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Differentiated flood-prevention in Hungary

Author's introduction of the Doctorial (PhD) dissertation

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Formulation of the scientific problem

"*There are few places in the world where floods, excess water and droughts with serious consequences can occur at the same time. The Carpathian Basin, and especially the Hungarian part of the Tisza Valley, is such a place. Knowing, predicting and forecasting floods, excess water and drought as well as possible is extremely important for the entire society and the economy. It is necessary to prepare for these water damages in that particular cases we have to protect and adopt as much as possible*". (Imre Pálfai: Excess water and floods, Hydrological studies, Budapest 2004, p. 433)

The effects of climate change can no longer be studied by ordinary people only from textbooks, but can be "*felt on the skin*" during the daily life. Dealing with the effects of extreme weather requires new methods.

The extreme droughts that can be felt today are also due to climate change. In addition to dealing with periods of water shortage, however, we must also be aware, that greater flood than ever before can occur on our rivers at any time. For these extremes caused by the weather, completely different technical solutions have to be applied. Water is one of Hungary's greatest natural assets and perhaps the greatest source of danger. More than a 25 % of the country lies below the flood water level of the rivers. There are several reasons for this. Our exposure to floods is due to our basin-like geographic location, and from the fact that our ancestors settled along the river, and later, most of the agricultural and industrial production was also established here.

As time progresses we started narrowing the areas flooded by rivers to increase the cropland. River regulation and flood protection development works have become essential for the economic development of the country. The narrowing of the floodplains, on the other hand, was accompanied by an increase in our exposure to floods. Long time ago we were able to live with nature and the floods, but now the “modern” population "regulated" the rivers with advanced technical knowledge. We cultivated the valuable agricultural land and located most of our industrial activities near the navigable rivers.

The flood water levels are demonstrably increasing on our rivers thus potentially endangering larger and larger areas. The recent events also prove this tendency. In recent decades, the trend of flood water levels measured on the Hungarian rivers has been increasing, and the occurrence is also increasing. The Hungarian legislation is clear. To guarantee the protection against floods is a basic task of the Hungarian State. Currently, in a significant part of the country, the flood water level that occurs once every hundred years (100 year return period) is considered the

basic data for planning. The only exceptions to this are the cities with a special risk, where this level is the flood level that occurs once in a thousand years. (1000 year return period)
The Hungarian flood protection strategy is a complex issue with socio-economic and technical aspects. The tasks and the goals are clear: we must create a flood protection system that is based on socially acceptable risks, economically tolerable and technically feasible, as well as sustainable in the long term. Dike heightening and development of our flood protection dikes are an essential part of our flood protection strategy, but on the other hand, great emphasis must be placed on the maintenance of the flood conveyance zones, the building of the flood peak reduction reservoir system and for our human resources performing operational flood protection activities. These four building elements, which cannot be separated from each other and increase the effect of each other, and meaning the backbone of our flood protection.
We squeezed the rivers into their flood river beds, which also meant that if we did not maintain flood conveyance capacity in this narrow lane, we would have to raise our flood protection dikes "to the skies". However, the increase in extremes caused by climate change requires a new approach from us. Thanks to modern technical developments, hydrodynamic models are available to us, which can be used to obtain a more accurate picture of the processes taking place in flood river bed. In accordance with the provisions of the European Union's Floods Directive, we have developed flood hazard and risk maps on the protected floodplains. (Riverine floods). Using flood risk, hazard plans and maps, I believe that in our future flood protection developments, not only flood levels based on hydrological statistical calculations can be considered as a planning basis, but also a differentiated development level approaching from the protected side, taking into account the flood risk reduction there.
By differentiated flood-prevention I understand the following:
The basic objective of the differentiated development, which is the development based on the protected side flood risk value of the flood protection dike, is to create a sustainable flood protection system which, in addition to creating flood protection safety, has a clear social acceptance and effectiveness.
Development to a differentiated flood protection level ensures a more efficient use of limited resources, thus maximizing flood risk reduction compared to development expenditures. The facts presented above highlight that the time has come for a paradigm shift in the Hungarian flood control, which is also urged by extreme weather conditions. In my opinion, the data is available that can help to develop a risk-based flood protection strategy.

Research hypotheses

In my thesis I would like to verify the following hypotheses:

- ***I assume*** that comparing the results of the survey conducted among colleagues working in the water management sector with national and international practice will help in determining the basics of the risk-based flood protection, and it can be proven that its implementation increases the efficiency and economy of the flood protection.
- ***I assume*** development and flood protection data in the water sector can demonstrate the difficulties and limitations of maintaining the current flood protection strategy in the long term. I also assume that the using the completed flood hazard and risk maps, the equivalent strength of flood protection lines can be achieved, furthermore, the expected results of flood protection development planned on flood risk based can be quantified.
- ***I assume*** that studies of regulations and flood control strategies of countries with similar geographical and hydrological situations can be used in the Hungarian development based on flood risk value.
- ***I assume*** that the flood protection developments should be implemented in locally weak points or weak sections in our flood protection system, because by eliminating the locally weak points, with relatively little cost, a significant reduction in the value of flood risks on the protected side of flood protection dike can be achieved.

Objectives of my research

In my dissertation, I undertook to create the foundations of a differentiated flood-prevention strategy based on the protected side risk values of flood protection dikes and to highlight that the current, rigid regulation cannot be sustained in the long term due to the increase in extremes caused by climate change.

- ***My aim*** is to present the opinion of recognised professionals working in the water management sector through the survey and evaluation of it, and to present the possibilities of risk-based flood development based on international practical examples and to prove its efficiency and economy.

- ***My aim*** is examining the changes in the Hungarian flood protection strategy, I should prove that the level of development calculated on risk bases is a sustainable solution in a long-term.
- ***My aim*** is prove the correctness of the differentiated flood-prevention strategy by examining and analysing the flood protection development concept of the neighbouring countries and to explore the methods and solutions that can be adapted during domestic protection.
- ***My aim*** is to demonstrate the calculation of the risk-based differentiated flood protection level through the example of the floodplain area of Szolnok. I also demonstrate that charging development to this level is cost-risk preferable to that required by current legislation.

Research methods

In order to implement the set goals, I worked with the following methods:

- ***With practical examples, questionnaire surveys and evaluations, I prove*** that it is necessary and timely to develop a more cost-effective flood protection planning level. I perform on-site non-destructive testing on a defined floodplain's flood protection line section in order to identify locally weak points and sections. Furthermore, I examine what legislative amendments are necessary for the implementation of a differentiated flood-prevention strategy, and I propose their introduction.
- By analysing the increase in extremes caused by climate change and changes in the flood riverbed, ***I examine*** how flood levels on our rivers have changed and are rising.
- ***I analyse*** the flood protection regulations and factors affecting flood protection capacity of neighbouring countries in order to be able to compare it with the development of the Hungarian flood protection strategy.
- ***I analyse*** the European Union's Floods Directive, the requirements of flood protection strategies of neighbouring countries, factors of affecting flood protection capacity and the practical experience of flood protection in order to compare it with the development and solutions of the Hungarian flood protection strategy.
- Based on the data, information and calculation methods available to me, ***I present and quantify*** the flood risk-reducing effect of load reduction and resistance flood protection measure. I am modelling the effects on the protected side the following interventions:

building of flood protection dikes, operational flood protection activities, the resistance of flood protection dike, and reservoir effects.

The structure of the dissertation, a concise description of the study carried out by chapters

My doctoral thesis consist of 5 chapters. The thesis deals in detail only riverine floods (rivers which has flood protection dikes, protected floodplains) and I did not elaborate on the flood safety in small water courses (pluvial floods) due to the limitations of length.

In main chapter 1. I presented the professional actuality of my research topic, my hypotheses, objectives and research methods. I explored and evaluated the research conducted so far in the national and international literature on risk-based flood planning and development.

I defined the concepts I used in my dissertation and I presented the Jenő Kvassay Water Strategy. The strategic plan also identifies the topic of my research, the introduction and subsequent application of considered protection and differentiated flood safety, as a conceptual change. It also states that the defence system must be sustainable and financeable, thereby creating public engagement in line with budgetary possibilities.

I also mentioned the flood hazard and risk maps, which Hungary had to prepare based on Directive 2007/60/EC of the European Parliament and of the Council.

In main chapter 2. I explored the development of the Hungarian flood protection system and the organizational structure and evaluation of flood protection.

Due to our geographical and hydrological features, the flood protection is one of the most important segment of the Hungarian water management. About 10% of the world's population is truly vulnerable to flooding. More than 20% of Hungary is floodplain area due to river valleys and small watercourses, so it is one countries with significant flood problems.

The country's exposure to flooding is extraordinary, which is reflected in the pace of development of the Hungarian flood defence system. However, we must evaluate progress not only on the basis of numerical data, but also take into account that, this work is based primarily on the voluntary and often difficult sacrifice of those affected, as well as on significant support from the State, and has often been carried out without knowledge of hydrology and soil mechanics and by the simplest means.

Nowadays, the water-related phenomena play a fundamental role in the closely interrelated relationship between social and economic and the natural environment. These processes can only be fully understood if we consider their complex relationships with the social and natural environment, as well as with hydraulic engineering solutions and methods. With their help, it is possible to reconcile natural water conditions with social needs.

Due to the large-scale water management developments carried out in neighbouring countries, increasing the safety of flood protection was high importance, because the waters that flowed faster to us, the lowland (downstream) country, were congested, and due to the uncompleted state of flood protection works, they could pose a serious risk of flooding in several places. Until the flood protection system were built in with the proper safety, the dike ruptures was causing significant damage on any incomplete or lack of height dike sections. Where the flood protection system were built with adequate security, the flood protection activity was more economical, safer and resources could be mobilized more efficiently. In order to take an effective flood protection action, it is crucial that specialized, organized and experienced experts are able to prevent and mitigate the flood related damages. Our present flood protection organization was developed from these considerations and defensive experiences.

In order to determine the strengths, weaknesses and possible development directions of the flood protection system objectively, not only through my personal perspective and experience, I completed a questionnaire survey.

The survey was prepared in order to provide a basis for further research on flood preparation, maintenance, operation and protection, and provide a conceptual approach to flood planning based on protected side risk, thus indirectly highlighting the paradigm shift in the calculation of planning baselines (flood design water levels).

In my opinion, it is the responsibility of the water management sector to propose directions for flood development. Of course, the formulation of flood protection developments requires serious planning and preparation, during which social needs must be identified as accurately as possible and the most cost-effective technical interventions must be implemented.

In main chapter 3. I analysed the changes in the strategic directions of flood protection in Hungary over the past 50 years, as well as the challenges of water management in the light of climate change.

In my opinion, it is currently an important task of the Hungarian water management to apply differentiate flood protection developments based on safety aspects in accordance with the needs of the population, protected values and agricultural areas, in order to ensure that investments are economical and the flood protection system is sustainable. Sustainable flood protection must meet the basic requirement of being able to monitor the development of water management at multiple levels and in multiple areas and to take immediate action to prevent dangerous situations from developing or reducing damage.

Because we live, work and plan in a natural geographic and hydrological environment where weather conditions vary and can change within a year, there is room for facilities and mindset in the water management sector that manage these changing conditions in a complex way.

The composition of the Earth's atmosphere and the evolution of currents in it are influenced by many external and internal factors. Our climate characteristics can change rapidly in the short term, making it difficult to verify the effects of climate change and determine how it affects the human activity.

However, the scientific evidence for global warming is growing, and we are also learning more about the process of climate change and its possible consequences. The Earth's atmosphere is closely linked to other parts of the natural environment, such as oceans, ice sheets, terrestrial layers, and wildlife.

As a result of changes in external factors – radiation from the Sun, in the Earth's orbit – and as a result of these interactions, the climate has changed and is still changing.

In the last two hundred years, the impact of human activity has reached a level that can bring about a fundamental change in the state of the earth's atmosphere and, more broadly, the earth's environment. Since the Industrial Revolution, due to the increasing use of fossil fuels – coal, oil, and natural gas – and the accumulation in the atmosphere of ozone-depleting substances emitted by industrial activity, the state of the atmosphere typical of previous millennia has changed. It is a fact that global climate change can periodically lead to extreme environmental conditions. The environmental change can have a significant impact on society, including through changes in water management, flood protection or radical changes in the conditions of agricultural activity.

The Hungarian water management is also affected by extremes triggered by climate change. Among the root causes of these, temperature and closely related precipitation have the greatest and most direct effect, so I presented their characteristics in detail.

I presented in detail the calculation of Flood design water level which is the basic planning data, the role of flood peak reduction reservoirs, as well as the planned interventions in the riverbed and these flood level decreasing effect. In addition to the planned interventions and calculations, I analysed the causes of the increase in flood levels of domestic rivers using long time series data. As an influencing factor in the rising flood levels, not only the drastic increase in the frequency of weather extremes, but also the neglected condition of riverbeds and floodplains, the flood conveyance is blocked and flood capacity is decreased.

Due to changes in natural processes and human interventions, the probability of floods has recently shown an upward trend. In Hungary, new highest water levels have been formed in the past 20 years on the Danube 3 times (2002, 2006, 2013), on the Tisza 5 times (1998, 1999, 2000, 2001, 2006), but also on the Sajó, Hernád (2010), Mura (2014) and smaller watercourses. The new record flood water levels posed a major challenge for the Water Directorates, which is responsible for flood protection.

In the past 20 years, floods have exceeded previous records on more than 50 water gauges. Research has shown that rising flood levels due to improper land use, floodplains, oxbows and climate change will threaten more and more areas in the unprotected floodplains. If this process is not stopped, the area of the riverbed will continue to grow and floods will pose an increasing threat to protected settlements due to the decrease in the safety of the height of the flood protection dikes. In order to mitigate the flood damage that occurs, the traditional developments (dike heightening, building dikes or reservoirs) are not sufficient (and cannot be financed) and land uses must be changed as necessary. The reason for the rising flood level is that poor runoff conditions resulting from excessive vegetation overgrowth have resulted in swelling in the narrow, built-up floodplain.

Flood levels are now about 1.5-2 meters above the maximums observed until the middle of the 20th century. This also means that the legal construction of flood protection dykes has decreased from 67% to less than 20%.

The widening of floodplains is only a solution on a small stretch of river, but it cannot provide a general solution for keep the safe flood capacity. The decrease in flood safety due to water level rises makes it increasingly likely that there will be unavoidable floods, and the resulting flood damage will increase by orders of magnitude.

The costs of flood protection, damage control and reconstruction have placed a heavy burden on the country. At the same time, it is important to note that in the past 120 years levee break have occurred in Hungary only on those flood protection dike sections that did not comply with the regulations.

In main chapter 4., I pointed out the factors influencing the flood protection capabilities of countries and their strategic characteristics of flood protection based on international examples. The frequency of severe floods in Europe has increased noticeably. The number of medium and large flash floods has more than doubled since the late 1980s. Changes caused by climate change play a significant role as it affect rainfall patterns, weather and sea level rise, resulting in more frequent and severe floods.

In order to address the worsening flood hazards, Directive 2007/60/EC on the assessment and management of flood risks entered into force on 23rd October 2007 of the European Parliament and of the Council. The Directive required a completely new approach from the Member States. Instead of the previous "*follower*" attitude, it focused on the accurate flood preparation and prevention against water damage.

In order to be able to prove the correctness of the path started in Hungary, the planning based on risk value, I examined the hazard and risk maps prepared by the Member States of the European Union, as well as the efforts made during the implementation of the Directive. In addition, I examined the methodology of hazard mapping in international terms and the possible methods of differentiation, so I sent a letter to the national water directors with the supporting of the Ministry of Interior. I sent the letter to countries whose hydrological and topographical conditions are similar to Hungary, and from the answers I can draw conclusions regarding flood protection in Hungary. I selected the following countries: Czech Republic, Austria, Poland, Slovakia, and Netherlands.

In recent decades, floods have become more and more frequent in Europe, especially in recent years, the trend can be observed that compared to the end of the 1980s, many more medium- or larger-scale flash floods had to be registered.

Rainfall trends caused by climate change are varied across Europe. Forecasts show that annual precipitation is expected to increase in Northern and Central Europe. Winter precipitation in Hungary has already increased by more than 10% in the last two decades.

There are other solutions to reduce flood risks that go beyond gray and green infrastructures. These solutions include land use change, awareness-raising activities and insurance options for people living in floodplains. These solutions can be classified as non-structural measures.

One of the significant results of the Flood Directive is the standardization of the definition of flood risk, which takes into account the probability of a flood event occurring, as well as the effects of the event on people, the environment, cultural heritage and the economy. The principles of responsible financial planning dictate that policy goals must be specific, measurable, relevant, and achievable and bound by deadlines. Article 7 of the Flood Directive obliges Member States to establish effective flood risk management objectives and then to include measures for these objectives in their flood risk management plans.

The Flood Directive does not require consideration of the effects of climate change when mapping flood risks. All Member States used flood scenarios based on the three probabilistic events required by the Flood Directive when creating the flood risks maps, which give the likelihood of a flood occurring based on "returning period times" or percentage chances.

However, these statistics only consider past meteorological and hydrological patterns and do not reflect the future effects of climate change. To account for future weather conditions, forecasts are needed that can take into account the potential effects of climate change on flood frequency and severity.

Flood protection can be divided into two large groups, which I dealt with in detail in ***main chapters 5 and 6.*** One group consists of all the interventions that reduce the flood load, thereby reducing the pressure on the flood protection dikes. The other group consists of measures that increase the flood resistance ability of the dikes.

The two packages of measures both affect the risk on the saved side of the embankment. I will justify this risk with calculations. In the Tisza valley, I have selected a flood basin where all the effects presented above can be expected.

I chose the Szolnok flood basin for my investigations, because dike heightening, riverbed interventions, building flood-peak reduction reservoirs were also implemented in this area, so all resistance-increasing and load-reducing effects can be demonstrated. The purpose of my study was to calculate the impact of these interventions on the protected side and prove that risk-based flood protection planning is the most effective on our rivers.

I presented in detail the development of the protection system of the flood basin as well as collected the floods that, at that time, peaked with higher water levels than ever before in the Szolnok section of the Tisza. It can be concluded that due to the increase in the flood water level experienced in the previous century, the lack of height of the flood protection dikes increased, although there were improvements during the period to the previous flood design water levels, but these height are still not adequate. Due to the rapid rise in the water level, the height of the development levels quickly became excessive. I completed the calculations using flood hazard and risk maps.

I carried out my calculations in scales of 10 cm relative to the applicable flood design water level (MÁSZ) in the range MÁSZ-360 cm - MÁSZ+150 cm.

The essence of my calculation is that I examined it for each 10 cm scale what combination of dike heightening, operational flood protection activity and emergency flood storage can be used to reach the desired level, that its initial cost is minimal, taking into account the associated risk reduction on the protected side.

At the cost of intervention I determined the initial costs from the flood protection activities and developments of the last 10 years. For the costs of the emergency reservoir I used the cost estimate used in the Tisza plant management project.

During the calculation, my objective was to minimize the acquisition cost and the residual risk on the protected side. To do this, I examined the most cost-effective way to reach this level. Taking these into account, I determined the level at which the flood basin can first be protectable by flood protection dike development, operational flood protection activities and emergency storage interventions.

This also means that, from the point of view of the full protection of the flood basin, the long-term goal is, of course, to develop it to its value as required by the current legislation, increased by height safety. However, as a result of the flood level calculation taking into account the risks on the protected side, an intermediate construction level is given as the optimal value from a cost-risk point of view.

In my opinion, this value can be incorporated into the legislation currently in force by setting it as a short-term objective, with the proviso that the final, complete deployment is represented by the flood level formed from the flood flow required by law once every 100 years. I dealt in detail with the reinforced concrete flood protection wall forming a flood protection system, which causes a decrease in resistance, and its protective capacity can be estimated by examining non-destructive concrete. During my studies in the University, I participated in a research project dealing with a non-destructive strength testing of concrete structures. Using the results and conclusions obtained there, I carried out a field measurement of the flood protection wall of the selected flood basin and determined the effect of the protected side risk reduction due to its technical condition.

I completed my Schmidt hammer non-destructive concrete tests on the flood protection wall in early spring 2023. This flood protection wall is protecting the city centre area of Szolnok against the floods on Tisza River, and situated in the inner area of the Szolnok flood basin. It can be concluded from the rebound values, that there was a significant decrease in strength at two expansion joint parts of the parapet wall next to each other (right river bank side of the Tisza, 10.02. flood protection section 65+400 tkm dike section). Therefore I took the section's standard cross-section in terms of strength to this low rebound value.

The points on the flood protection line, where the failure is difficult or not quantifiable, can be called singular sites. The flood protection line behaves significantly differently at these points, and we cannot weigh safety. Therefore I had to assess what areas would be flooded and at what water depth would be formulated in case of a possible levee break situation. In addition to the above, the evacuation of the population living in its vicinity should also be highlighted.

A localisation plan must be drawn up to formulate the protected side effects and interventions caused by possible levee break situation. The main goal of the localization plan is to return back the water from erupting during a levee break situation to the river with as little damage as possible. I also examined what kind of flooding could be caused by a levee break around the locally weak section.

My on-site inspections highlight that restoring the protective capacity of locally weak sections found in the flood protection system is an extremely important and indispensable task. The implementation of well-organized operational flood protection activities are becoming more and more valuable due to the locally weak section on the flood protection dike system. Providing of professionals and flood experts with the appropriate expertise and experience is essential for the implementation of a successful flood protection.

Summary of conclusions

In my doctoral thesis I dealt in detail with the most important and, in my opinion, the most topical issues of Hungarian water damage protection. I **highlighted** that the increasing in extremes caused by climate change can also be seen at the height of flood waves.

During my research, I **established** that there is an international example that shows the correctness of the paradigm shift taking place in our country regarding the flood design water level planning.

Based on calculations, I proved that our floodplains must first be protected by flood control reservoirs, operational flood protection activities and we must make it protectable with implementing flood protection developments for a flood design water level, which is determined on a risk basis. Considering our poor development costs this is the only available and a long-term sustainable solution in the near future

I highlighted it and proved it with on-site measurements that firstly we have to detect and develop locally weak points in our flood protection system, because when eliminating these critical weak points, a significant risk reduction can be achieved on the protected side with a small investment of development costs.

I found, that the effect of flood control reservoir, operational flood protection actions and the developments can be calculated in flood basin level, and by choosing the right combination of these three types of intervention, the stability in terms of protective capacity in flood basin level and can be available.

New scientific results

1. **I made a proposal** to amendment of the law. The aim of the legislative amendment proposal is to establish or create (scheduling) an intermediate, protectable water level, taking into account the risk values. The flood protection must be based on this protectable water level. **I proved** that the development and the financial resources of flood protection should be prioritized not only nationally, but also within the flood basin. This method enable the creation of a flood protection system that operates economically and at a reassuring safety level.

2. Based on my analysis, **I found** that due to the increase in weather extremes, a paradigm shift is necessary for the further, effective development of the Hungarian flood protection system, the basis of which is flood protection based on risk value.

3. **I found** that the Flood Directive of the European Union standardized the flood risk calculation methodology of the Member States and pointed out that when planning our developments, we must analyse not only the hydrological data, but also how much risk we can reduce on the protected side with our flood protection investments. The correctness of the new method started in our country was supported by international experience, according to which we place the emphasis on a risk basis when planning our flood protection developments.

4. Based on my research, **I proved** that development of flood protection dykes for floods that occur once in a 100 years, but also we have to take account the emergency flood storage, the locally weak points and sections on the flood protection dykes and the operational flood protection activities in order to increase the effectiveness of the flood protection. I also proved that, in addition to purely hydrological statistics, it is necessary to quantify the safety reserves inherent in our flood protection system and to take them into account in the protective capacity.

Practical applicability of research results

The practical applicability of the research results detailed in my doctoral thesis is summarized below:

1. It supports the decision-making of the responsible leaders of the field of water damage prevention, flood protection and disaster prevention, and can contribute to a change in their attitude when determining flood protection levels based on risk value.
2. It contains information supported by data and calculations regarding the applicability of differentiated flood protection regulations both nationally and at the flood basin level.
3. It can serve as a basis for planning future developments of the Hungarian flood protection system.

Recommendations

I recommend considering my research results and incorporating them into everyday work for the following:

1. for colleagues working in the Hungarian water management sector,
2. for teachers, researchers and students of institutions dealing with the water management
3. For the local governments: mayors and technical colleagues.
4. For colleagues working at the General Directorate of Water Management and the Regional Water Directorates.

List of publications on this topic

Peer-reviewed book, application, notes

1. Kristóf Dobó: Using of flood hazard and risk maps, Knowledge of flood protection, ISBN 978-963-498-231-9, p. 699-722.

Peer-reviewed professional articles

In foreign language journal published in Hungary

2. Dobó Kristóf - Tóth Rudolf: The Role of the Hungarian Defence Forces Skills in the Protection against Water Damages – The Extraordinary Flood on the Danube River 2013, Műszaki Katonai Közlöny, ISSN 2063-4986; 2019; 29. évfolyam; 3. szám; 55-65. oldal; DOI 10.32562/mkk.2019.3.1.
3. Dobó Kristóf: The necessity of the riverbed management treatment in the mirror of the introduction of the differentiated flood-prevention, Katonai Logisztika, ISSN 1588-4228; 2020, 28. évfolyam; 3. szám; 141-149. oldal, DOI 10.30583/2020.3.141.

4. Dobó Kristóf: The flood protection developments on Sajó-Hernád rivers is relation to the 2020 flood event, Katonai Logisztika, ISSN 1588-4228; 2021, 3-4. szám; 98-108. oldal, DOI 10.30583/2021-3-4-098.

In a Hungarian standard journal (categories A, B, C, D according to MTA classification)

5. Dobó Kristóf: A hazai árvízvédelmi stratégia főbb irányai, Műszaki Katonai Közlöny; ISSN 2063-4986; 2019.; 29. évfolyam; 2. szám; 133-144. oldal; DOI 10.32562/mkk.2019.2.11.
6. Dobó Kristóf: Differenciált árvízvédelem Magyarországon, Hadmérnök, ISSN 1788-1929; 13. évfolyam; 4. szám; 184-189. oldal.
7. Dobó Kristóf: Változások kora az árvízvédelemben, Műszaki Katonai Közlöny, ISSN 2063-4986; 29. évfolyam; 1. szám; 57-64. oldal; DOI 10.32562/mkk.2019.1.5.
8. Dobó Kristóf - Göncz Benedek - Iványi Krisztina: Az árvíz- és belvízvédelem országos helyzetképe, Hidrológiai Közlöny, ISSN 0018-1323; 100. évfolyam; 1. szám; 5-19. oldal.

Professional-scientific biography

I was born on August 2, 1988 in Mosonmagyaróvár. My parents participated in the construction works of the Dunakiliti weir, and my paternal grandfather was, among other things, one of the designers of the Kiskörei barrage, so I am the youngest member of a multi-generational hydraulic engineering family.

I completed my primary school studies at the Lajos Kossuth Primary School in Székesfehérvár, and then obtained an excellent school graduation certificate at the István Szent High School of the Cistercian Order.

In 2005, I obtained an intermediate "C" language exam in German and in English in 2008.

After the high school, I got my BSc degree at the Budapest University of Technology and Economics, after that, I also completed the master's course with an excellent qualification, so my qualification is a certified structural civil engineer.

During my University studies, I also got involved in research related to the non-destructive strength testing of concrete, from the results of which I achieved national 3rd place in 2012 with my Scientific Student Conference thesis.

Since the end of my university studies, since 2012, I have been working at the General Directorate of Water Management. I was employed at the Central Duty Department and then at the Flood Protection Department. Since 2016, I have been working as leader of the flood protection head department.

In 2015, I also completed the specialized engineer of flood management course in the József Eötvös College.

In 2017, I applied to the Military Technical Doctoral School of the University of Public Service. I passed the complex exam in 2019, and in 2021 the pre-degree certificate stating that all course-units have been completed.

I was a regular lecturer at professional conferences during the entire duration of the training, I also presented at events organized by the General Directorate of Water Management, the Hungarian Hydrological Society, and the University of Public Service. I am a regular lecturer at the courses of the Faculty of Water Sciences of the University of Public Service.

Among my professional works, I highlighted the following activities: the management of the flood hazard and risk mapping project, participation in making riverbed managements plans and localization plans. I actively participated in the recalculation of the flood design water level, the formulation of Tisza Valley Flood Analysis Centre and in the designing works of the upper Tisza municipal waste interceptor.

I took part in the listed water damage prevention interventions in the work National Technical Committee as a leading technical duty officer until 2016, and from 2016 in the position of deputy leader of the National Technical Committee:

In 2013 extraordinary Danube flood protection,
In 2014 Dráva, Mura flood protection,
In 2014 and in 2018 the protection activities against water swinging caused by wind on Lake Balaton
In 2017, in the ice protection of the joint Serbian-Croatian section of the Danube and the Hungarian section of the Tisza,
In 2018 Ráckevei-Soroksári Danube branch water quality prevention protection activities – construction of temporary pump provision at Kvassay pumping station.
In the coordination of the 2019 Hableány ship lifting activities,
In 2020 Dredging water quality damage prevention activities in the Lake Balaton.
In 2020 Szigetszentmiklós oil spill ordered water quality in damage prevention,
In 2021 Szamos water quality damage prevention activities ordered due to heavy metal pollution,
In 2022 the defence activities against the drought,
In the implementation of the Sió Canal shipping program in 2023,
In 2023 Rába-Dráva-Mura flood protection activities.

In recognition of my professional work, I got an award of Pro Aqua commemorative medal from the Hungarian Hydrological Society in 2022.

Budapest, August 11, 2023

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Kristóf Dobó