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Current status of and possibilities for improvement in the training for the management of hydrologic disasters caused by climate change

Abstract

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Budapest

2014.

TOPICALITY OF THE RESEARCH SUBJECT

Climate change has been a much debated subject for many years now. According to some opinions, there is no causal link between the changes in the climate and the frequently occurring natural phenomena that are becoming more extreme and unusual. These voices suggest that it has to be accepted that unprecedented *blizzards, floods, storms and other natural disasters* can occur any time.

It is my strong belief that our environment, the nature wishes to signal to us that it is unfortunate to strengthen the effects of climate change with the pollution of the environment and our way of living, which does not respect nature and is wasteful, because the environment will answer with drastic weather anomalies and natural disasters.

Today, the mitigation of the harmful effects of climate change and the compliance with these effects have to be regarded as a global goal.

The past few years have brought the recognition of the importance of this problem in Hungary, and the realization that it is not enough to talk about it, actions are needed.

Unusual and extreme natural phenomena and weather anomalies have become more frequent. *They effect the whole of society*, therefore we have to start applying to them in all social and economic fields.

It is particularly important in the field of disaster management to prepare for the challenges posed by the weather extremities caused by climate change becoming more frequent and intense. It is a fact, that the events occurring due to these extremities shift extra duties to the disaster management organizations of today, and put coping strategies in a different light with regard to prevention, response and recovery as well.

Today, the presumption that disaster management organizations, beside their traditional duties in fire prevention, civil defense and disaster management have to face serious challenges with special regard to the *security and disaster management questions* posed by climate change, has become relevant. My thesis focuses on the management of disasters of hydrologic origin, in particular on the *prevention of floods, inland excess water, local damages caused by water, flash floods and droughts.*

In my thesis I will examine droughts beside hydrologic disasters, because in my opinion the lack of precipitation over a prolonged period of time is just as much a hydrologic disaster as the one caused by sudden and heavy rainfall.

Because of its geological conditions, Hungary has always been and will always be at risk from the dangers and devastating effects of disasters of hydrologic origin.

In my opinion, the basis for successfully preparing for these is found in the extensive, high-standard and complex training in emergency management. The fundamental tasks of disaster management are prevention, response and recovery. The importance and key role of prevention have been pointed out on numerous professional and scientific channels. In my view, the basic building blocks of successful disaster management are *well-trained professionals* with up-to-date, current and profound professional knowledge, as well as *well-informed civilians* who acquired their knowledge from modules in school education.

In my opinion, as with any profession, the basis of the effectiveness, quality and efficiency of disaster management lies in high-standard education. I believe that it is extremely important that the training material of existing and future disaster management professionals includes information about climate change, thus providing them with the knowledge that sheds light on the causal link between natural disasters and climate change, and helping them in *effectively* planning prevention and protection.

Statements on climate change call our attention to the fact that it is necessary to *spread information* about climate change among the population and to include this information in school education material from the elementary school level up to university training.

In my view, the whole of society can benefit from the knowledge about climate change. On the one hand, for moral reasons, so that we become aware of the effects of our wasteful and polluting way of living. On the other hand, for possible innovations, since the more people are aware of and concerned by this problem, the greater the chance for the success of a global social union to control the change and to comply with its effects.

THE SCIENTIFIC PROBLEM

Some consider climate change a too broad, too inconceivable, too trite, too "fashionable" subject, while others blame climate change for the extinction of species of plants and animals, harmful effects detrimental to health, extreme weather conditions, devastating disasters and economic damages.

In my opinion, one of the chief duties of disaster management professionals is to be aware of the complexity of this problem, to comprehend its effects on the operation of the organization

using *systems thinking*, and beyond it, to understand their role and responsibility in solving this problem and in complying with the effects of climate change.

I believe this, because the tasks of disaster management and the job of disaster management professionals are considerably influenced by weather anomalies.

This thesis aims to call attention to the fact that the core material for primary, secondary and post-secondary education in emergency management should provide students with more information regarding climate change.

Weather extremities caused by climate change affect virtually all fields of disaster management from flood prevention to the protection of critical infrastructure, fire safety and technical rescues. In spite of this, however, the core material in emergency management training programs currently includes *insufficient* amounts of information about climate change. The programs lack a dedicated course that would shed light on the *complexity* of the problem and would *prepare students with systems thinking* for acknowledging these effects in their respective fields of work.

It is my strong opinion, that beyond disaster management trainings, it would be crucial to include information of climate change in public education from the primary school to the post-graduate level, so we could live in a more environmentally aware and responsible society, and so could our children.

My thesis focuses mainly on the training in the Disaster Management Education Center and the Institute of Disaster Management at the National University of Public Service.

It has sentimental reasons, since I worked at the Disaster Management Education Center from 2008 to 2012, I was employed as a disaster management professional here from 2010, and in 2012 I started working at the Institute of Disaster Management as an assistant lecturer.

It also has objective, professional reasons, since the above two organizations are responsible for the professional training in disaster management, and the problem of climate change, even if only indirectly, shifts extra duties and poses new challenges to disaster management professionals.

Therefore, it is not only morally but also professionally justified to include information about climate change in disaster management training.

HYPOTHESES

This thesis investigates the following hypotheses:

- Since one of the chief global challenges of the past decades has been the attempt to control climate change and to comply with the effects of climate change, in my opinion, it would be necessary to include either a dedicated course or dedicated modules in related courses regarding climate change at all levels of public education to make students aware of the problem. Currently, despite the numerous professional appeals, there is very few training and material available on the subject.
- Climate change has an effect on the occurrence of disasters of hydrologic origin and it alters the characteristics of these, which poses increased and new challenges to emergency management professionals.
- Currently neither the Disaster Management Education Center nor the Institute of Disaster Management at the National University of Public Service offers a course or a training program that focuses on climate change management. Hence the inclusion of a climate change course in the curriculum and the drawing up of course contents would be absolutely necessary.
- Information regarding climate change is connected to the operation of emergency management, it influences the day-to-day working of many fields of it. Therefore, I believe it is necessary to update the curriculum of specialized courses by extending it with material about climate change.
- Between 2007 and 2013 no major alteration has been implemented in the level of education about climate change at the courses and training programs offered by neither the Disaster Management Education Center nor the Institute of Disaster Management at the National University of Public Service. The analysis and evaluation of questionnaires have proven that the participating students' level of knowledge about climate change is insufficient and did not improve from 2007 to 2013.
- The practice training base of emergency management (either the current one in Hatvan-Nagygombos, or the future base) should contain life-like constructions that

will enable the training of well-prepared professionals who are familiar with emergency situations caused by extreme weather.

THE AIMS OF THE RESEARCH

My research had the following aims:

- To **examine and determine** whether the teaching of information on climate change is important and justified based on natural and economic effects. To **analyze and determine** whether the necessity of the teaching of this information is justified in the interest of improving the level of disaster management training. To **analyze and expose** the international and Hungarian statements that support the key role of education in the compliance with the effects of climate change. To **conclude** whether it is really necessary to improve the level of education about climate change in all public education institutions, with a special emphasis on disaster management training.
- To **examine and evaluate** the effects of climate change on the formation of hydrologic disasters and the alterations in their characteristics. To **analyze** the danger of floods, inland excess water, flash floods and droughts nationally and in respect of the European Union. To **survey** the characteristics of Hungary's streams with regard to water level, climate and the effects of climate change on these. To **analyze and evaluate** the characteristics of the formation of inland excess water, inland excess water recovery methods and their legal background. To **examine and evaluate** the connection between climate change and the frequency of droughts. To **survey** relevant national and international policies and regulations with regard to exposing existing difficulties and tasks as well as possible solutions to these. To **conclude** that disaster management organizations require an up-to-date and well-trained staff to face renewed challenges, and the education of these professionals is key to this.
- To **analyze and organize** the results of my questionnaires from 2007 and 2013 based on the acquired data. To **survey, analyze and evaluate** the options for teaching climate change management as a dedicated course or as part of related courses. To **determine** the necessary improvements in the interest of increasing the

efficiency of the practical training in emergency management. To **survey** the international background of environmental education.

RESEARCH METHODOLOGY

During my research, I aimed to formulate the vertical and horizontal connections of my thesis and to retain the consonance of the research aims, the applied methodology, the conclusions and the scientific results based on these conclusions. During the survey of each hypothesis, I aimed to apply a complex methodology.

- I used the method of **literature survey and analysis** when expounding on the complexity of the problem of climate change, on the appeals for teaching information about climate change and on the renewed and increased challenges caused by frequent extreme weather conditions that disaster management organizations are faced with by citing reliable Hungarian and international sources.

- I aimed to **synthesize** knowledge when examining the connections between disasters of hydrologic origin and climate change.

- I used the method of **analysis** when evaluating the questionnaires. I used **comparison** and **analysis** when evaluating and organizing the questionnaires from 2007 and 2013. When examining the courses connected to emergency management and their links to climate change, I used the methods of **analysis and synthesis**.

- I used the method of **deduction** when drawing conclusions from the results of the analyzed questionnaires. I used the same method when outlining the possibilities of teaching climate change management applying systems thinking.

CHAPTER 1

In Chapter 1 I presented the extreme natural anomalies caused by climate change globally and nationally as well. Based on my research, I called attention to the connections and effects of our polluting way of living, greenhouse effect and climate change.

I emphasized that the effects of climate change are wide-ranging and that they influence virtually all areas of life, or will in the near future.

This chapter sheds light on the complexity of the problem of climate change, on the urgency for a solution and on the fact, that it is not only useful to attain knowledge of climate change, it is also our long-term duty to be aware of the price of our current way of living and to conclude what price the next generations will have to pay if we do not change our attitude.

I presented the global effects of climate change on the environment and on the economy, as well as the Hungarian characteristics, to demonstrate the importance of teaching climate change management.

I demonstrated why climate change means extra duties for emergency management organizations on the long run.

I collected the most important concepts, organizations and policies on a national and international level as well that are connected to climate change.

I discussed the effects of climate change on the economy in a separate subchapter to emphasize the high price we pay for our current way of living and the necessity of a change in our attitude.

CHAPTER 2

In Chapter 2 I considered disasters of a hydrologic origin, such as floods, inland excess water, droughts and flash floods.

I analyzed the risk of floods with regard to Europe and Hungary as well. I presented possible responses to different disasters of hydrologic origin based on numerous Hungarian and European strategies and policies.

I presented the characteristics of the formation of floods in Hungary, as well as the methods and options of flood relief and flood protection; I pinpointed possible shortcomings and problems.

I presented the characteristics of Hungarian streams with regard to their stream flow discharge, the climate of their drainage area and the effects of climate change on these.

I analyzed the characteristics of the formation of inland excess water in Hungary and the methods of inland excess water recovery as well as current regulations relying on relevant Hungarian sources.

With regard to local damages caused by water I emphasized the role of environmental characteristics and human activity in their formation, and I enumerated major local water damage disasters in Hungary in the past two decades.

When presenting and analyzing droughts, as the fourth type of hydrologic disasters, I relied on the National Drought Control Strategy. I presented the connections between climate change and the frequency of droughts with its help.

I called attention to the international danger of droughts and presented possible resolutions by analyzing UN and EU policies.

CHAPTER 3

In Chapter 3 of my thesis I presented why climate change management is an important part of disaster management training.

By analyzing and evaluating trustworthy statements, I demonstrated the topicality and the urgency of teaching climate change management at all levels of education.

I summarized the most significant information about the Hungarian emergency management training institutions from primary to post-graduate level.

I presented, evaluated and drew conclusions from the results of my questionnaires.

I presented the options for teaching climate change management both as a dedicated course and as a module complementing already existing courses, whereby I also demonstrated the connections between the effects of climate change and the different fields of disaster management.

I drew up necessary development options that would make the practical training more efficient.

I surveyed the international background of environmental education.

CONCLUSIONS

I realized my research aims as stated in the beginning of my thesis as follows:

I **justified** the necessity of teaching information about climate change in Chapter 1 by presenting natural and economic anomalies that are present both nationally and globally as a negative result of climate change.

Based on my research, Chapter 1 shed light on how and to what extent climate change effects currently and might effect in the future our environment directly and the economy indirectly. These factors and effects, in my point of view, express the vast and complex challenge of emphasizing environmental considerations and controlling negative global tendencies.

I called attention to the fact that the topicality of the teaching of climate change management originates in this vast task, since an environmental mentality as well as integrating knowledge about climate change into professional mentality and the need to be aware of our responsibility toward future generations in providing them with a healthy environment are important stepping stones in the fight against climate change and toward sustainable development.

Based on the National Disaster Risk Assessment, climate change is among the major risk factors in Hungary.

Weather extremities caused by climate change pose either directly or indirectly renewed challenges to disaster management organizations in prevention, response and recovery as well.

The renewed challenges are rooted in the elevated frequency and intensity of natural phenomena, and in the often fundamental alteration of their characteristics.

The risk factors listed in the National Disaster Risk Assessment and the weather and environmental anomalies caused by climate change are in many cases identical, which means that the effects of climate change increase the risk of environmental disasters.

Based on this, I justified the necessity of including climate change management in disaster management training.

In Chapter 2 I presented the complexity of new tasks and characteristics with regard to managing hydrologic disasters caused by extreme phenomena of increasing frequency and intensity.

According to statement 7 of the European Union Water Framework Directive, climate change will pose a challenge to water management throughout the European Union.

The 2007 statement on the management of water shortage and droughts of the European Commission claimed that the execution of the Water Framework Directive is of vital importance.

I surveyed the characteristics of floods, inland excess water, local damages caused by water and droughts nationally and international, and the effect of climate change on their formation and the alteration of their characteristics.

Based on my research, I demonstrated that atmospheric processes vastly influence the hydrologic processes in Earth's water bodies. The changes in the state of the atmosphere and weather tendencies directly affect the stream flow discharge, water level and water output of streams, the water level of lakes and the changes in the water level of the ground.

The hydrologic effects of climate change were thoroughly researched by the 2nd team of the Intergovernmental Panel on Climate Change. Based on their statements, the risk of hydrologic disasters in Central and Eastern Europe will increase significantly.

The extent of local damages caused by water depends on the state and intensity of the precipitation as well as temperature, thus the extremities caused by climate change hugely influence their formation.

Desertification, soil degradation and drought affect directly or indirectly all parts of the world, therefore global collaboration is necessary to mitigating their effect and controlling them.

The Convention to Combat Desertification was adopted at the 1977 United Nations Water Conference, and in 1994, the United Nations Convention to Combat Desertification was adopted, which was later ratified by Hungary as well.

The European Union is struck by droughts, too, and their frequency and gravity have increased significantly in the past three decades.

In Chapter 3 of my thesis, I called attention to the importance of teaching information about climate change based on the sections on education, training and altering people's mentality of the National Environment Protection Program. Furthermore, I collected numerous statements by disaster management and environmentalism professionals that also support the importance of spreading information about climate change.

The UNESCO's statement on the implementation of education for a sustainable future was presented at the UN Johannesburg summit, and is adopted as a key document by the EU member states. Based on this document, **the period between 2005 and 2014 is the Decade of Education for a Sustainable Development**.

With the help of my questionnaires from 2007 and 2013 I inquired into the knowledge of the participating students on climate change and compared the results for the individual questions.

I drew the following conclusions:

Based on the questionnaires, the participating student in 2013 were **more knowledgeable** in the following topics than the students in 2007:

- Listing greenhouse gases
- Sustainable development
- Whether the emission of greenhouse gases depends on human activity
- The economic effects of climate change
- The extra tasks of disaster management caused by climate change

The participating students' level of knowledge has not increased significantly from 2007 to 2013 in the following topics:

- The VAHAVA (Change-Effect-Response) project
- Hungary's obligations by the Kyoto Protocol
- Hungarian climate policy
- National Climate Change Policy
- The EU's activity on climate change

The participating students' level of knowledge has not changed from 2007 to 2013 in the following topics:

- How climate change affects Hungary
- National Disaster Management Policy
- Topicality of climate change

By evaluating and presenting my questionnaires, I mapped the level of knowledge of the participating students and pointed out gaps in their knowledge.

I **analyzed** the characteristics of the training in disaster management and the teaching of information about climate change.

I **presented** the training programs and the structure of the Disaster Management Education Center and the Institute of Disaster Management at the National University of Public Service.

I examined the options for teaching climate change management as a dedicated course. I suggested a possible course goal and made suggestions regarding the course contents.

I **examined** the available literature for a climate change management course at the university library that would be accessible to the students. I concluded that it would be absolutely necessary to compile a textbook that would contain up-to-date and complex information about climate change and that would demonstrate its connections to and effects on disaster management.

I examined and summarized the options for teaching climate change management supplementing existing courses as part of the disaster management training.

The effects of climate change influence either directly or indirectly many fields within disaster management and disaster management training, which poses renewed challenges to leaders and the responding staff as well.

With regard to practical training, I **made suggestions** to modernize the training base of disaster management in order to train well-prepared professionals who are familiar with methods of preventing and responding to disasters caused by extreme weather phenomena. I suggested building traffic junctions, an embankment, buildings of high and medium height, an artificial pond, public utilities, power lines and ruins of buildings to enable lifelike training exercises.

NEW SCIENTIFIC FINDINGS

I request the acceptance as new scientific finding of the following:

1. After examining and evaluating the complex environmental and economic effects of climate change both globally and nationally, I identified the challenges climate change poses to society and disaster management organizations, and based on this
    - I **demonstrated** the necessity of teaching climate change management at all levels of public education in order to form an environmentally responsible mentality in the society, and especially at disaster management courses and training for professional reasons.
    - I **suggested** options for teaching climate change management as a dedicated course and ways of integrating climate change management into already existing courses.

2. Based on the conclusions I drew from analyzing and comparing the results of my questionnaires from 2007 and 2013
    - I **demonstrated** the gaps of knowledge of the participating students about climate change and thus **proved** the necessity of teaching up-to-date information about climate change.
    - I **published new findings** about the change of students' level of knowledge by 2013 about concepts and information on climate change.
3. By analyzing trustworthy national and international statements, I **summarized** the characteristics of hydrologic disasters, such as floods, inland excess water, local damages caused by water and droughts on a local and global scale as well, the effects of climate change on these, and Hungarian and international policies and regulations.
4. I **made specific suggestions** to modernize the existing disaster management training base in Hatvan-Nagygombos or to develop a new training base in order to train well-prepared professionals who are familiar with methods of responding to disasters caused by extreme weather phenomena.

RECOMMENDATIONS

I recommend the utilization of my research findings for the improvement of disaster management training to make it more environmentally conscious for moral and professional reasons as well.

1. I recommend the utilization of my suggestion to include climate change management as a dedicated course in disaster management training programs, possibly with the course contents I compiled.
2. I recommend the utilization of my suggestion that the teaching of information about climate change at professional courses is necessary in order to make these courses more up-to-date.
3. I recommend the modernization of practical training and the training bases so that prevention and response to extreme weather phenomena will be more efficient.

My thesis paper as well as its separate chapters after appropriate editing can be used as a textbook at the courses of the Institute of Disaster Management at the National University of

Public Service, the Disaster Management Education Center, the Doctoral School of Military Sciences at the Faculty of Military Sciences and Officer Training, the Doctoral School of Military Engineering at the Faculty of Military Sciences and Officer Training and professional disaster management training programs.

However, for moral reasons and in order to form an environmentally responsible mentality and to raise awareness of the problem in the society, information about climate change, in my opinion, can be e taught on all levels of public education.

LIST OF PUBLICATIONS

Revised articles:

1. Növekvő hidrológiai veszélyeztetettség- csökkenő műszaki szakállomány, Budapest, Kard és Toll Válogatás a hadtudomány doktoranduszainak tanulmányaiból, 2007/2. 73-79. oldal

http://193.224.76.4/download/konyvtar/digitgy/tartalomjegyz/kard_toll_2007_2.pdf

2. Az Egyesült Királyság éghajlatváltozási programjáról, Hadtudományi Szemle, 2008. 1. évfolyam, 1. szám 75-84. oldal

http://hadtudomanyiszemle.zmne.hu/?q=hu/2008/1-%C3%A9vfolyam-1-sz%C3%A1m%C3%A1ltal%C3%Alnos/az-egyes%C3%BClt-kir%C3%A1lys%C3A1g-%C3A9ghajlatv%C3%A1ltoz%C3%A1si-programj%C3%A1r%C3%B3l

3. Rácz Réka Magdolna – Lóderer Balázs: A klímaváltozás és annak következményeire való felkészülés lehetséges jövőbeni aspektusai, Hadtudományi Szemle, 2011. 4. évfolyam 3. szám

http://hadtudomanyiszemle.zmne.hu?q=hu/authors/r%C3%A1cz-r%C3%A9ka-magdolna

4. Rácz Réka Magdolna – Bonnyai Tünde: A környezeti neveléssel és a kritikus infrastruktúrák védelmével kapcsolatos felkészítési és oktatási kérdések a Nemzeti Környezetvédelmi Program tükrében, Hadtudományi Szemle, 2014/2. 181-187. oldal

5. The economic aspects of the climate change, AARMS: Academic and Applied Research in Military Science 2011. 9. évfolyam 1. szám, 153-157. oldal

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7. The function of the system of national defence and disaster management int he disaster management structure, AARMS: Academic and Applied Research in Military Science, 2011. 10. évfolyam 1. szám, 173-181. oldal

http://www.zmne.hu/aarms/docs/Volume10/Issue1/pdf/14.pdf

8. The National Environmental Protection Programme of Hungary, AARMS: Academic and Applied Research in Military Science, 2014. 13. évfolyam 2. szám, 313-318. oldal

Studies:

1. Rácz Réka Magdolna – Bonnyai Tünde: Az új katasztrófavédelmi szabályozás jegyzet és jogszabálygyűjtemény a közbiztonsági referensek felkészítéséhez, BM Országos Katasztrófavédelmi Főigazgatóság kiadványa, 2012.

http://vas.katasztrofavedelem.hu/cms_files/content_93421.pdf

2. A klímavédelem oktatásának aktualitása, szükségessége a ZMNE védelmi igazgatási szak, katasztrófavédelmi szakirányán, Zrínyi Miklós Nemzetvédelmi Egyetem Központi Könyvtár, KK537., 2007.

Paper accepted at the National Scientific Students' Associations Conference:

1. Az átalakuló Magyar Honvédség lehetőségei a katasztrófák elleni védekezésben, különös tekintettel a klímaváltozásra és az árvédekezésre, XXIX. Országos Tudományos Diákköri Konferencia, 2009.

RÉSUMÉ

I came into contact with disaster management in 2003 as a student at the Zrínyi Miklós National Defense University. I obtained my degree in 2008 at the defense faculty where I specialized in disaster management.

During my years at university, I widened my professional scope at specialized courses and competitions. Among others I participated in a basic level voluntary firefighter course and a comprehensive radiation protection course. My professional interest was focused on flood prevention, global and local climate change and the disaster management activity of the Hungarian Defense Force. Since 2007 I have had several publications in these topics in Hungarian and in English as well. At university I joined the scientific students' association. I participated in the National Scientific Students' Associations Conference twice, my competition

papers were recommended for the national level. In 2009 I participated in the National Scientific Students' Associations Conference, where my paper was awarded 2nd place and a special prize in the disaster management category. After graduation, I was admitted to the School of Military Sciences at the Zrínyi Miklós Defense University in September 2008. I completed my courses by September 2011. I took language examinations in English and French. In 2007, I passed an intermediate level general English and military English language examination. In 2011, I passed a basic level general French language examination.

In 2008, I started working in the field of disaster management. At first as a civil servant in the Disaster Management Education Center, then from July 1, 2010 as a firefighter officer I worked as an educational administrator. During my years here, disaster management and the connecting educational systems underwent a major change. I was a witness to the change in the professional examination requirements for firefighters and other civil defense professionals, I took part in drawing up the new training programs and course contents as well as the organization of courses and trainings for several new professional posts. Since 2008, I have held trainings, been an educational administrator and developed course material in topics related to disaster management. At the Disaster Management Educational Center my job was to hold courses for our students and the students of the Police College, and to develop and update training programs for them. Currently I work with the National University of Public Service and the National Directorate General for Disaster Management, Ministry of the Interior. Since April 1, 2012 I have been employed by the National Directorate General for Disaster Management, Ministry of the Interior as an assistant lecturer at the Department of Disaster Management Operations in the Institute of Disaster Management at the National University of Public Service. Through my work I have become acquainted with the educational system of disaster management, hence my professional interest in the analysis and development options of this system. I have endeavored to fulfil my duties as best I can in all my posts.