AUTHOR'S INFORMATION ON DOCTORAL (PhD) THESIS

NATIONAL
UNIVERSITY OF PUBLIC SERVICE
Council of Doctors

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Sustainable protection of the quality of Hungary's groundwater bodies in the light of legal regulation and possible remedial activities

doctoral (PhD) thesis

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Budapest
14 March 2018

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Budapest, 2018

DRAFTING OF THE SCIENTIFIC PROBLEM

Climate change and the resulting extreme climate events do not leave ecological, social and economic processes unaffected in the Carpathian Basin either. Such events have been increasing in terms of both frequency and intensity. The number of floods, the sheer volume of water passing down river valleys, as well as protracted droughts, are causing major problems but the intensive fluctuation between the two extremes is a source of extreme stress on the environment. Moreover, hitherto unknown climate phenomena also need to be faced – they also affect the ecosystems, their water resources and, of course society itself.

Water is the basis of life on Earth. The amount of freshwater that is suitable, and that is actually available, for human consumption equals less than a mere 1% of the total quantity of water on the planet and we are not managing adequately, i.e. sustainably, even the relatively little amount of water we have. Freshwater has been growing in importance, as the size of wetland habitats is on the decrease as a consequence of a variety of active and passive impacts. Conservative estimates show that about 40-45% of the Earth's population live without access to drinking water of adequate quality and quantity day after day, and this ratio has been and is growing continuously.

Excessive exploitation of environmental resources has entailed changes in social habitus as well; humankind has become more vulnerable and less resilient when it comes to the impacts of climate change. Similarly to people, ecosystems – and, consequently, agriculture, water management and drinking water supplies – are also affected by climate change. The availability or lack of drinking water of adequate quality and quantity is thus becoming increasingly suitable for generating social problems, uncertainties and insecurity, therefore, water also affects (national) security.

Hungary is rich in high quality water resources which alone could – by adequate and proper management and operation – ensure sufficient long term supplies of drinking water for the population. Water needs to be carried over long distances from its source to the place of its consumption, during which it may be exposed to a series of risks and hazards which may cause deterioration in water quality, or indeed, the destruction of complete aquifers. The relevant pieces of legislation, regulations, quality assurance systems and standards in place in Hungary and in the European Union have all been designed to ensure progress towards the right objectives; experience has shown, however, that they can only solve some of the issues being faced, partly owing to inadequate or not sufficiently accurate statutory regulations, lack of experience for putting regulations into practice and/or the absence of a preventive approach in certain specific fields. Existing water resources are affected by climate change, global anthropogenic impacts, diminishing annual precipitation, different forms of water withdrawal – including normal and compliant as well as non-compliant forms – as well as various natural circumstances and processes. Although in many cases waters and water resources are affected by only

minor impacts, the quantities of water available for use have been decreasing significantly as a consequence of the so-called domino effect and the cumulative effects of multiple minor impacts.

RESEARCH TARGETS

In my thesis I undertake to assess and describe the vulnerability of Hungary's groundwater reservoirs, discuss inadequacies of the legislative background in place to provide for their protection and the monitoring of their quality, and, finally, make proposals for possible actions and methods to enable improvements.

1. My objective is to *prove* – by exploring inadequacies in the statutory regulations in place to protect critical infrastructure elements and by describing the vulnerability of the infrastructure elements – how a sound legislative background contributes to mitigating various risks. Moreover, I wish to *highlight, in particular, the importance of paying attention to risks stemming from occurrences entailing risks of disasters, or from other problems, and to prove how important it is that they be taken into account in planning and in working out designs. This is because despite experiences of recent years they still do not appear in or are reflected by plans and designs.* It is not easy to identify risks and hazards that have never occurred in a given river basin or water resource but whose potential occurrence should nonetheless be taken into account. *However, the principle of prevention is the first priority consideration in water safety planning and its observance and application is indispensable for effective and efficient protection.*

2. My goal is *to enable*, by clarifying some of the key terms and concepts applied – terms and concepts relating to water resources and water withdrawal points tend to be unclear and mixed up in the applicable legislative background, and water withdrawal points do not comprise the water resources underneath – and by factoring in the vulnerability of water resources, *to eliminate shortcomings* in their protection *and make a proposal for adequate activities of protection to improve water safety.*

3. My goal is to *find loopholes, contradictions and shortcomings*, in the effective Government Decrees regulating water quality examinations, tests and inspections, as well as the criteria pertaining to them, and in the Hungarian Standards applied in the testing, rating of drinking water *that result in difficulties and complications in the "production" of safe drinking water of adequate quality. Having identified such loopholes, contradictions and shortcomings, I wish to draw the attention of those involved in drafting legal regulations, to the fact that the mere application of the existing regulations is not sufficient and not satisfactory for achieving adequate water safety and quality, as well as to work out a proposal or proposals for improving the existing regulations.*

4. My objective is to *highlight* – by describing the physical, chemical and biological methods applied in water damage response, together with their advantages and drawbacks

– the fact that it is not sufficient to merely eliminate contaminants (whether of a general nature or resulting from emergencies) from our water resources. *Owing to* an increase in importance of considerations of *sustainability and environmental awareness* among other factors efforts should be made to enable the adoption of practices of carefully designed *water pollution management of a biological background* and faster, and more effective *cooperation among* all of the *organisations concerned.*

RESEARCH HYPOTHESES

Setting up hypotheses necessitates an extension of the scope of the research. This thesis focuses primarily on underground water resources; however, owing to their very nature, it is imperative that a description of surface waters, and the impacts of climate change on surface waters, also be provided here because underground water resources are resupplied partly from surface water bodies and changes in their quality affect the quality of underground waters even in spite of the presence of the soil and other filtering functions.

1. Adequately designed protection, enshrined in statutory regulations, plays a major role in the mitigation of the environmental safety risks of public drinking water supply. Legal regulations must – if they are to fulfil their protective role – be suitably drafted. Certain disaster hazard occurrences, the possibility of third party involvement, the **complex issue** of contaminations inherited as a result of careless management and practices before the system change **entail risks even today. Such risks are very rarely analysed and assessed as part of water safety planning activities. The principle of prevention may only be applied and observed if even occurrences of very low levels of probability** but of potentially disastrous consequences, **are explored and taken into account.**

2. The relevant requirements laid down in pieces of legislation concerning water quality and water safety currently in force – Government Decree 201/2001. (X. 25.) and Joint Decree 6/2009. (IV. 14.) KvVM-EüM-FVM, issued by the Minister of Environmental Protection and Water Management, the Minister of Health and the Minister of Agriculture and Rural Development – **are not sufficient for ensuring adequate water quality. These decrees are fraught with loopholes, contradictions and shortcomings that may affect water quality.** Moreover **drinking water rating** is based on the statutory regulations and standard systems applied on a mandatory basis in drinking water supply. These systems comprise elements that are either without any real background applied in practice or not applicable to the medium for which they have been prescribed, as a consequence of which they **do not fulfil their functions; in other words, there is no general comprehensive method that should be applicable to and by all on a mandatory basis.**

3. **As regards critical infrastructure protection** the **statutory regulations pertaining to critical infrastructure protection, and underlying the designation of** domestic **system elements** – which were adopted in Hungary to ensure protection of underground water resources, as a consequence of legal harmonisation with the EU law, and which are in force even today – do not, or **not adequately, deal** with certain risk factors. Moreover, the **concept background** comprised in them **is not** sufficiently **unambiguous either**, as a consequence of which the **implementing decree is not**, in its current form, **suitable** for designating in practice the critical infrastructure elements in the planning of protection.

4. The **need for sustainability** may, also in the field of water safety, require that the **methods of damage control applied in the wake of contaminations be shifted**, to the extent possible, from the physical-chemical methods known and used so far, **towards** the use, in part or in full, of **methods** based on **a biological approach supported by environmental awareness**. This however, is impeded by the **absence** of **coordination** – **with the aim of introducing biological methods as quickly as possible** – of the existing and currently developed **capabilities** with the **requirements** as they emerge.

RESEARCH METHODS

Based on, and in order to accomplish, the research objectives built up in view of, the title of the thesis, and to prove the hypotheses set up, I used a variety of research methods. In addition to the studies prescribed by the university context, I put together an individual study and research plan in order to support the accomplishment of my scientific objectives and the confirmation of my hypotheses.

I gathered and studied authoritative domestic and international literature on the topic, including publications, studies, pieces of legislation, manuscripts and online sources, together with some of the most recent research findings, using the lessons drawn, in the various chapters of my thesis. I interviewed, and consulted with, renowned and recognised professionals and researchers of the various fields of relevance to gather as extensive information as possible concerning the subject of my thesis.

In addition to gathering literature on my own and then processing the material so collected, on the basis of face to face consultations I conducted targeted research in libraries and I visited institutions, laboratories engaged in testing water for the purpose of rating as well as waste water treatment plans.

In the course of my research of the subject I applied a variety of techniques to accomplish my goals, such as *analysis, synthesis, induction and deduction.*

I carried out analyses in exploring environmental safety factors, in gathering relevant pieces of legislation and collating factors threatening water resources, as well as in examining the standardised background of water quality control activities. Having

explored the applicable statutory regulations, I applied the technique of synthesis in collating those in which I see shortcomings and/or terminology/concept ambiguities in the existing rating system.

By way of induction I highlighted deficiencies in the standardised procedures applied in rating drinking waters.

I used the deductive method in drawing attention to issues relating to implementing decrees concerning the designation of critical infrastructure elements.

I carried out a questionnaire survey concerning the population's habits as regards drinking water, methods of using water and possibilities for reducing the amount of water wasted. I edited and proof-read technical and professional publications.

I participated in domestic technical/professional conferences and forums (delivering presentations and among the audience), and in study tours, and compared the lessons drawn and experience gained, with my scientific results achieved so far, drawing conclusions and adjusting my results, as well as setting new research targets. I edited and proof-read technical and professional publications.

A BRIEF DESCRIPTION OF MY RESEARCH, BY CHAPTER

In my thesis I described water, as a fundamental element of our lives, first. In that chapter I discussed not only the characteristics and attributes of water but also reasons why it is indispensable. I also described the water resources available in Hungary, in the Carpathian Basin and on Earth, along with (environmental safety) factors endangering water and our waters that affect our water reserves.

In the second chapter I made a detailed analysis of and categorised factors threatening water quality, pollutants and contaminants according to a variety of perspectives, highlighting their impacts on water resources and also emphasising how easily they reach and contaminate or pollute the water resources.

The third chapter of my study dealt with issues of the rating of waters, particularly its integration in and alignment to system of applicable statutory regulations. The currently effective and applicable statutory regulations contain a wide variety of contradictions and inadequate rules which – in my opinion – do not guarantee thorough analytical procedures and drinking water of adequate quality. I explored the rules on essential system elements and the regulatory background underlying their designation in this chapter, with the aim of proving how regulations currently in force, including their latest amendments, do not meet the relevant environmental safety requirements pertaining to water resources, particularly in view of their vulnerability and exposure to adverse impacts.

The fourth chapter includes a description of water treatment procedures and techniques, with a focus, in particular, on general day-to-day waste water treatment practices and

methods used in the removal of one-off pollutants or contaminants released by emergency occurrences. Biological techniques were also described, the increasingly widespread introduction of which is especially important for our future and the sustainability of our way of life. In addition to the methods I discuss details of the domestic water administration, damage control and regulatory system in place which – both on account of its fragmentation and the approach taken to the issue at hand – are not, in my view, suitable for enabling a shift in the methods of damage control towards biological, therefore sustainable, techniques regarded as desirable for our future.

SUMMARISED CONCLUSIONS

In connection with the hypotheses set up in my thesis I examined various segments of public safety statutory regulations pertaining to water resources. First I explored risk factors affecting water resources, assigning them to two categories: those of relevance to the quantity and those affecting the quality of water, and identifying contaminants and their sources. My research proved that all possible risk factors are still not realistically assessed and examined, despite the availability of ample experience accumulated over long years of work and efforts in this field. As a conclusion, I noted that risk analyses often fail to factor in the increasingly frequent occurrences of weather extremes triggered by the ongoing process of climate change and that no solution has been worked out for a comprehensive assessment of the areas of former chemical plants that have been closed down by now.

As regards water quality, I presented a list of examples showing how effective regulations of relevance to the rating of waters contain major loopholes which are bound to affect, and be reflected by, water quality assurance.

I reflected on the differences between the meanings of the terms “water resource” and “water withdrawal facility”, along with the associated risk factors. In case protection continues to be restricted to water withdrawal facilities and is not extended to cover water resources as well, in certain critical situations the population will continue to be exposed to the uncertainty entailed by the possibility of even a temporary loss or manipulation of certain water resources.

From the results of my research and the facts found, I concluded that it is the very fragmentation prevailing among the competent authorities and the control and authorisation functions in the protection of waters that makes it impossible for sustainable water treatment and damage control techniques to be increasingly widely adopted.

NEW SCIENTIFIC RESULTS

1. By way of my analyses and by processing and comparing the available data as well as by performing various examinations and tests I proved how vulnerable and easy to manipulate our underground drinking water resources are. I established the relevant risk factors and proved how important it is that they be taken into account in water safety planning activities, highlighting that these are often disregarded in assessments of environmental risks pertaining to public water supply.

2. I performed analyses to drive home the fact that the effective Decree 201/2001. (X. 25.) on the obligations pertaining to water quality and water safety planning and Joint Decree 6/2009. (IV. 14.) KvVM-EüM-FVM, issued by the Minister of Environmental Protection and Water Management, Minister of Health and Minister of Agriculture and Rural Development setting out limit values do not, at the level of statutory regulation, provide comprehensive support.

Describing the domestic practice of water rating I drew attention to the fact that in its existing form the system is not adequate, the standardised rating procedure has become outdated and it does not even fulfil its function properly. Having found loopholes and deficiencies in the existing legislation I made proposals for technical solutions and worked out the necessary directions of development.

3. By reviewing the decree on the designation of critical system elements and analysing the quantitative data contained in its, as well as by contrasting the technical data of water facilities in Hungary to cases of contamination during the recent period I proved that the decree on designation cannot fulfil its role. Having reviewed the list of system elements to be designated as crucial I also pointed out that our water resources are not sufficiently protected in regard to the cases of contamination described. Based on the above I worked out the list of parameters that should be integrated in the applicable pieces of legislation in the way of clarification can help eliminate the above loopholes.

4. By a comparative and descriptive analysis of the methods applied in the decontamination of underground water resources I identified the advantages offered by bioremediation techniques over conventional physical and chemical processes, together with the reasons why, consequently, they should be introduced in order to promote sustainability. By comparing scopes of duties of institutions affecting the choice of damage control techniques I highlighted overlaps and deficiencies in collaboration among organisations, identifying a body that could take care of central management or coordination.

RECOMMENDATIONS OF THE THESIS AND THEIR PRACTICAL APPLICABILITY

I recommend the results of my thesis primarily to the attention of those engaged in the drafting of legislation. In addition to experience and guides already available this thesis may also be taken into account in working out amendments to the existing regulatory background. My findings and conclusions may help those working out statutory regulations avoid leaving contradictions, gaps or errors in their proposals to be submitted to specialised committees for commenting and approval. Reviewing my thesis may also provide advice and useful notes for use during the mandatory reviews of already existing regulations and decrees.

Moreover, I recommend it for use by individuals and businesses engaged in water damage response and/or waste water treatment, drawing attention to the need for giving preference to biological damage control techniques to facilitate the sustainability of our way of life. Biological methods should also be introduced in waste water treatment as well, since the technology based activated sludge method based on biological processes provides significantly more effective access to drug residues and hormones contained in waters. Moreover, Hungary has adequate capacity in this field, with a significant number of recognised professionals working on the development and improvement of adequate methods.

I offer my thesis both to those engaged in providing training in the field of disaster management, in relation to general water-related subjects, e.g. chemistry, and to those delivering lectures at higher education institutions concerning technical matters relating to cases of water contamination, e.g. water treatment or purification, environmental protection.

As I pointed out in the chapter on practical applicability, I offer this piece of work to businesses and professionals engaged in disseminating information and/or knowledge among the general public.

LIST OF THE AUTHOR'S PUBLICATIONS ON THIS SUBJECT

Proof-read articles in periodicals:

- Hajnalka Hegedűs: Auswirkung von feuertechnischen Eingriffen, HADMÉRNÖK XIII: (KÖFOP special edition) pp.62-76. (2018)

- Hajnalka Hegedűs: A felszín alatti vizek szennyezéseinek eltávolítása, a vízminőségi kárelhárítás módszerei, 2. rész (*Removal of contaminants from underground waters, methods of water quality damage control, Part Two*), HADMÉRNÖK XII:(2) pp. 151-162 (2017)

- Hajnalka Hegedűs: A Magyar Honvédség fenntarthatósági törekvései a hulladékgazdálkodás terén (*Efforts of the Hungarian Defence Forces towards sustainability in waste management*), Műszaki Katonai Közlöny, XXVII: (3) pp. 224-238 (2017)

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- Hajnalka Hegedűs: A haderő és a háborús konfliktusok vízkészleteket, vízminőséget befolyásoló szerepe (*The role of the army and armed conflicts in affecting water resources and water quality*), HADMÉRNÖK 2016/1.: pp. 79-88. (2016)

- Hajnalka Hegedűs: Wetland Ecosystems in Hungary's Nature Conservation Areas and Problems Relating to their Economic Utilization, from the Aspect of Nature Conservation, ACADEMIC AND APPLIED RESEARCH IN MILITARY AND PUBLIC MANAGEMENT SCIENCE 15:(2) pp. 121-140. (2016)

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- József Dobor, Zoltán Grósz, Rebeka Szendi, Hajnalka Hegedűs (10 %): Über die Belange der Bildung naturwissenschaftlicher Fächer für die Studiengänge des Katastrophenmanagements im Hochschulwesen Ungarns, HADTUDOMÁNYI SZEMLE 7:(4) pp. 133-141. (2014)

SCIENTIFIC BIOGRAPHY OF THE PHD CANDIDATE

Name: Hajnalka Hegedűs

Place and date of birth: Budapest, 28.02.1976

Studies: She obtained her first degree from the Teacher's Training College of Eötvös

Loránd University, as a teacher of literature and language in German and Russian. Thereafter she obtained an university degree in the Russian language from the Language Institute of the Faculty of Economic Sciences of the Budapest University of Technology, where she also passed an examination as technical interpreter and translator. At the same time, she completed the Hungarovox literary translator course in German and acquired advanced qualification foreign trade sales and customs administration in the National Register of Vocational Qualifications, in a training programme operated by KOTK, Foreign Trade Training Centre.

She commenced her BsC studies at the disaster management administration department of Zrínyi Miklós University of National Defence, specialising in local governmental functions, in 2010. Finishing her studies there, she took up another course at the National University of Public Service, specialising in defence administration management with a focus on disaster management.

She started studies as a full time student with scholarship in the context of the Military Technical Doctoral School at the Institute of Disaster Management. She finished the last three terms at the Institute of Military Leadership Training.

Language skills: She has an advanced type C certificate of proficiency in German, plus commercial language skills and an advanced type C certificate of proficiency in Russian, plus technical language skills. The process of obtaining intermediate type C certificate of proficiency in English is in progress.

Professional career: During her career so far she has organised a number of domestic and international professional conferences on a wide variety of subjects, including sustainability and environmental protection. She has proof-read or edited a number of books, including one written by Dr. Schuster, former Mayor of the town of Stuttgart, published in Hungary with the title 'Fenntartható városok – a jövő életterei' (*Sustainable towns – living spaces of the future*).

During her years of training she delivered presentations in a number of conferences, she participated in the evaluation of Academic Students' League works and theses for degrees and chaired doctor candidate conferences. Moreover, teaches her fellow students languages and proof-reads articles. In addition to the Hungarian, she publishes works in German, Russian and English.

She submitted a successful piece of work in the Concha Győző Doctoral Excellence Programme and participated in one of the Ludovika Priority Research Workshops as scientist and administrative staff member.

Budapest, 24 March 2018

Hajnalka Hegedűs