AUTHOR'S REVIEW OF THE DOCTORAL (PHD) DISSERTATION

UNIVERSITY OF PUBLIC SERVICE
FACULTY OF MILITARY SCIENCE AND OFFICER TRAINING
DOCTORAL SCHOOL OF MILITARY ENGINEERING

Zsuzsanna Priváczki-Juhászné Hajdu

Increasing the effectiveness of inland excess water protection, with particular attention to the groundwater flood phenomenon

Supervisor:

Dr. Árpád Muhoray, Civil Protection Major General (ret.),
honorary university professor, PhD

Budapest, 2023.

FORMULATION OF THE SCIENTIFIC PROBLEM

I have selected inland water protection as the topic of my scientific research within the field of water damage control. My aim was to study the effects of the groundwater flood phenomenon and the changing land use practices on excess water protection systems.

Combating water damage in our country has a centuries-old tradition. Extensive inland excess water flooding events typically occur during periods of significant river-flooding, especially in the Tisza Valley. As the human resources of the organisations involved in protection are limited, it is essential that protection tasks should be carried out in an emergency with effective cooperation between organisations.

The relevance of the research topic is underlined by the fact that as a result of the observed and predicted impacts of climate change, the frequency of inland excess water events is expected to increase in Hungary, mainly due to the variable seasonality and more extreme intensity of precipitation. At the same time, the duration and severity of droughts is expected to increase, which necessitates the coordination of flood and drought management measures.

In my research I identified and examined the following main problems on the topic of inland excess water:

1. Inland excess water discharge in the border plain areas can be provided by transboundary canals and rural drainage systems. This can be carried out on transfer from our territory to the territory of a neighbouring country, or from the neighbouring country to the domestic recipient’s water systems. My research is focused on the inland excess water as surface water and the groundwater relationship. Groundwater movements exist independently of national borders and have an impact on surface water systems in the neighbouring countries. The institutional framework of cross-border water damage management is formed by transboundary conventions and regulations on water. The question raised is whether the actions set out in the present agreements will ensure the implementation of the water damage mitigation measures required in the affected areas of Hungary in the context of the expected extreme water events of climate change and at the same time the implementation of the requirements formulated in the international water conventions. What is the influence of EU common regulations on the Parties' cooperation on inland water, in particular the implementation of the Water Framework Directive, which aims to improve the ecological status of waters?
2. The human resources of the organisations, which are responsible for water damage prevention, are limited during the disaster response periods; therefore further cooperation

should be encouraged between these organizations. To explore the legislative environment of the inland excess water protection task, a joint examination of the disaster prevention and the water management legislation is necessary. The competences in the field of water management, the situation of the water management directorates and the legal framework for the implementation of water damage control activities are also constantly changing. In many cases, the different ownership, operational and property management structures of the canals cause disruption to the conservation work. The question arises as to how the changes in legislation in recent years have influenced the water damage protection activity, the organisations of the protection administration and their cooperation. The question is how it will affect the feasibility of protection activity from 2014 by the change in ownership and management circumstances of the water protection infrastructure.

3. To support the decisions of the protection manager in prevention, the knowledge of excess water inundation as a natural hydrological phenomenon and the capacity of the water system are essential. The technical guidelines for the calculation of water discharge to water systems only indirectly address the impact of the groundwater. This poses the question of how, for example, the effective capacity of a water system is influenced by the additional load from groundwater flooding, which would affect the success of the protection action. A preliminary analysis of the available data shows that the infrastructure of water management, as drainage channels, pumping stations and other structures are highly affected by the ground water phenomenon. A surplus water event may occur in the pilot area even when not justified by the local hydrological situation. The question arises as to how the spatially and temporally varying excess water volume will affect the technical drainage facilities, because knowledge of the specific characteristics of the areas is necessary to the decisions of the protection manager.

In the development of inland water situations, the approach is in the literature so far has mainly focused on the determination of surface accumulations, so the loads are generated by the accumulation of precipitation and snowmelt on the ground. Both the theories describing the generation of inland excess water floods and the specifications and standards defining the design of drainage systems have mainly focused on the surface accumulation process, while the treatment of groundwater issues relies on generous estimates. Experience in inland flood protection has shown that groundwater movement and upward flow, especially in areas affected by the groundwater flood phenomenon, is also an important element in the occurrence of inland water floods. The dynamics of groundwater changes, including regional influences on groundwater changes, significantly determines the development of inland excess water protection tasks, the length of protection periods and the resources needed to mitigate them.

Based on my literature research and my own experience, there have been significant changes in catchment areas in the last decades: changes in former land use (e.g. increased built-up areas, development of low-lying areas, etc.), which have an impact on the runoff process of waters. Other discharges (e.g. treated wastewater, thermal sewage) have also been added to canal networks, which have an impact on the performance of the water systems. In some areas, changes in land use have increased the vulnerability to damage due to the appearance of the protected value.

4. The loads on regional water systems have therefore changed, but there is no quantitative data on these loads to make better-informed decisions by the Chief Executive. This has a negative impact on the effectiveness of inland excess water protection and water safety. There is currently no consensus on how to quantify the effects of these changes and how to define the impact of loads on inland water systems.

I have developed my research hypotheses and objectives in order to address the scientific problems described above.

RESEARCH HYPOTHESES

After defining the scientific problem, I established the following hypotheses for the realisation of my research task:

1. I assume that the current practice and regulations of inland excess water protection in the transboundary areas need to be revised in order to adapt to the extreme water situations expected due to climate change.
2. I suppose that further possibilities can be revealed to ensure effective protection against inland excess water damage, especially in prevention actions, for this to be achieved cooperation is needed between public administration organizations.
3. I assume that the designing guidelines for water systems do not give sufficient attention to the discharge coming from groundwater, especially in areas affected by the phenomenon of groundwater flooding. I also assume that in catchment areas the changed land use practices and human activity have modified conditions in accumulation and runoff of waters, which causes different loads and discharge that could not be taken into account by the current designing methods. It is assumed that the impact of human activity and the effects of groundwater and groundwater flooding on water system can be determined by hydrodynamic calculations.

4. I presume, that on the basis of my research and modelling, a general methodology can be defined which can be used as a basis for a uniform approach to redesigning other water systems with coordinating flood and drought management measures to support the decisions of the protection manager.

THE RESEARCH OBJECTIVES

I have defined my research objectives to validate my hypotheses in order to investigate the scientific questions presented. To achieve, I have set the following research objectives:

1. International relevance of inland excess water protection:

   I explore the historical development of transboundary water conventions and the specificities of transboundary water systems.

   I examine whether, in the case of water management extremes due to climate change, the current regulation on inland excess water protection provides an adequate framework for the implementation of measures for transboundary excess water protection activities and also drought damage mitigation, moreover for achieving the good ecological status of waters.
2. As regards the cooperation between organisations involved in protection:

   I examine the role of the state as a leader manager in excess water protection through the history and the legal background of excess water protection.

   I explore the further cooperation possibilities between organisations in disaster prevention activities to improve the effectiveness of excess water protection, in particular in the case of excess water flooding causing disaster emergencies and also in prevention.
3. In the context of determining the load on inland water systems:

   I examine the current design methods for calculating loads in water systems to determine their ability to detect and manage discharge from groundwater, including the groundwater flood phenomenon, and load from changing land use practices, which knowledge is necessary for effective implementation of excess water protection activity.

   Therefore, I identify and systematize that those human activities and changing land use patterns have a presumed effect on the accumulation and runoff of inland excess waters.

   In national and foreign examples I study the relevant hydrological models that are able to describe the hydrological processes of excess water floods and also to show the impact of groundwater and also the changing practice of land use on water systems.

   I explore and analyse with the selected hydrodynamic model in a pilot area, that is affected by the groundwater flood phenomenon, the plus loads in drainage water systems comes from groundwater and also because of the changing practice of land uses.

4. In the context of general methodology:

   Based on my research and the pilot modelling results I investigate the feasibility of developing a general methodology which is available for redesigning other water systems.

THE RESEARCH METHODS

In my research, I used a variety of methods to achieve my different research objectives. These research methods are:

1. I used the method of comparison and generalisation to investigate the legal background of inland excess water protection and water damage management. I examined the relevant literature and legislation in Hungary and abroad. I also investigated databases, plans, technical materials, reports of the water directorate and other organisations. My research involved both the study and processing of relevant documents. I also examined activities of inland excess water protection in the border countries.
2. I carried out chronological studies in the course of researching legislation, and also in the processing and analysis of hydrological and protection data.
3. Using the analytical-logical method, I analysed the current legal regulatory environment, hydrological and data of protection activities, and concluded and made recommendations based on the results.
4. The empirical method was mainly based on personal and other experts' experience in the field, typically implemented through the analysis of the results of available inland water protection measures.
5. Using the method of deduction, I utilised other modelling experience to build the pilot area model.
6. I have used a range of natural science contexts and technical approaches to the numerical modelling method to investigate inland water runoff processes.
7. During my research work, I regularly consulted with recognised experts.

In addition to the methods mentioned above, my research was greatly assisted by the professional interviews I conducted, as well as by participation in professional events and conferences. The experiences and results were also included in my thesis. I also gained useful experience in the preparation of a joint professional article with a student from another doctoral school.

A BRIEF DESCRIPTION OF THE STUDY PERFORMED BY CHAPTERS

1. Examining the international aspects of inland water protection

   While inland flooding as a water damage event can basically be considered as a local damage event, this specific protection activity in transboundary water systems also has an international implication. In this chapter, I describe the occurrence of water damage in relation to international disasters.

   I present the results of climate research so far, which indicate that we should expect an increase in extreme weather events. The chapter introduces the conventions on inland excess water protection in the cross-border areas of Hungary. It demonstrates how other international conventions and EU directives on water protection are reflected in cooperation with neighbouring countries. I reveal the territorial specificities of the Boundary Waters Conventions and examine measures to manage insufficient and water scarcity situations in addition to inland excess water protection.

2. Examining the role of the state in excess water protection activity

   In the second chapter of the thesis, I examine the basic concepts related to excess water security. By presenting the geographical location of our country, the risk of excess water inundation, the history of water regulation and the process of legislation on water damage, I show through a historical process, how the role of the state in the excess water protection activity has evolved in our country.

   I jointly assessed the inland water and drought vulnerability of our country. I have examined the situation of the water management boards as the organisation responsible for water protection, also in connection with the takeover of the water works of the water management associations. I studied the work of organisations with a direct and indirect impact on water protection activity.

3. Examining the impacts of changing land use and the design of inland water systems, with particular reference to the land flood phenomenon

   The third chapter of the dissertation deals with inland excess water as a natural phenomenon from an engineering approach. The main types of inland excess flooding and the main natural and anthropogenic factors influencing the process are presented. I describe the phenomenon of ground water flooding, which is a specific type of the inland excess water. I analyse the natural, land-use and human-induced changes that are assumed to affect the run-off and

accumulation of inland excess water. I will examine current technical guidelines to determine the loads in designing water systems to support the decision of managers.

4. Pilot area modelling study - investigating the effects of ground water flooding and changes in land use practices

   The fourth chapter of my research deals with the quantitative quantification of water loads, the relevant hydrodynamic models are presented. I present the features of the pilot area in the construction of the selected model. Based on a field study performed for a specific period, I analyse the processes influencing inland water generation and the model execution results for the scenarios. To summarise the research, I present the proposed general methodology for the revision of river basins and water systems.

SUMMARIZED CONCLUSIONS

Based on my research, I have made the following conclusions:

In the context of the inland excess water protection, the Boundary Waters Conventions are of fundamental importance for our country. Today's water damage protection is typically concerned with the management of water surges („river" floods and excess water floods), which support the common practice of the inland excess water protection activity. However, adapting to the extremes of climate change requires a complex approach to water damage management in the response to periods of water surplus and scarcity. Therefore, in the future, cooperation should be complemented with measures to share water resources, restore natural waterways and create flexible water management facilities to manage the lack of water conditions.

Water quality and the complex solutions to water retention and the conservation of used water resources will be prioritised.

In Hungary, historically, the state has had a strong and significant role in the field of excess water control and disaster management, through its competent organisations in legislation, financing, implementation and also in management.

By analysing the impact of changes in the catchment area on the drainage system, I pointed out that, in the context of prevention, the coordination of a number of measures involving the responsibilities of other land users, institutions, local authorities, public authorities and the agricultural sector is necessary in order to ensure that the water management, including the protection against water surpluses and shortages, can be implemented at the level of society as a whole. Therefore, cooperation could be improved, especially in the field of prevention, for example in the water permit procedures. In this context, the use of land for

construction and agriculture purposes should be rational authorised to support inland excess water and drought protection activity, moreover protection activities should be supported in the water permit procedures.

The strengthening of the state's management and executive role has not been fully achieved due to the unresolved ownership of drainage works which was taken over from the water management associations by the water management directorates. Chaotic property ownership of the drainage system is a major obstacle to the establishment of a unified operator system and the successful implementation of water rights licensing procedures.

The transfer of the drainage water works from the water management associations to the water directorates imposes an additional workload on the directorates, and also means an additional demand for resources for the state to provide additional financial and Human Resources needed for the directorates to carry out the operation and maintenance tasks for implementing effective excess water control.

In addition to natural conditions, inland water generation is also influenced by human activity, on which processes the water management directorates have no significant influence.

I found that the existing guidelines for the design of drainage water systems are not able to describe the dynamic changes in the catchment area, moreover that the diagrams and basic data used for the design have become obsolete. A further problem is identified that there is considerable uncertainty in estimating the groundwater load on water systems. This state of uncertainty poses a risk to the implementation of the effective excess control activity.

Over and above the traditional computational methods, modelling means evolution in the complex numerical methods. After studying the main models identified in the literature, I selected the MIKE hydrodynamic model for inland water systems to carry out field studies. I performed and evaluated the results of the model calculation based on my procedure to detect and verify the impact of groundwater and groundwater flooding in the water system. Based on the pilot area results, I developed a groundwater load diagram in each point of channel test section. In this manner, I have confirmed the impact of the groundwater flooding phenomenon on the drainage water system in the relevant catchment area and its impact has been quantified.

By further developing the model, I quantified the water loads resulting from land use changing and human influences in the model area, and based on the studies, I determined and quantified the impacts of different scenarios I investigated on drainage water system...

The groundwater flood phenomenon in the pilot catchment area in period of 2010-2011 required such inland excess water protection action, which had a different nature from the quantitative and temporal occurrence of local rainfall activity. The difference has resulted from

the dynamic changes in subsurface water movement; the groundwater flow (pressure wave) came from outside of the catchment area. As a further result, the pilot area study demonstrated that the dynamics of groundwater flows are significantly different from surface processes, and therefore the impact of groundwater on the design of water drainage systems and also the establishment and implementation of inland excess water protection measures should be emphasised as a result of a dynamic process. My conclusion is that the groundwater storage of 2010 precipitation greatly reduced the damage of the 2011 drought.

Considering that hydrodynamic models are not available to detect and quantify the impacts mentioned above for each river basin, I recommend the elaborated methodology and quantified results of the pilot area to assist water damage management decisions.

Based on my research and modelling implemented, I have concluded that inland excess water and drought management need to be handled together with using a complex approach and measures.

A revised vulnerability assessment is needed for the agricultural sector. For example, a small scale inundation during the wet season may result in a surplus of crops. In the long term, the excess water flooding could be taken into account as a potential water resource being utilised later on in the area.

By creating flexible water management options, it is necessary to ensure the primary relief of inland areas by diverting water surpluses to less damage-sensitive areas or to less loaded water systems.

The loads on water systems should be reviewed. Wherever it is possible, alternative disposal methods to sewer discharge or delayed discharge should be implemented. For example, it should be necessary to inject back the thermal water used for heating purposes to the aquifer and to develop infiltration rate of rainwater, to equalization of the concentrated flows (treated wastewater, rainwater) into the drainage system should be discharged through temporary reservoirs, moreover, improving the water storage and management status of the soil would be necessary.

The issue of water quality is being increasingly raised due to the limited available water resources, which requires further consideration of water quality pressures on water systems. It is reinforced by the social demands on water management and water retention, for example in relation to recreational and leisure activities, moreover to increasing irrigation water uses.

NEW SCIENTIFIC RESULTS

The scientific results of my research are summarised below:

1. Based on my research on global climate change scenarios, I have ***demonstrated*** that in addition to inland excess water protection, drought protection must also be prepared in transboundary water systems due to the increase in extreme water events.

   On the basis of my preliminary investigations, I have ***established*** that the regulations of transboundary water conventions concerning transboundary water systems emphasise provisions only for periods of surplus water surges.

   I also ***found*** that a general review methodology is needed to identify common measures for the management of drought periods in transboundary water systems, the improvement of ecological status under the Water Framework Directive and the restoration of natural flow conditions.
2. By examining the new functions of canals, I have ***determined*** the capacity of the inland water systems, that, in order to reduce the negative impact on inland water protection and improve prevention, cooperation is needed between the organisations. Moreover, to ensure the priority of inland excess water protection activity it is also necessary to uniform the procedures for the water rights authorisation of channels with unresolved ownership and also in multi-purpose water systems
3. Based on the analysis and systematisation of the impacts of human activities and land use change on water systems, and the review of the current guidelines of designing methods of water systems, I have ***confirmed*** that the methods currently used are not suitable for determining dynamic and time-varying processes such as groundwater level change (groundwater flood) and the loads resulting from land use changes. In order to solve the scientific problem - with the help of the hydrodynamic model and the methodological procedure I developed - I have ***quantified*** the impact of the groundwater mass on the inland water system, as the impact of the local specific phenomenon of groundwater flooding, and also the water loads generated by the land use changes on water system. My results in the pilot area contribute to the scientific agreement of technical measures and decisions of defence managers.
4. Based on my preliminary results and the pilot modelling, I have ***developed*** a coherent and complex revision methodology for catchment areas and water systems, which is generally available in case of water surpluses combined with water scarcity situations to support the planning and management decisions in any other water systems.

RECOMMENDATIONS

I suggest sharing my dissertation result with colleagues at water directorates or disaster management organisations who are working in water damage prevention or water management. I recommend public safety officers at municipalities, notaries, specialists working for water authority in licensing or for agricultural water management to read my paper, furthermore town planning engineers, legislators and also planners allocating grant funds. Statements of my thesis should be useful in rural development strategies and developing agricultural production support schemes. Moreover it can be used by all those professionals who can support the overall implementation of the complex approach in inland excess water and drought risk management and prevention.

In my paper, I have focused on the generation process and management of inland excess water, at the same time the need for coordinated measures to mitigate drought damages. I respectfully recommend my thesis to the lecturers of the National University of Public Service, the Institute of Disaster Management and the Faculty of Water Sciences, as well as to students of disaster management and water management.

PRACTICAL APPLICABILITY OF THE RESEARCH RESULTS

1. My research results on international conventions foreshadow the need of revision of water management conventions for drought situation approach and also for a complex approach of transboundary water management actions. The presentation of the international aspect of the inland water protection provides useful information for disaster management and water management professionals dealing with transboundary water management conventions.
2. The dual presence of the inland water and the drought draws the attention of professionals for prevention and a complex approach in addition the increasing emphasis on the combined management of water quality issues. Duality should be taken into account in water rights licensing process, planning of agricultural, irrigation, urban and rural developments and also in water management strategies.
3. The results of the pilot modelling highlight the importance of the groundwater load in drain systems. The developed methodology will present a more reliable estimation of groundwater loads.
4. The developed methodology of reviewing the present canal-systems will assist professionals in planning implementation of engineering tasks that support effective inland water protection.

LIST OF MY OWN PUBLICATIONS ON THE SUBJECT

PRIVÁCZKINÉ HAJDU ZS.: Groundwater flood, a special type of inland excess water phenomenon of the Southern Great Plain. In. HÁBERMAYER T. (ed.), *Disasters, risks, volunteers*, Szekszárd: Disaster Management Directorate of Tolna County, 2020, 177-188.
Online availability:
https://tolna.katasztrofavedelem.hu/application/uploads/documents/2020-05/71152.pdf

PRIVÁCZKINÉ HAJDU Zs. (2020): Inland excess water safety. In: HAUSNER G. (ed.), *Excerpts from the results of military engineering II*. Budapest: Ludovika University Publishing, 250-266.
Online availability:
https://nkerepo.uni-nke.hu/xmlui/bitstream/handle/123456789/16208/905_KDMI_II_hallgatoi_tanulmanykotet.pdf#page=278

NAGY Zs.; PÁLFI G.; PRIVÁCZKINÉ HAJDU Zs.; BENYHE B. (2019): Operation of canal systems and integrated water management - the Dong-ér catchment area. In. LADÁNYI Zs., BLANKA V. (ed.), *Monitoring, risks and management of drought and inland excess water in South Hungary and Vojvodina,* Szeged: University of Szeged, Department of Natural Geography and Geoinformatics, 2019, 83-96. (HU) 172-185. (SRB), 262 -275. (ENG)
Online availability:
http://www.geo.u-szeged.hu/wateratrisk/sites/www.geo.u-szeged.hu.wateratrisk/files/pdf/kotet.pdf

PRIVÁCZKINÉ HAJDU Zs,, MUHORAY Á.: Improving resilience of settlements situated in plain areas in relation to inland excess water flood and drought risk. „Polgári Védelmi Szemle" Journal, XIII special issue (2020), 238-266.
Online availability:
http://www.mpvsz.hu/hirek/706-megjelent-a-darenet-projekt-kulonszam

PRIVÁCZKINÉ HAJDU Zs., MUHORAY Á.: State involvement in inland excess water protection. „Hadmérnök" Journal, 13 4 (2018), 221-240.
Online availability:
http://hadmernok.hu/184_18_muhoray.pdf

PRIVÁCZKINÉ HAJDU Zs.: Impact of the water management situation of municipalities on vulnerability to inland water damage. „Hadmérnök" Journal, 13 3 (2018), 274-289.
Online availability:
http://hadmernok.hu/183_21_hajdu.pdf

PRIVÁCZKINÉ HAJDU Zs.: The inland excess water situation in Hungary in the light of the Boundary Waters Conventions. „Hadtudományi szemle" Journal, 12 3 (2019), 177-199.
Online availability:
http://journals.uni-nke.hu/index.php/hsz/issue/view/37

PRIVÁCZKINÉ HAJDU Zs., MUHORAY Á.: Increasing the resilience of plain settlements to inland excess water and drought. „Hadtudomány" Journal**,** 30 (2020), 31-54.
Online availability:
http://mhtt.eu/hadtudomany/2020/2020e/Privaczki_Muhoray_Telep%C3%BCl%C3%A9s%20reziliencia.pdf

PRIVÁCZKINÉ HAJDU Zs.,Endrődi I., MUHORAY Á.: New opportunities for inland excess water protection with a modern civil protection system. „Védelem Tudomány" Journal, 2 4 (2019), 183-210.
Online availability:
http://www.vedelemtudomany.hu/articles/10-privaczkine-endrodi-muhoray.pdf

PRIVÁCZKINÉ HAJDU Zs.: The challenges of inland excess water protection and drought management in dual-use water systems. „Polgári Védelmi Szemle" Journal, 14 Különszám (2022), 89-104.
Online availability:http://www.vedelem.hu/letoltes/document//478-kat5.pdf

PRIVÁCZKINÉ HAJDU Zs. (2014)**:** Analysis of the operation of the Orosháza pumping station during significant excess water periods or the need to revise the design guidelines. In. *XXXII. National Hungarian Hydrological Society Conference*. Budapest: Hungarian Hydrological Society, p 20
Online availability:
http://www.hidrologia.hu/vandorgyules/32/dolgozatok/word/0314_hajdu_zsuzsanna.pdf

PRIVÁCZKINÉ HAJDU Zs. (2016): Water management issues in the Hungarian basin of the Mures - surface water. In. *Papers of the XXXIV. National Hungarian Hydrological Society Conference,* Budapest: Hungarian Hydrological Society, 2016. p 9
Online availability:
http://www.hidrologia.hu/vandorgyules/34/dolgozatok/dolgozatok.html#1

PRIVÁCZKINÉ HAJDU Zs., KISS R., HORNYÁK S. (2018): Groundwater protection - aspects of the municipal water management in areas affected by ground water flood. In. *Papers of the XXXVI. National Hungarian Hydrological Society Conference in Gyula,* Budapest: Hungarian Hydrological Society, p 15
Online availability:
http://hidrologia.hu/vandorgyules/36/word/0416_privaczkine_hajdu_zsuzsanna.pdf

PRIVÁCZKINÉ HAJDU Zs., VARGA D., BÍRÓ T., HUBAYNÉ HORVÁTH N. (2019): Impact of land use changes on inland water protection infrastructure. In. *Papers of the XXXVII. National Hungarian Hydrological Society Conference.* Budapest: Hungarian Hydrological Society, p 20
Online availability:
http://hidrologia.hu/vandorgyules/37/word/0217_privaczkine_hajdu_zsuzsanna.pdf

PRIVÁCZKINÉ HAJDU Zs.(2019): Water management characteristics of settlements in flatlands. In. BÍRÓ T.(ed.), *Papers of the II. National Conference on Precipitation.* Budapest: Ludovika University Press, 2021, 221-235.
Online availability:
https://tudasportal.uni-nke.hu/tudastar-reszletek?id=123456789/16658

PRIVÁCZKINÉ HAJDU Zs.: Effect of ground water phenomenon on inland excess water protection infrastructures - hydrodynamic modelling in inland excess water research. Presented at „*PhD students in the service of science"* online conference, University of Public Service, Budapest, 2020. november 11.
Online availability:
https://kmdi.uni-nke.hu/aktualitasok/doktoranduszok-a-tudomany-szolgalataban-konferencia/2020

PRIVÁCZKINÉ HAJDU Zs. (2022): Inland excess water and/or drought protection. In. BODNÁR L.,HEIZLER Gy. (ed.), *Papers of the II. International Scientific Conference on the occasion of the World Day for Disaster Reduction,* Budapest: National Association for Radio Emergency and Infocommunication, (2022) 436 p., 118-127.
Online availability:
http://vedelem.hu/hirek/0/3784-nemzetkozi-tudomanyos-konferencia-a-katasztrofak-csokkentesenek-vilagnapja-alkalmabol-%E2%80%93-konferenciakotet

AUTHOR CV (RESUME)

I was born in Csongrád on 26 June 1968. I am married, mother of 2 children.

Studies

In 1991 I graduated from the Faculty of Civil Engineering of the Budapest University of Technology with MSc. degree in Civil Engineering. In the last semester of my studies I participated in an exchange programme at the Technical University of Leeuwarden in the Netherlands. In 1992 I graduated from the Finnish Tampere University of Technology with a degree in "Water and Environmental Engineering". In 1998 I graduated from the College of Finance and Accounting with a BSc. in Economics.

Professional career

I started as an engineer at the Lower Tisza Environmental Authority, and then worked for UTB Ltd., a company that built wastewater treatment plants.

Since 2003, I have been working for the Lower Tisza Water Management Directorate (ATIVIZIG) in the field of inland excess water protection and water damage prevention.Between 2013-2019, I worked as Head of the Water Protection and Watershed Management Department, and since 2019 I have been working as Head of the Water Planning and Irrigation Department. From 2005 to 2020, I was Head of the Directorate's Central Technical Service, and from 2020 till now I am deputy leader of the directorate's protection organization.

Educational and scientific activities

In addition to my professional work, I am also involved in teaching activities, for example as a consultant for Bsc and MSc engineering theses, as a guest lecturer in professional engineering and other technical courses, as a tutor in internal training courses and as a professional helper for young engineering colleagues.

I have been a member of the Hungarian Hydrological Society since 2003, since 2007 I have been the secretary of the Szeged organisation. I have been a member of the Hungarian Military Science Society since 2017.

Motivation goals

Based on my experience in the flood and inland excess water protection activities implemented, I was motivated by the need for higher professional work and a deeper understanding of the generation of excess water and the phenomenon of the special groundwater flood, which I carried out within the scientific framework provided by the Military Technical Doctoral School.

Budapest, February 2023.

Zsuzsanna Priváczki-Juhászné Hajdu