of fundamental rights during special legal order. In the activity system of disaster management, the importance of the applied sciences in parallel lies in the fact that their practical utilization provides socially sensitive and important results, so the protection of life and property is of fundamental importance. However, this activity cannot be carried out in isolation, but with a holistic approach, involving representatives of the relevant fields of expertise and many other scientific fields. The authors' conclusion is that the identities that necessarily exist behind the investigated activity, as well as the reciprocity, dependencies and methods shown in research and development, can be marked as additional points of connection, given that the results can only be successfully implemented in practice if it is possible to simultaneously save the scientific concepts and structures as well. It can be concluded that disaster management is a set of integrated professional fields that are decisively connected to the disciplines of law enforcement and also affect certain aspects of military science.

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