POLICY PROPOSAL – 2024 No.4

HOW CAN HUNGARY BECOME A COUNTRY RICH IN WATER?

The Equilibrium Institute's policy proposals for long-term water security in Hungary

Equilibrium Institute

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for long-term water security in Hungary

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Future for Hungary

Equilibrium Institute

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02

Contrary to popular perception, Hungary is not a water superpower but a water-scarce country. 94% of Hungary's surface water resources come from rivers and streams originating abroad. Hungary ranks 164th globally in terms of internal renewable freshwater per capita and second to last in the EU-27. This poses serious risks: the quantity and quality of water flowing through our country is subject to impacts outside our borders over which we have no control.

03

Climate change is worsening our exposure: Extreme weather events can lead to flooding and rainfall damage, as well as droughts caused by water scarcity. The number of heatwave days per year has increased by seven days since the beginning of the last century, and this trend will only accelerate in the future; meanwhile, average annual rainfall has decreased by 4%, and its distribution has become more disproportionate. In the coming decades, summer precipitation will decrease while winter precipitation will increase. As a result, prolonged dry periods and extreme wet days will alternate.

04

In addition, we are also exacerbating the situation through our own imprudent and wasteful use of water. One of the main areas of waste is agriculture, which has an interest in draining inland water as quickly as possible and irrigating in times of drought, with intensive use of water and depletion of our groundwater resources. The sector's demand for water is constantly increasing, and in the long term, it will erode its own resources.

05

In cities, today's priority is to drain rainwater as fast as possible — although retaining as much of it as possible would make rainwater an important resource if used properly. Rainwater can provide for at least one-third and up to 90% of household water use. However, most of the urban sewerage systems built in the past now collect rainwater with wastewater — resulting in the loss of 100 million m3 of water a year in Budapest alone, equivalent to three times the volume of water in Lake Velence. During periods of heavy rainfall, the sewerage network itself is often overloaded, which is contributed to by a lack of green spaces and an increase in the proportion of paved surfaces.

06

Although we cannot control our geographical exposure, we can reduce water safety risks. To this end, we need to naturally retain as much water as possible from incoming flows while responsibly managing the water resources generated in the country.

07

The Equilibrium Institute's policy proposal calls for preventing the depletion of our groundwater resources and helping them to recharge. To achieve this, we should restore the sinuosity of over-regulated rivers wherever possible, in consultation with landowners, to keep water in the country for as long as possible. Where possible, retain and infiltrate rainwater runoff into the ground! Let's also help keep water in place by restoring our wetlands!

08

Instead of intensive irrigation development, let's reduce drought risk by water-saving agricultural production (drought-tolerant crops, promotion of precision irrigation)! Provide information to encourage farmers to use land-based subsidies for land set-aside and cover crops! As many drainage channels and ditches as possible should be dual-use, i.e. they should also be able to retain water, thus helping to raise groundwater levels. Set up water retention associations to balance diverging farmer interests!

09

Increase the proportion of forests in agricultural areas! In water scarce areas, preference should be given to grasslands and wetlands instead of forests.

10

In urban areas, instead of draining rainwater as quickly as possible, let's try to retain it! Increase the proportion of unpaved or permeable surfaces by building drainage ditches and rain gardens. Relieve the sewerage network by increasing evaporation (green roofs, green facades, evaporation ditches). Develop a sponge city concept at the national level!

11

Continue to build stormwater drainage systems that are separate from sewers! dditional stormwater storage reservoirs should be built next to the sewage treatment plants to retain rainwater. All urban development projects must take water retention into account! For new buildings, make the connection to the combined drainage and sewer system conditional on rainwater retention measures. Price stormwater drainage and reward rainwater retention! Give a new watering discount only if there is some form of water retention on the site!

12

In cities, all new paved surfaces should be accompanied by a proportionate improvement of green areas. In the capital, increase the ratio of green space per capita to 9 m2 by 2030! Support the operation of blue-green infrastructure from a separate municipal fund!

13

Well drillers should be obliged to declare new wells. Free online registration should speed up the registration of agricultural and domestic wells. Well owners should be obliged to measure water and report the amount of water withdrawn. The authorities should regularly check the authenticity of the data!

14

Create a water think tank, bringing together all relevant disciplines! Ensure that monitoring wells that monitor groundwater quantity and quality can be telemetered as often as possible and that regular sampling is required. Use robotics' innovations for monitoring work (e.g. mapping illegal wells): drones, satellite monitoring and laser scanning.

1. WHAT IS THE PROBLEM?

The importance of adequate water quantity and quality will increase worldwide in the coming decades. **Water security, access to clean drinking water, and predictable and safe availability of water as a key resource for agriculture, food supply, industry, trade, or tourism** will become key issues for all countries - and less and less a given. It is also an **issue of growing importance in international relations.** Water scarcity is already a central factor in major conflicts and will become even more so in the coming decades.

In this situation, Hungary has a particularly large amount of work to do, since, contrary to popular perception, **Hungary is not a water superpower but a water-scarce country. 94% of Hungary's water resources come from rivers and streams from abroad, and in terms of per capita domestic renewable water resources per year, Hungary is a water-poor country.** Climate change further increases our vulnerability: extreme weather events result in both damages due to seasonal water abundance and droughts due to water scarcity. This is compounded by the **thoughtless and highly wasteful use of water**: in agricultural areas and our cities, we want to get rid of rainfall as quickly as possible without considering the needs in the period of water scarcity or the positive impact of retained water on the quality of life of local residents. Meanwhile, **we are using up our groundwater resources without ensuring they are renewed.** In doing so, we are creating serious risks for drinking water security, agriculture, tourism, commerce, the livability of cities and, above all, the quality of life of the Hungarian people.

In comparison, **the importance of achieving sustainable water security in the long term is not sufficiently reflected in public debates in Hungary today.** The Hungarian national water management framework strategy, the **Jenő Kvassay Plan, rightly identifies the key tasks of avoiding water crisis,** preserving water resources, making economic use sustainable and preventing potential water damage. However, **it does not say what concrete steps should be taken to achieve this.**

> "Rather than resigning ourselves to our exposure and focusing solely on mitigating avoidable damage, we should work to create the competitive advantage that comes from ensuring long-term water security."

There is no time for inaction. **Rather than resigning ourselves to our exposure and focusing solely on mitigating avoidable damage, we should work to create the competitive advantage that comes from ensuring long-term water security.** To do this, however, we need to intervene as soon as possible. The following proposal is put forward by the Equilibrium Institute.

2. KEY CHALLENGES FOR OUR WATER SECURITY

2.1. WHY ARE WE NOT A WATER SUPERPOWER?

It is widely believed that our country is exceptionally rich in water. It is often discussed that Hungary is a mineral water superpower, that the Danube is practically unlimited, that our drinking water supply can provide for millions of people and can even be exported, and that our thermal water reserves are unrivalled not only for tourism but also for energy use. In reality, the facts show that **our status as a water superpower is no more than a myth - actually, the opposite is true.**

The main reason for our water scarcity is that, due to its geographical characteristics, **more water flows out of Hungary than flows in, and the flow is very quick, while the rainfall we receive is not retained.** 94% of Hungary's water resources come from rivers and streams from abroad, **making Hungary the country with the highest exposure to water from external sources in the European Union** (Figure 1).

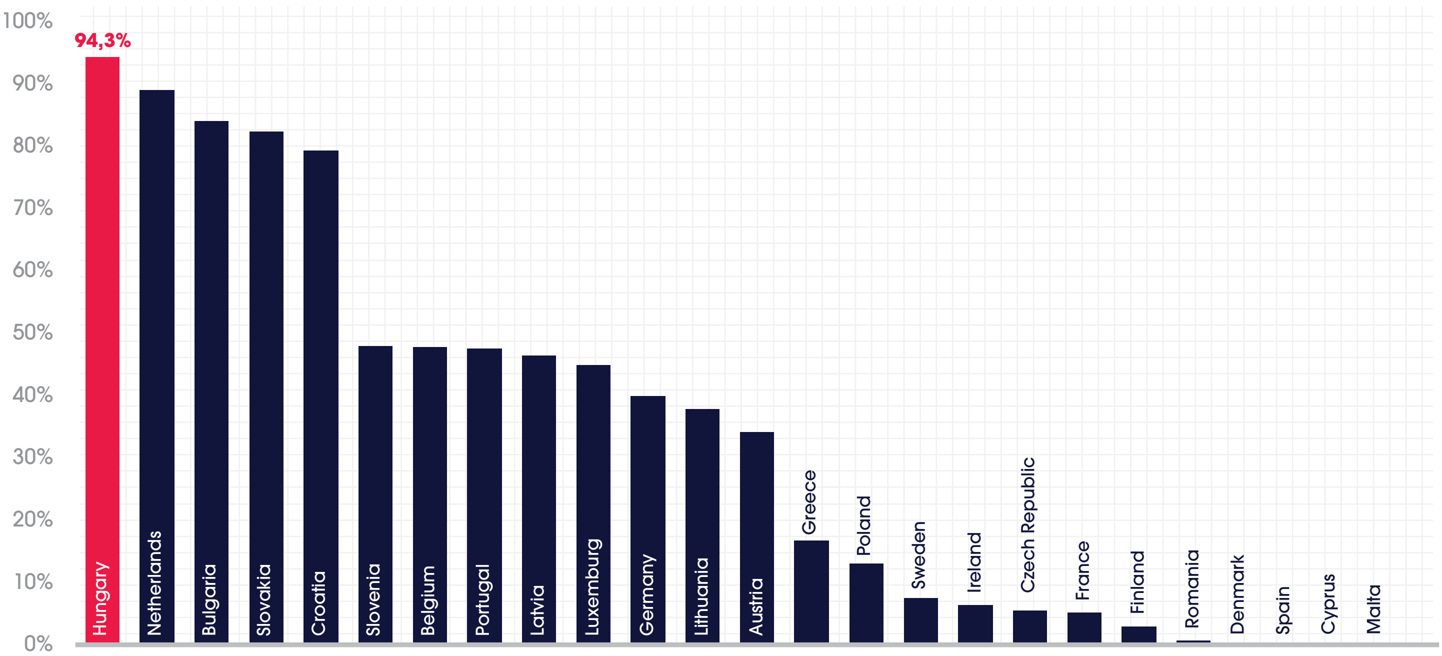


Figure 1: Percentage of freshwater from external sources in EU Member States (excluding Italy and Estonia), 30-year average (source: Eurostat)[1]

1 Water Statistics. *Eurostat*, https://ec.europa.eu/eurostat/statistics-explained/index.php?oldid=37036 – Last accessed: 25 November 2024.

Our total renewable water resources (i.e. the combined volume of water from precipitation and runoff in the country) **are slightly more than 10,000 m^3 per capita per year**. This ranks us 57^{th} in the world and 7^{th} in Europe, which in itself does not seem bad (Figure 2).

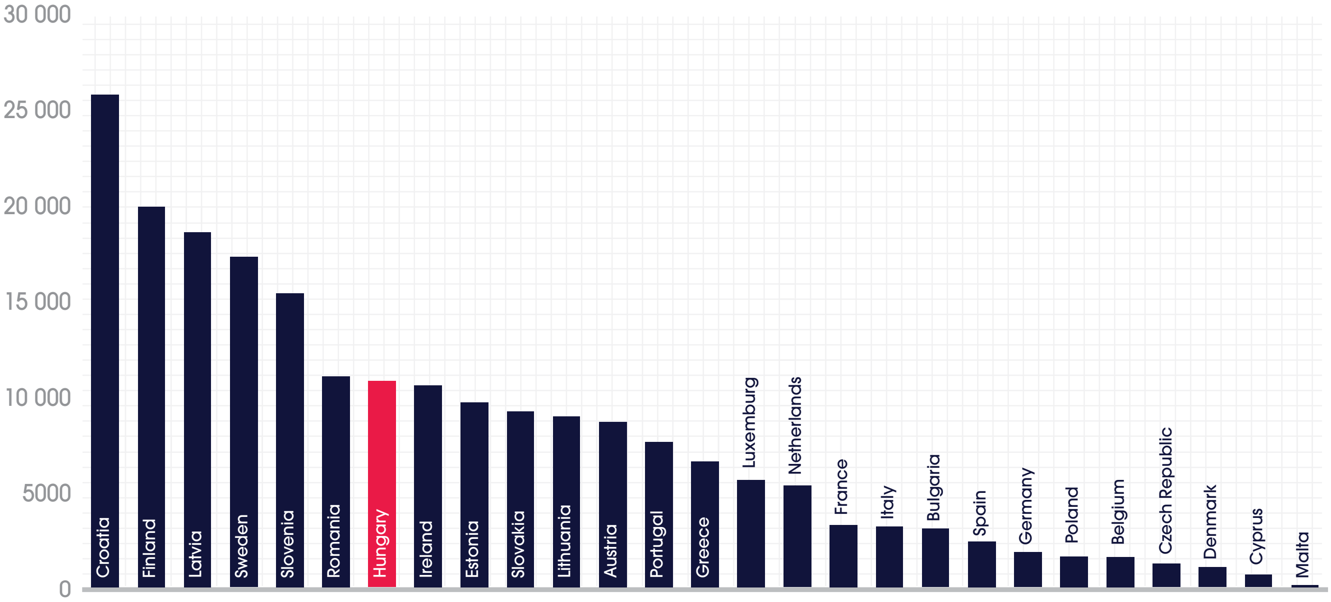


Figure 2: Total renewable water resources in EU Member States, m3 per capita, 2020 (source: Eurostat)[2]

However, if we look only at internal renewable water resources, i.e. not taking into account the flow of water from rivers passing through the country, the situation is gloomier. With 615 m^3 of internal renewable freshwater per capita, Hungary ranks only 164^{th} globally[3], ahead of only Malta in the EU (Figure 3). **This figure shows that the country is distinctly water-poor - below 1000 m^3 is considered a state of water scarcity.**

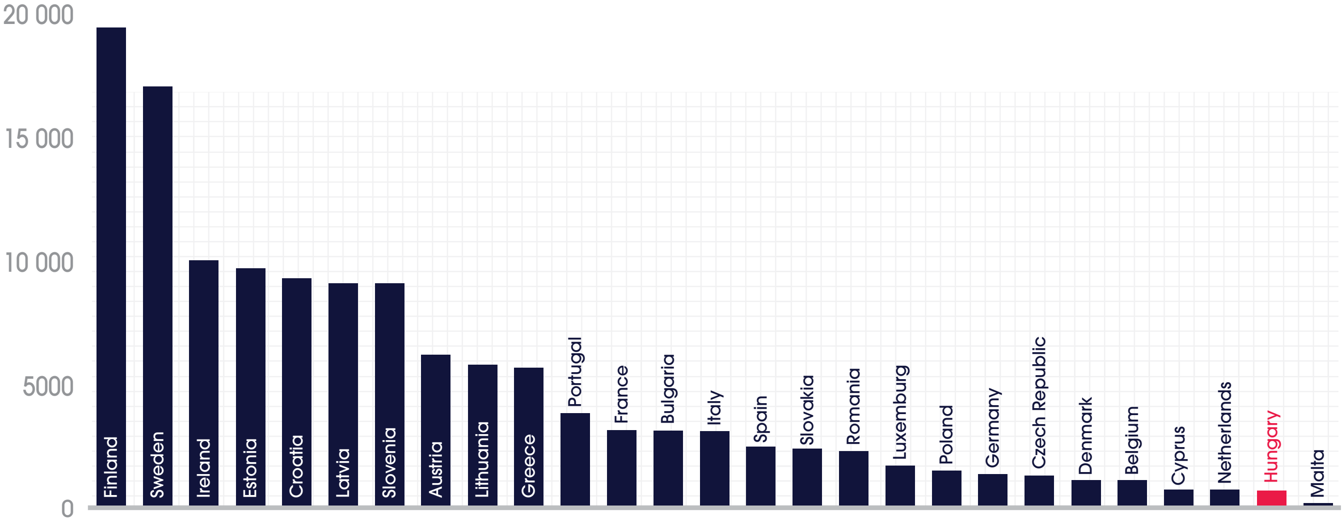


Figure 3: Internal renewable freshwater resources in 2020 in EU Member States, m3 per capita, 2019-2020 (source: Our World in Data)[4]

2 Renewable Fresh Water Resources. *Eurostat.* https://ec.europa.eu/eurostat/databrowser/view/env_wat_res/default/table?lang=en; https://worldpopulationreview.com/countries – Last accessed: 25 November 2024.

3 Renewable internal freshwater resources per Capita. *Our World in Data,* https://ourworldindata.org/grapher/renewable-water-resources-per-capita; Renewable internal freshwater resources, total (billion cubic meters). *World Bank Group,* https://data.worldbank.org/indicator/ER.H2O.INTR.K3?end=2020&start=2019&view=chart – Last accessed: 25 November 2024.

4 Renewable internal freshwater resources per Capita. *Our World in Data,* https://ourworldindata.org/grapher/renewable-water-resources-per-capita – Last accessed 25 November 2024.

This exposure carries serious risks: the quantity and quality of water flowing through our country is subject to impacts beyond our borders that we cannot control. Interventions abroad, in the upper reaches of our rivers, have a significant impact on how much and what kind of water we can manage, whether they are measures to conserve water or failures to take action to ensure water quality. **Although we cannot control geographical exposure, we can reduce water security risks. To do this, we need to retain as much water as possible naturally from flowing water while responsibly managing the water originating in Hungary.**

2.2. MAIN CAUSES OF OUR WATER EXPOSURE

Our water security is threatened by a number of environmental and social factors. There is also a third type of risk linked to the previous two: **poor water quality.**

OUR GEOGRAPHY

The Carpathian Basin is one large hydrographical unit divided only by political borders. **On average, our domestic watercourses collect around 118 km³ of water per year: 112 km³ of this comes from beyond our borders, and only 6 km³ originates in the country.**[5] As mentioned above, our water resources (i.e. from rainfall and local sources) are the **second smallest in the EU.** Our country is in a vulnerable position compared to the Visegrad countries and our immediate neighbours: **we are in last place out of the 10 countries in the wider region, with less than a tenth of the total renewable freshwater resources on our territory** (Figure 4).

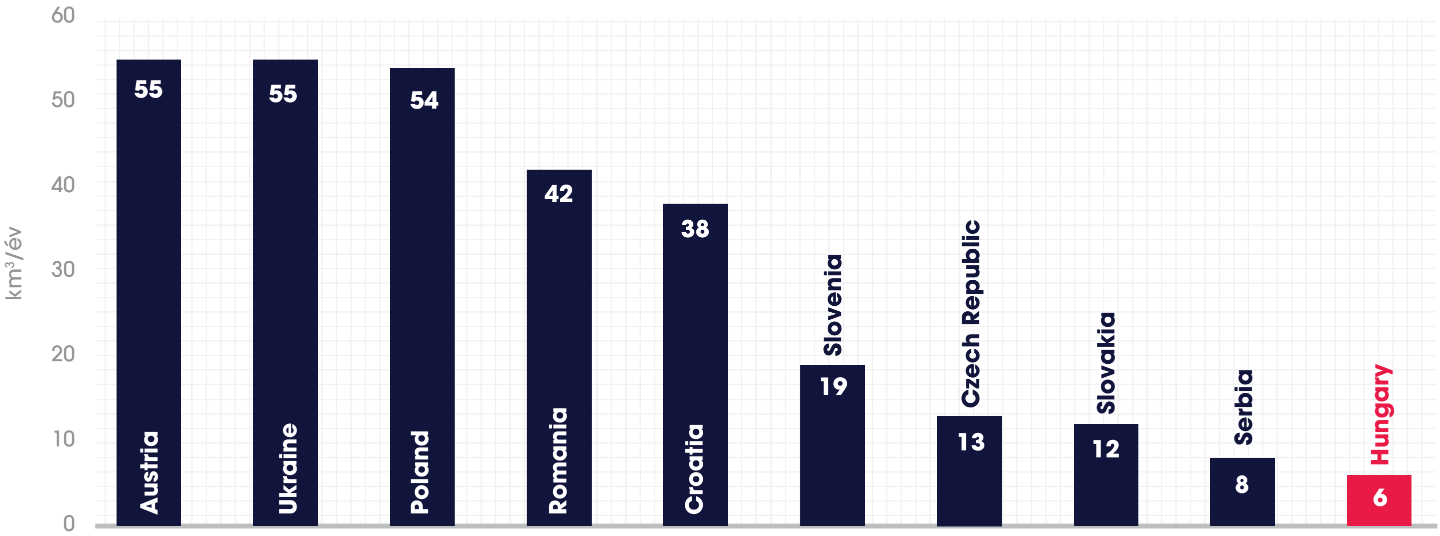


Figure 4: Renewable internal freshwater resources in the countries of the wider region, 2020, billion m3 (source: World Population Review)[6]

5 György Varga – László Alföldi – Gyula Gábris – Gergely Horváth – Károly Kocsis – Ildikó Lázár – János Maginecz – József Szalai – Miklós Szalay (2024): Waters: In Károly Kocsis (ed.): *National Atlas of Hungary. Natural Environment.* Geographical Institute, Research Centre for Astronomy and Earth Sciences, Hungarian Academy of Sciences. pp. 70–81.

6 Fresh water per Country, 2024. *World Population Review,* https://worldpopulationreview.com/country-rankings/fresh-water-by-country – Last accessed 25 November 2024.

However, the distribution of exploitable renewable water resources across the country is highly uneven. **There are already many water scarce areas** in, most notably the Nyírség and the Homokhátság in the Danube-Tisza Interfluve - the latter is now **officially a semi-desert. In the near future, exploitable groundwater resources in the Great Hungarian Plain could decline[7] to the point where drinking water supplies are threatened.**

CLIMATE CHANGE

Hungary's annual mean temperature increased by 1.7°C between 1981 and 2020, and the mean summer temperature by 2.1°C. Between 1901 and 2022, the number of heatwave days (i.e. days when the daily mean temperature exceeds 25°C) **increased by 7 days.** Moreover, the pattern is exponential (Figure 5), and the trend is not likely to stop in the foreseeable future.[8] This will continue to increase the extent of water scarcity in the coming decades, especially in the karst areas of the Transdanubian Central Range, the North Hungarian Mountain Range and the Great Hungarian Plain.

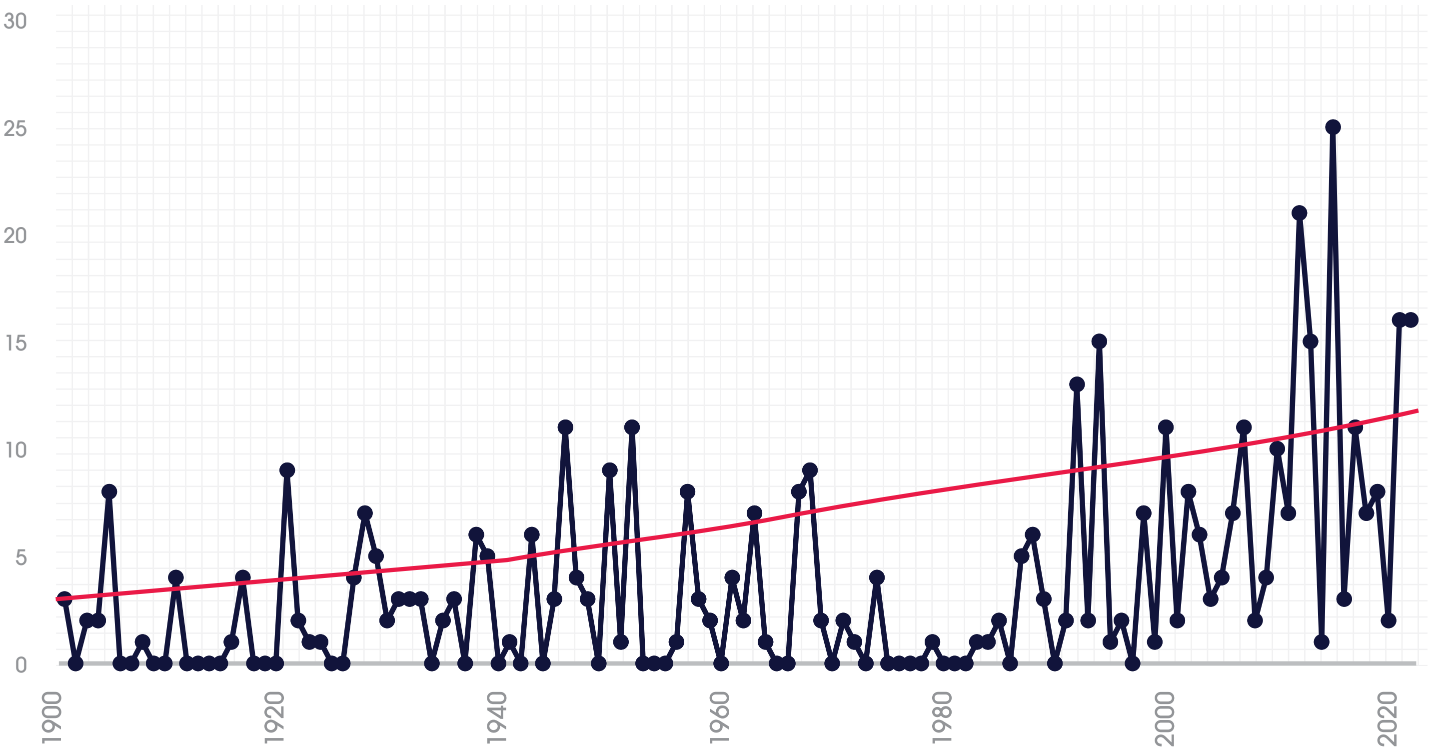


Figure 5: Number of days affected by heatwaves and exponential trend fitted to the data series between 1900 and 2022 (source: Central Statistical Office, KSH)[9]

7 The Water Management Organization. *Ministry of Energy, General Directorate of Water Management, Water Management Website.* https://www.vizugy.hu/index.php?module=content&programelemid=75&id=78&page=6 – Last accessed: 25 November 2024.

8 Changes in Annual and Seasonal Mean Temperatures. *HungaroMet Hungarian Meteorological Service Nonprofit Ltd.*, https://www.met.hu/eghajlat/eghajlatvaltozas/megfigyelt_hazai_valtozasok/homerseklet_es_csapadektrendek/kozephomerseklet/; Heatwaves in Hungary. *HungaroMet Hungarian Meteorological Service Nonprofit Ltd.* https://www.met.hu/ismeret-tar/erdekessegek_tanulmanyok/index.php?id=3196 - Last accessed: 25 November 2024

9 Weather Data for Hungary and Budapest. *Hungarian Central Statistical Office (HCSO),* https://www.ksh.hu/stadat_files/kor/hu/kor0037.html – Last accessed: 25 November 2024.

The annual average precipitation sum in Hungary decreased by 4% on average between 1901 and 2020 (Figure 6); this was most drastic in spring (-17%) and autumn (-10.62%) precipitation totals.[10]

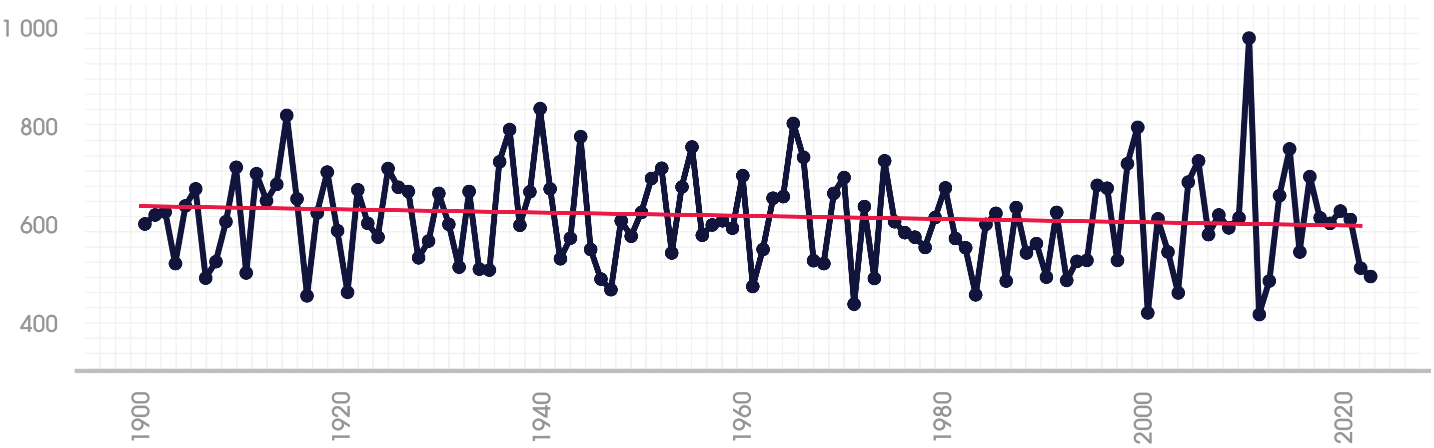


Figure 6: Precipitation amount and fitted trend between 1900 and 2022 (source: Central Statistical Office, KSH)[11]

Over the same period, the number of precipitation days decreased by 32% (Figure 7). This means that the amount of precipitation is becoming less and less and that this precipitation is concentrated on fewer days, resulting in longer dry, drought periods. Climate change will make extreme weather events, such as **floods and inland floods, heatwaves and droughts, more frequent and severe in the future**.

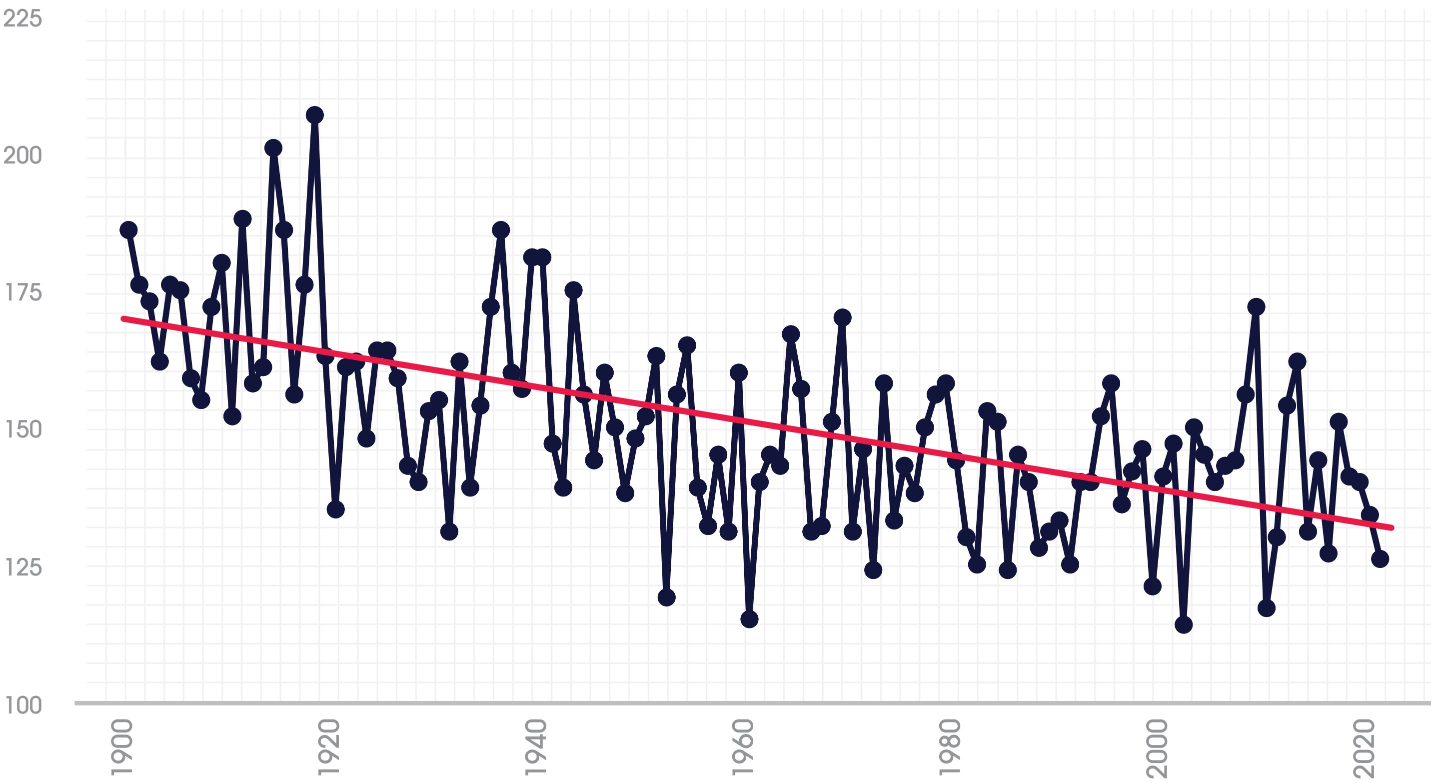


Figure 7: Evolution of the number of precipitation days and fitted trend based on national data from 1900 to 2022 (days/year) (source: Central Statistical Office, KSH)[12]

10 Hungary's River Basin Management Plan – 2021. MET, https://www.met.hu/eghajlat/eghajlatvaltozas/megfigyelt_hazai_valtozasok/homerseklet_es_csapadektrendek/csapadekosszegek/ – Last accessed: 25 November 2024.

11 Weather Data for Hungary and Budapest. *Hungarian Central Statistical Office (HCSO)*, https://www.ksh.hu/stadat_files/kor/hu/kor0037.html – Last accessed: 25 November 2024.

12 Ibid.

The wettest season in Hungary is currently summer, while the driest is winter. In the coming decades, **summer precipitation will decrease, and winter precipitation will increase, alternating between prolonged dry periods and extreme wet days**.

USING UP AVAILABLE WATER

The impacts of climate change are exacerbated by our **wasteful use of available water: we are rapidly draining out of the country the rainfall and much of the water entering through rivers, and at the same time, we are irrigating so much during the summer water shortage that we are overusing groundwater.** The depletion of our water resources is one of the reasons why groundwater levels in some parts of the country have dropped by up to 3-5 metres in a few decades.[13]

Agriculture is a key area of unsustainable water resource management. In Europe today, this sector is responsible for 50%[14] of total water use and is a major source of nutrient pollution. Although this figure is around **12%** in Hungary,[15] agriculture still significantly impacts water use. **Today, irrigation is the largest real water user:** all the water is used up by crops or evaporation and is not returned to the surface or groundwater. Experts estimate that when we irrigate 1 hectare with groundwater, we dry out roughly 5 hectares around it.

Irrigation helps stabilize and increase crop yields, but it also has several negative consequences. These include, first and foremost, **the over-abstraction of groundwater in areas where it is already depleting.** In periods of water scarcity, irrigation can only be carried out using underground water where surface water is not an option. Today, 90% of the annual rainfall falls in 65-70 days, meaning that there is no rain on approximately **300 days each year.** The average yearly rainfall in the Great Hungarian Plain is about 500 mm, while 800 mm could evaporate.[16] **Some of the water not available on the surface for irrigation is taken from groundwater, and no provision is made to replenish this precious water resource.**

It is in agriculture's interest, of course, to have a water supply adapted to the needs of production, i.e. to have water available at the place of production only when needed and in the quantities required for agricultural work. **This leads to the need to drain off 'surplus' water as soon as possible and, in the event of a water shortage, to bring water to the same place for irrigation purposes.** The spatial distribution of agricultural water demand is also a challenge: roughly 75% of water is available in the Danube Valley and 25% in the Tisza Valley, while most of the water demand is in the Tisza Valley.[17] It is a self-defeating practice **to immediately divert water from agricultural land: around 1.8 km^3 of water is drained out of the country every year, which is the equivalent of Lake Balaton.**

A further problem is that **only estimates are available on the extent of illegal agricultural use of water, in particular, the number of illegal wells.** The number of unauthorised wells for agricultural purposes ranges from **10,000 to 100,000,**[18] which, together with the estimated 1 million[19] domestic wells, represent a significant abstraction of water

13 Hungary's River Basin Management Plan – 2021. General Directorate of Water Management, 2022: Annexes 6–14 and 6–15. Strategic Environmental Assessment of the Regional Water Management Plan for the FETIVIZIG operational area and the TIVIZIG Nyírség area, coordinated with authorities.

14 Zhang, Shan – Wang, Xiujuan – Zhou, Lingshan (2022): Review on Water-Saving Agriculture in Europe. *Journal of Water Resource and Protection,* (14)4: 305–317. https://www.scirp.org/journal/paperinformation?paperid=116420 – Last accessed: 25 November 2024.

15 Water Use and Stress. *Our World in Data,* https://ourworldindata.org/water-use-stress – Last accessed: 25 November 2024.

16 Takács-György, Katalin – Nagy-Kovács, Zsuzsanna (2024): Evaluating Climate Change Impacts on Water Safety: A Case Study of the Danube in Budapest. *Ecocycles,* (10)2: 14–25: 16.

17 Lábdy, Jenő (General Directorate of Water Management): *Presentation at the MAÚT Innovation Forum: Urban Stormwater Management in the Context of Climate Change.* MAÚT Innovation Forum, https://innovaciosforum.maut.hu/konferencia – Last accessed: 25 November 2024.

18 Data request from the Ministry of Agriculture, 2024.

19 Tamásné Szabó, Zsuzsanna (2023): *The Majority of Nearly One Million Illegal Garden Wells Could Fail to Obtain Permits.* 24.hu, April 22. https://24.hu/fn/gazdasag/2023/04/22/kutengedelyezes-illegalisan-letesitett-kutak-megszuntetes/ – Last accessed: 25 November 2024.

- the approximate nature of this estimate highlights the shortcomings in data collection. In addition to the fact that the **lack of data makes water management planning impossible,** considering that no one pays the price for water from such wells is a barrier to responsible water use. In addition, professional drilling and use of wells are not ensured, which can lead to contamination of the deeper, potable groundwater.

The quantity and quality of water are also compromised by the fact that **domestic wells less than 50 metres deep do not need to be notified and authorised at all in areas that are classified as risk-free under the relevant legislation.** New domestic wells in risk areas must be notified to the emergency services, but not those installed before 1 January 2024. **This is dangerous because these wells affect groundwater resources, including the recharge and quality of deeper water resources used for drinking water supply.**

OVER-REGULATION OF RIVERS

One of the cornerstones of our water management is the amount of water that flows down our major rivers. These have been regulated at great cost over the centuries. It has enabled safe navigation, given agriculture access to new farmland and made considerable parts of the country's inland floods disappear. **But all this has come at the cost of land salinisation, drying up and more frequent droughts.** All of these are closely linked to river regulation, which is partly the reason why the Carpathian Basin has seen its water surface area reduced and its microclimate changed.

Regulation has typically resulted in a **very narrow floodplain, i.e. the area in which river water can 'move' - the narrow margin of movement, the straightened riverbeds, means that water moves very quickly across the country.** This means it has much less time to seep into the ground, and only a very small area is flooded during floods, again to the detriment of groundwater recharge. In addition, the rapid run-off deepens the riverbed, which has a suction effect on the surrounding areas, reducing groundwater levels.

ILL-CONCEIVED URBAN STORMWATER MANAGEMENT

A common challenge in our cities is the management of the periodic and increasingly frequent extreme rainfall. **Today, the priority is to drain rainwater as quickly as possible while retaining it is hardly an issue. But if we can retain as much of it as possible, rainwater can be an important resource,** as it can be used for virtually any purpose other than consumption and cooking, from washing and washing up to flushing toilets and watering gardens - but only if it can be retained and treated separately from runoff that is not suitable for these purposes. International examples show that **rainwater use can account for at least one-third of household water use and up to 90% depending on the characteristics of the household.**[20]

> "Rainwater use can account for at least one-third of household water use and up to 90%."

In Hungary, urban sewerage systems built up to the middle of the last century were combined sewer systems, i.e. they discharge wastewater and rainwater through the same system. The two are separated only by the newly built sewerage network; in areas that have been sewered for a long time, such as some city centres and a large part of the capital, there is a combined stormwater and wastewater

20 Opportunities for Rainwater Harvesting and Use: Legal Framework, International Experiences, and Public Health Risks. National Public Health Center, Division of Public Health Laboratory Services. N.d. NNGYK Public Health, https://www.nnk.gov.hu/attachments/article/1968/Csapadékvíz%20gyűjtésének%20és%20felhasználásának%20lehetőségei.pdf – Last accessed: 16 October, 2024.

network. Once the **rainwater enters the sewer system,** it is immediately mixed with wastewater, **and there is no possibility of using it separately before the two are mixed**. **In Budapest alone, 100 million m³ of rainwater is lost every year - the equivalent of three times the volume of water in Lake Velence.**[21] This also increases the heat island effect: we do not exploit the vital cooling potential of evaporation into the air and infiltration into the soil during hot periods. The resulting excess heat in Budapest is in the order of 45 TWh per year, which is roughly equivalent to the country's annual electricity consumption.[22]

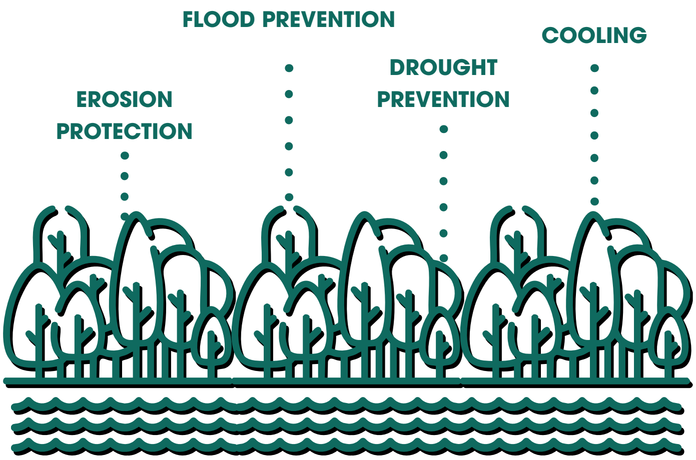
The condition of urban infrastructure is severely damaged **when sewer networks are overloaded by stormwater runoff exceeding their capacity during heavy rainfall.** The intermittent load on the sewerage network and wastewater treatment plants is illustrated by the fact that, for example, in Budapest, the main sewer flow to the **South-Pest Wastewater Treatment Plant is equal to the flow of the Zala River during a major summer rainstorm.**[23]

The continuous increase in the proportion of paved surfaces also contributes to overloading. Rainwater runs off quickly from surfaces that impede infiltration (concrete or asphalt), making it difficult to drain, which is essential when rain is unable to infiltrate into the ground.

LACK OF URBAN GREEN SPACES

Green spaces, i.e. the vegetated parts of the city, play an essential role in urban water retention. These areas help to sequester carbon, control soil and coastal erosion, prevent flooding, and protect the environment.

The current tree cover of Budapest stands at 26%, falling short of the EU capital average of 30% and the regional capital average of 35% (Figure 8). **One of the main obstacles to the installation of roadside tree lines is that they do not have enough space in most places due to the "spaghetti-like" utility lines under the pavement.** Because of this lack of space, trees are sometimes damaged or destroyed during utility development, as there is no legally required setback distance for trees because they are not considered infrastructure.



21 Amrein-Tamásné, Miskolczi Boglárka (2024): *One Million Cubic Meters of Rainwater Disappear Annually from Budapest Alone – Lessons from the Green Civil Meeting.* Egy.hu, June 6. https://egy.hu/aktiv/csak-budapest-teruleterol-evente-100-millio-kobmeter-csapadekviz-tunik-el-a-zold-civil-talalkozo-es-tanulsagai-114785 – Last accessed: 16 October 2024.

22 Based on Water Holistic calculations (personal communication).

23 TRINITY ENVIRO Ltd. – LIFE Urban Rain Project. Urban Rain, https://varosieso.hu/a-varosieso-projektrol/ – Last accessed: 16 October 2024.

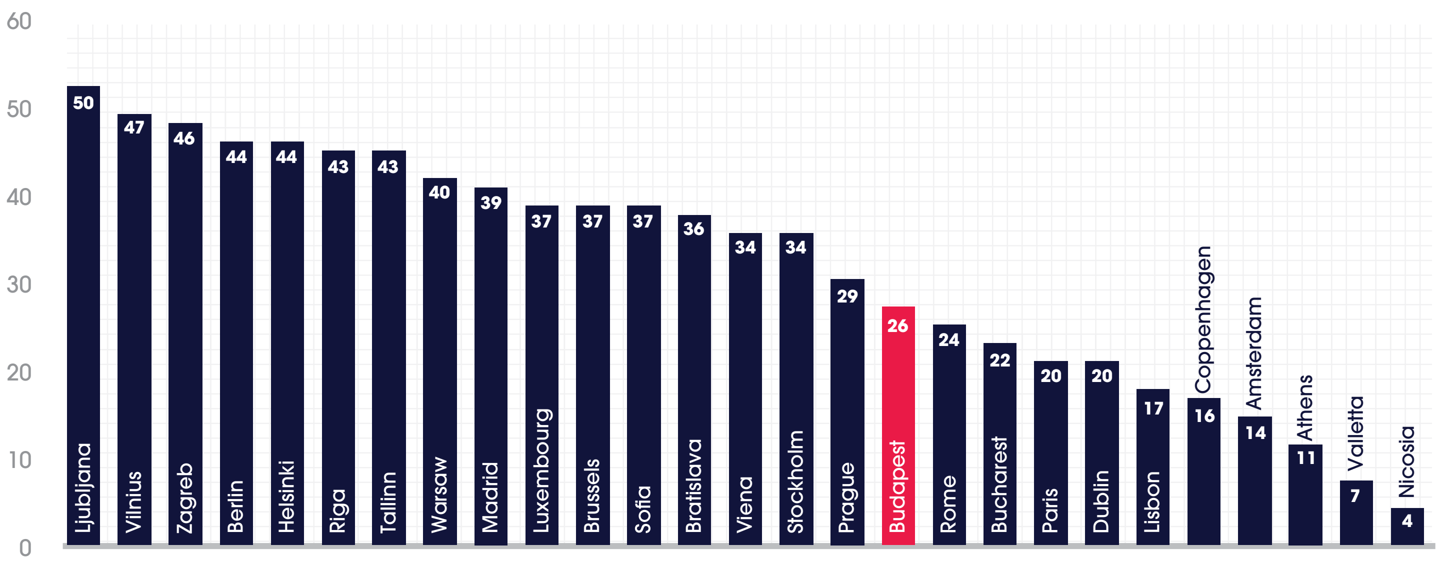


Figure 8: Percentage of tree cover in EU Member State capitals, 2022 (Source: European Environment Agency)24

It is worth noting that although the **total green cover in the capital is now 51%, it is unevenly distributed.**[25] Therefore, to conserve water in the city, it is necessary to increase the proportion of green spaces not only in general but especially in the **more densely populated urban areas.**

INSTITUTIONAL FRAGMENTATION

The Hungarian institutional system for water management was built up to provide protection against floods and inland floods, and it is **only in recent, more drought-prone times that water retention has emerged as a key task.** This would require not only a new approach from professionals but also a rethinking of the existing infrastructure: the acceleration of the water cycle and the increase in extreme and unpredictable weather events call for a much more flexible water management system, with a faster response to changes and a wider range of tools. Moreover, modern water management can only be based on the coordinated and up-to-date knowledge of a wide range of disciplines, but the conditions for this are not yet in place in Hungary. Today, **one of the main challenges is the fragmentation of the water institutions, i.e. water management in Hungary has several owners.**

This fragmentation is also linked to a chronic lack of data: it is difficult to track how much money has been spent on water-related measures over the past decades and what their impact has been. The sources for planning and operation are different for climatic (Hungarian Meteorological Service, from 2024 HungaroMet), environmental and hydrological (General Directorate of Water Management, Measurement Centres, National Public Health and Medical Officer Service), landscape management or agricultural (Ministry of Agriculture) and other economic data (KSH). In addition, the databases are not always public, nor are they interoperable. Since dismantling the Environmental Protection and Water Management Research Institute (VITUKI), **the research network supporting the institutional system for water management with data and technical analysis has also become fragmented.** Hydrological, economic, ecological or engineering knowledge can, therefore, hardly come together, leaving decision-makers without a reliable compass.

24 Urban Tree Cover. European Environment Agency, https://www.eea.europa.eu/en/analysis/maps-and-charts/urban-tree-cover-dashboards – Last accessed: 25 November 2024.

25 Budapest Sustainable Energy and Climate Action Plan (Budapest Climate Strategy). Municipality of Budapest, March 2021. Budapest.hu, https://archiv.budapest.hu/Documents/klimastrategia/BP_klímastratégia_SECAP.pdf – Last accessed: November 26, 2024.

2.3. RISKS FROM WATER EXPOSURE

If our water resources lose their capacity to renew themselves, the environmental, economic and social costs will be almost incalculable. The risks are **higher than average in some areas** - these areas are presented below.

UNSUSTAINABLE AGRICULTURE

Changes in the water cycle have already caused serious damage to agriculture. The 0.2 to 0.6 metres drop in groundwater levels in Hungary between 1986 and 2010 is responsible for 18 to 38% of the change in maize yield. In contrast, in the **Great Hungarian Plain, every 100 mm increase in the water table would raise the average maize yield by 0.23 tonnes per hectare.**[26]

In Hungary today, 2-3% of agricultural land is irrigated (120,000 ha in 2023). **This is lower than the EU average of around 8% but much higher than in the other Visegrad countries.**[27] The Hungarian state has set itself the goal of spreading and developing irrigated farming, and there is a demand for it: in recent years, farmers have indicated a new demand for irrigation on nearly 300,000 hectares. This extra water demand alone would amount to some **12 million m³ of water per day, equivalent to the annual water demand of a city of 150,000 inhabitants.**[28] This will have to be met from surface water or, where it is not available, from groundwater. **The problem is that we are already using far more groundwater than the pace of recharging would allow us to do - for example, over the last 30 years, groundwater levels have fallen by 2-3 metres in almost all of the Great Hungarian Plain.** 80% of irrigated areas are in the Great Hungarian Plain, while there is no additional free groundwater available for irrigation development in this area.

Increasing the irrigated area will lead to serious water security risks in the medium term if we do not monitor our water resources and use more water than the amount that can be recharged. **An inappropriate sowing structure makes it impossible to store water and contributes to further droughts. In other words, agricultural production is destroying its foundations.**

THE STAGNATION OF INDUSTRIAL PRODUCTION

Many economic sectors exploit surface water and groundwater resources simultaneously: in addition to the Paks nuclear power plant, aquaculture, food, paper, machinery, and chemical industries are major water users. Between 2010 and 2020, the most considerable amount of water extracted from surface water in Hungary was for industrial purposes: 108 million cubic metres.[29] It is worth stressing, however, that **industrial water withdrawals do not include the cooling water demand of the Paks nuclear power plant, which is orders of magnitude higher, as it amounts to 3 billion cubic metres per year.**[30]

The reduction in the amount of water available and the increasing drying up of watercourses pose a serious risk to the industry: for example, the gross value added of the manufacturing industry, which is particularly exposed

26 Pinke, Zsolt – Decsi, Bence – Kozma, Zsolt – Vári, Ágnes – L. Lövei, Gábor (2020): *A Spatially Explicit Analysis of Wheat and Maize Yield Sensitivity to Changing Groundwater Levels in Hungary, 1961–2010. Science of the Total Environment,* 715: 136555.

27 Agricultural Irrigated Land (% of Total Agricultural Land) – European Union. World Bank Group, https://data.worldbank.org/indicator/AG.LND.IRIG.AG.ZS?locations=EU – Last accessed: November 25, 2024.

28 Information on Average Water Consumption. Mavíz, https://www.maviz.org/tajekoztato_adat_atlagfogyasztasrol – Last accessed: November 25, 2024. Dr. Tóth, Árpád (2020): *Determining the Water Demand of an Irrigation System.* Agrárágazat, October 19. https://agraragazat.hu/hir/egy-ontozotelep-vizszuksegletenek-meghatarozasa/ – Last accessed: November 25, 2024.

29 Water Withdrawal. Hungarian Central Statistical Office (KSH), https://ksh.hu/s/kiadvanyok/fenntarthato-fejlodes-indikatorai-2022/3-12#1-abra – Last accessed: November 25, 2024.

30 Danube Water Temperature Monitoring. MVM Paks Nuclear Power Plant, https://atomeromu.mvm.hu/hu-HU/Rolunk/Vizhomerseklet – Last accessed: November 25, 2024.

to water availability, was close to HUF 13 000 billion by 2023.[31] The problem is also a matter of energy security: the Paks nuclear power plant provides 40% of the country's electricity. If the cooling water is not available in sufficient quantities and/or at the right temperature, it will hamper the utilisation of the plant's capacity and may even require its shutdown. For example, during the drought of 2022, the 2000 MW Paks nuclear power plant had to be scaled back by 240 MW due to low water levels and overheating of the Danube.[32]

DECLINE IN TOURISM

Although the share of water-based tourism in total tourism is steadily declining, it still accounts for a significant share: around 27% in terms of number of visitors and 30% in terms of overnight stays. **The revenue from water tourism reached EUR 193 billion in 2018.**[33] **However, the decline in the volume** of our waters could, over time, **make it impossible to practice certain water sports or to sail on our major rivers,** not to mention the reduced attractiveness of waterfront holidays. **As water quality deteriorates** - often closely linked to a decline in quantity - **our living waters may be downgraded to the category not recommended for bathing,** and fish kills may reduce bathing and fishing.

The role of Lake Balaton in tourism and, thus, in the Hungarian economy is outstanding, not to mention the traditionally close emotional ties of Hungarians. Rising temperatures are accelerating the evaporation of the lake's waters, which is causing water levels to fall - hence, **Lake Balaton's water resources have been steadily declining over the past century.**[34] **Meanwhile, the development and paving of the shores of the lake and its connecting watercourses are leading to a deterioration in water quality** - riparian habitats retain and clean the water flowing into the lake, and their destruction will remove this cleansing function.

DETERIORATION OF URBAN QUALITY OF LIFE

People living in cities are also feeling the effects of climate change: the periodic downpours of rainfall, the increasing heatwaves, the more frequent and longer droughts, and all the health consequences of these. **Young children and the growing elderly population are the most vulnerable to these health-related consequences.**

The combination of long, dry periods and the growth of the suburban population is leading to situations of water scarcity and droughts across the country. More and more often, and in an increasing number of municipalities, cases such as the one in Pest and Heves counties in the summer of 2022 are becoming more and more frequent: water supply reached a critical situation, and water restrictions had to be introduced in many municipalities due to water shortages. **The high proportion of paved surfaces and extreme rainfall lead to the overloading of combined sewer systems and increasingly frequent urban flooding.** In addition, **flash floods are also expected** due to the drainage of rainwater into streams, especially in peri-urban areas and in the agglomerations.

31 Gross Value Added and Its Distribution by Sector. Hungarian Central Statistical Office (KSH), https://www.ksh.hu/stadat_files/gdp/hu/gdp0006.html – Last accessed: November 25, 2024.

32 Operational Event: Power Reduction Due to High Cooling Water Temperature. MVM Paks Nuclear Power Plant, June 30, 2022. https://atomeromu.mvm.hu/hu-HU/Rolunk/Hirek/20220730_Uzemiesemeny – Last accessed: November 25, 2024.

33 Hungary's River Basin Management Plan – 2021. Annex 5-1: Presentation of Water Uses and Assessment of Their Economic Significance.

34 Ministry for Innovation and Technology (ed.) (2020): *Report on the Scientific Assessment of the Potential Impacts of Climate Change on the Carpathian Basin.* https://m2.mtmt.hu/api/publication/31130164 – Last accessed: November 11, 2024.

DISRUPTION OF WATER SUPPLY TO THE POPULATION

82% of the domestic water supply relies on groundwater, partly the same as irrigation.[35] Groundwater irrigation today relies mainly on shallow groundwater. **However, this still threatens drinking water supplies in times of drought, as the impact of increased agricultural water use spreads to the aquifers that provide drinking water.**

As our groundwater resources diminish, **some of the wells developed for agricultural irrigation now affect deeper and deeper groundwater, which is unable to regenerate from rainfall and inland floods in the short term.** This in itself is a depletion of water resources, but if irrigation wells break through the aquifer uncontrolled, there is also a threat of irreparable contamination of these water resources. Nevertheless, irresponsible use is not penalised today.

> 82% of the domestic water supply relies on groundwater, partly the same as irrigation.

35 Hungary's River Basin Management Plan – 2021: Section 2.1.2 Groundwater Drinking Water Sources. https://vizeink.hu/vizgyujto-gazdalkodasi-terv-2019-2021/vgt3-elfogadott/ – Last accessed: October 16, 2024.

3. THE EQUILIBRIUM INSTITUTE'S POLICY PROPOSALS FOR LONG-TERM WATER SECURITY IN HUNGARY

3.1. WATER RETENTION IN THE LANDSCAPE

Water retention must be a priority if we want to avoid persistent and severe water scarcity, desertification, decline in agricultural and industrial production and tourism, deterioration of the quality of life in cities, and threats to drinking water supplies in many parts of the country in the medium term. **We must prevent and slow the depletion of our groundwater resources and help them to recharge.**

RESTORE THE MEANDERING OF RIVERS!

Give enough space to water! Restore the sinuosity of our watercourses in as many areas of the country as possible to offset the harmful effects of the former river controls! The way to do this is to dig bends along the riverbed and build on the former riverbeds and backwaters to guide the river through them. If the floodplain - the area that can be flooded between the dams - is wide enough, the river has more room to meander, which slows the flow of water and positively affects the level of the surrounding groundwater. **This will increase the residence time of water in the country, reducing the velocity of the water while eliminating or at least slowing down the deepening of river beds and the lowering of groundwater levels in the surrounding areas.** This should be started on smaller rivers, where the banks are not yet built up, where installations can be removed at a reasonable cost, or where the river flows through public land.

UTILIZE THE STORAGE CAPACITY OF GROUNDWATER RESERVOIRS!

There are more than just surface solutions to retain water. **Groundwater resources can be directly augmented by taking advantage of the subsurface by eliminating evaporation loss. To do this, use so-called targeted groundwater recharge!** This can be done by infiltrating rainwater runoff from settlements and local treated wastewater directly into the groundwater table. This has immediate benefits to both wildlife and agriculture, with the stored water subsequently being reclaimed through wells during periods of drought. It can also be used to store excess water during extreme weather events. The most appropriate surface or groundwater retention solution should always be chosen according to the specific conditions of the area.

RESTORE WETLANDS TO ALLOW WATER TO STAY IN PLACE!

By regulating rivers and draining wetlands and flooded inlands, we prevent groundwater recharge and often grow crops on land that is not suitable for it when it is vital for groundwater recharge. This use of wetlands is not economically sustainable and is detrimental to the water balance of the areas concerned. Where the scale and type of development allows, **these waters should be let in or left in place to infiltrate into the soil and improve the water supply of the surrounding land. Restore natural and semi-natural wetlands in as many places as possible to replenish groundwater!**

An effective way to do this is to **include standing water and farmland exposed to inland flooding in the core area of the National Ecological Network.** The National Ecological Network aims to link unprotected natural and semi-natural habitats with protected areas to ensure the survival of each habitat. In the core area, no activities that threaten these habitats can be carried out - the biodiversity and water balance of the wetlands included in the network are thus improved.

LET'S SET UP REGIONAL PILOT PROJECTS TO RETAIN WATER IN THE LANDSCAPE!

Develop national level systems to retain water in situ! This objective can be realised through the implementation of a long-term strategy, encompassing model projects initiated by the state. These initiatives should be first introduced in **state-owned, protected nature reserves, where the cultivation of best practices can be undertaken with minimal conflict.** The selection of pilot project locations should be conducted in a manner that ensures the representation of challenges and potential solutions on a national scale. The solutions adopted in these pilot projects can subsequently be applied in other regions, thereby facilitating a comprehensive and replicable approach to water resource management. A notable example of this approach is the Old-Drava programme, which is implementing a comprehensive water retention and land use change plan.

For example, the 180,000 hectares of the **Hortobágy** region, which is a major tourist attraction, is particularly suitable for water retention projects because it is essentially a natural landscape, i.e. less man-made, and because a large part of it is a protected natural area of national importance. The project should restore the natural course of all the watercourses in the Hortobágy and restore the damaged banks. The removal of existing ditches, channels, and embankments is imperative to ensure the retention of natural rainwater. In instances where the elimination of former channels, bypass channels, or settlement protection ring fills and protective ditches is hindered by vested rights (e.g., settlements or building development), alternative measures should be implemented. The water supply of wetlands must be ensured through the retention and utilization of grey water and treated wastewater from settlements. The development of multifunctional reservoirs within the framework of the pilot project is recommended, with a view to their utilization for purposes including irrigation, fishing, water purification, and the alleviation of atmospheric drought. Let's create a small fishing lake in each municipality in the Hortobágy, which can be rented out to the local community on a concessionary basis. Start reforestation of arable land within the protected area to achieve climate and soil protection goals! For all non-protected, enclosed areas and marginal land, declare protected areas so that the whole area can be managed as one! Improve the tourist attractiveness of the area by restoring the Hortobágy Great Fishponds into a chain of natural wetlands and developing the tourist infrastructure. Operate the tourist facilities partly on a concession basis to involve local people!

3.2. MAKING AGRICULTURAL PRODUCTION SUSTAINABLE

The greatest enemy of agriculture today is itself, as it is systematically depleting the water reserves that are its foundation. The promotion of irrigation investments does not take into account the changed climatic conditions in our country and the fact that the water requirements of intensive irrigation development far exceed the available water resources. **It is, therefore, in the vital interest of agriculture as well to act as soon as possible.**

SUPPORT WATER-SAVING AGRICULTURE INSTEAD OF IRRIGATION DEVELOPMENT!

It is imperative that farmers are made aware of the fact that **in the medium term, irrigation will no longer be a possibility without water retention**. **Rather than developing intensive irrigation, the risk of drought should be mitigated by the promotion of water-saving agriculture.** This can be achieved through the promotion of soil-covering technologies and the utilization of technologies that do not involve soil disturbance, or by the implementation of a system of precision irrigation. A general objective should be to irrigate from surface water as much as possible, **extract as little water as possible from underground sources and from rivers for irrigation, and retain as much water as possible at its source.**

> In the medium term, irrigation will no longer be a possibility without water retention.

Agricultural production limits its competitiveness by failing to take account of the characteristics of the land under cultivation and the water requirements of the crops grown. In the Nyírség region, for example, where one of the most drastic groundwater shortages is found, the problem is primarily caused by the abstraction of groundwater for irrigation purposes - at the same time, **maize and sunflowers, which are nowadays largely grown here, are highly water-intensive.** Climate change will make it increasingly difficult and costly to grow crops like these with high water demand, and this problem in the long term will not be solved by increasingly intensive irrigation. **Let's renew the range of crops grown: support cultivating drought-tolerant crops such as sorghum instead of millet or maize.**

PROMOTE PRECISION AGRICULTURE AND WATER RETENTION ADAPTED TO THE LANDSCAPE!

EU funds are available to support precision agriculture (based on modern technology and data-driven solutions) under the Common Agricultural Policy. The primary objective for the 2023-2027 period is to modernise agriculture by supporting knowledge sharing, innovation and digitalisation, which is essential for precision agriculture. To take advantage of this opportunity, farmers need to be aware of it and understand its benefits. **Therefore, we should help to pass on knowledge about precision agriculture and the resources available from EU funds in as many forums as possible (in university education, at events organised by the Hungarian Chamber of Agriculture, etc.) and by addressing farmers directly.** In addition to transferring information, the state should **provide special financial support to farmers whose lands in deeper areas are designated as flood plains,** as they are providing a public service! Farmers who also use their land as wetlands should be compensated for the loss of income they have undertaken for the community!

CREATE DUAL-USE CHANNELS TO RAISE GROUNDWATER LEVELS!

In addition to surface water retention, **the retention and augmentation of groundwater resources should be a strategic objective.** This can be achieved by eliminating some drainage canals or recharging natural wetlands, but there is also scope for modifying existing infrastructure. For example, **canals currently used exclusively for inland water drainage could be used for water retention,** while canals linked to rivers could be used to store water during times of abundance. This would allow time and opportunity for water to seep into the ground. **As many of the drainage channels and ditches as possible should be dual-purpose, i.e. they should also be able to retain water.** Let's make possible the control of how much water is released from these to avoid drying out. This will reduce the need for irrigation and make irrigation itself more sustainable.

ESTABLISH WATER RETENTION ASSOCIATIONS!

Increased water retention would take out of arable cultivation some of the lower-lying fields prone to inland flooding and thus be pumped to be dry enough for the cultivation of crops. However, their use as pasture or mowing would not be hindered, while the water supply to neighbouring areas at higher altitudes would be improved, and the effects of groundwater and rainfall deficits causing desertification could be mitigated.

Let's create water retention associations to balance diverging farmer interests! These should also include a financial incentive: **owners of lower-lying land should be compensated if they allow their land to flood from time to time to improve the water supply to higher-lying land!** Farmers can also be brought together to develop water retention solutions by setting up a network of landscape caretakers. **A landscape caretaker is a kind of "landscape manager" who helps bring together different stakeholders for sustainable landscape management.**

AFFORESTATION AT THE REGIONAL LEVEL, FOREST STRIPS TO PROTECT FIELDS!

For water protection, soil protection and public health reasons, it is also essential to **increase the proportion of wooded habitats, i.e. forests and tree belts in agricultural areas.** Large areas of woodland attract moist air masses, and cloud cover due to water evaporated by trees reduces atmospheric pressure, which in turn causes more moist air to flow into the regions concerned. Therefore, tree planting on a regional scale, and the establishment of forest strips to protect fields can be useful in improving the microclimate and reducing evaporation and even result in extra rainfall.

At the same time, afforestation must consider local water resources and the landscape. Afforestation in areas with water scarcity can have a drying effect, while in areas with water surplus (e.g. floodplains), afforestation has a positive impact precisely because of the additional water demand. To this end, **the spatial zoning category "area proposed for afforestation" in the National Spatial Plan should be revised throughout the country to serve water retention and ecological rehabilitation objectives.** In areas where this is relevant, introduce the category of "areas proposed for planting climate-protection grassland and for creating wetlands". In addition, the designation of areas proposed for afforestation to reduce evaporation losses should be developed.

MAP THE TERRITORIES SUITABLE FOR WATER MANAGEMENT AND THE AREAS PROPOSED FOR AFFORESTATION!

In some areas, the conditions for agricultural production and forestry are particularly unfavourable due to the high risk of inland flooding and drought, and farmers in these areas can only survive with considerable public support. **Let's map these areas and make it possible to designate them as water management areas.** (These are areas for the coordinated use and conservation of water, the protection of its ecosystem and the recreation of the population.)

There are already valuable maps, models and research results available in water management institutions, but they are fragmented and do not support each other. **Let's build on valuable cartographic works such as the inland water hazard map, the flood hazard map or the National Ecosystem Map of Hungary!** These categorise the whole country's territory regarding water management and land use - helping to identify what activities are taking place in areas with different water retention capacities. **Identify areas where neither agricultural activity nor afforestation is recommended because of climate protection and areas where afforestation is necessary!**

3.3. WATER RETENTION IN CITIES

In cities, we need to focus on water retention rather than rainwater run-off - we must keep rainfall in the local water cycle. However, as life and property must be protected, this can only be done in parallel with improvements to drainage, which can become overloaded during extreme rainfall events.

BLUE AND GREEN ROOFS, RAINWATER HARVESTING TANKS, RAIN GARDENS, DRAINAGE DITCHES, AND RESERVOIRS - LET'S HELP WATER GET INTO THE GROUND!

In the case of Hungary, **one of the simplest urban water retention solutions is rainwater percolation, i.e. water infiltration into the ground.** This can be achieved with any vegetated surface (e.g. lawns) or permeable paving (paving stones, rubber pavement, etc.). **Create percolation trenches or percolation gardens/rain gardens!** In the case of the former, a slightly sunken grassy ditch is used to channel the water into the ground, while in the case of rain gardens, the sunken area is planted with water-tolerant vegetation.

Storage is also a crucial means of keeping rainwater in place. **Short-term reservoir solutions** can slow the run-off of water, thereby relieving the drainage system and preserving its condition more effectively. **Let's develop deeper grassy ditches or reservoir spaces that can be accommodated in areas densely built-up or even deepened sports fields!** For buildings, promote the spread of green roofs and green facades, which are also useful for cooling. To make further use of rainwater and greywater, **create biological filtration ponds outside the municipalities, from which the water can be discharged into the municipalities after the purification process!**

Long-term water storage allows the use of valuable rainwater. **As an above-ground solution, create surface rainwater harvesting tanks, reservoir ponds and so-called green-blue (vegetated or water-retaining) roofs with good water-retaining plants to slow down rainwater run-off, cooling the building and its surroundings! As an above-ground solution, create water storage tanks** into which some excess water run-off from the roofs can be discharged! The water stored in these tanks can be used later while not evaporating over time due to heat.

RELIEVE THE SEWER NETWORK BY INCREASING EVAPORATION!

Planting trees with high canopy cover and **increasing green areas is the easiest way to increase evaporation.** This can relieve the sewer system in two ways: by slowly evaporating the precipitation and delaying the flow of water into the sewer system, reducing the load on the sewer. **Create evaporation ditches with waterfront plants and build water catchment ponds and pools in larger areas!**

DEVELOP A SPONGE CITY CONCEPT!

The combined municipal use of infiltration, storage and evaporation is also called the sponge city concept. **Rather than primarily channeling sudden, heavy rainfall into the urban sewerage system**, the aim is to **retain water,** thereby reducing the risk of flooding, improving the urban microclimate and storing valuable water for dry periods. To this end, **underground water retention spaces are created from which trees can draw water during periods of drought, and which can also allow for the creation of rain gardens.** The sponge city concept also helps to manage and clean up sudden rainfall and to bridge periods of drought. The vegetation planted in this way contributes to cooling by evaporation, reducing the heat island effect and making our cities more liveable. Such projects have already been launched in Budapest and Pécs - let's integrate the lessons learned from these projects and develop sponge city concepts in other cities across the country!

CONTINUE TO BUILD RAINWATER DRAINAGE SYSTEMS SEPARATED FROM THE SEWERAGE NETWORK!

With increasingly frequent droughts and sewer systems overloaded by heavy rainfall, it is **unacceptable for rainwater treated together with wastewater to flow into the watercourse without being used after the treatment pro-**

cess and quickly leave the country. In order to ensure safe drainage and avoid urban flooding, it is essential to adapt the sewerage network to changing demands gradually. **Wherever possible, separate sewer systems should be built to ensure that rainwater is drained separately and used for domestic purposes (irrigation, flushing, etc.)!**

BUILD MORE STORMWATER STORAGE TANKS TO RETAIN RAINWATER!

Where combined systems prove to be an unchangeable feature, interventions, before the water reaches the sewer, can be complemented with interventions helping retention before the water reaches the biological treatment plant. **Build more stormwater tanks next to wastewater treatment plants!** These will capture water during heavy rainfall and allow it to be released into the treatment plant when the load is reduced. This prevents the treatment plant from becoming inoperable for weeks as bacteria and other microorganisms that break down pollutants are washed out.

WATER RETENTION SHOULD BE MANDATORY FROM THE PLANNING STAGE OF URBAN DEVELOPMENT PROJECTS!

Any investment that directly or indirectly affects urban water management should be required to take water retention into account right from the planning stage! We should strive to retain and recycle rainwater locally for all new investments and renovation or reconstruction projects.. **In the case of new construction, the issue of drainage and treatment of rainwater should be part of the permit process, as well as clarification of the accessibility of other utilities!** This requires closer cooperation than at present between landscape architects, engineers, environmental protection and utility providers. For all investments and developments, interdisciplinary collaboration is needed right from the planning stage. **Joint planning should, therefore, be a mandatory requirement, regardless of the investment size!**

FOR NEW BUILDINGS, LINK CONNECTION TO THE COMBINED SYSTEM TO STORMWATER RETENTION MEASURES!

Property owners should be encouraged to retain and use rainwater as efficiently as possible! This can be done in several ways. For some new buildings, the Budapest Sewage Works only accepts wastewater and stormwater into the combined system if the retention of stormwater on the property is already solved to the limit of the technical possibilities. Promoting water retention on private land not only improves the water balance of the area but also reduces the amount of pollution entering the watercourse during heavy rainfall by relieving the sewerage system.

STORMWATER DRAINAGE SHOULD BE PRICED, AND MUNICIPALITIES SHOULD REWARD STORMWATER RETENTION!

To do this, **we must first create the financial basis for operating stormwater drainage,** which is currently only available for combined systems, not separated systems and surface drainage. Since the municipality is responsible for stormwater drainage, the costs of providing this service must also be covered. This will provide the basis for the application of public incentives. If there is already a price for stormwater drainage, financial incentives can motivate residents to retain rainfall on their property, thereby reducing the price they pay for stormwater drainage. Put a price on stormwater and provide financial incentives to retain it!

MAKE AN APPLICATION FOR A NEW IRRIGATION REBATE POSSIBLE ONLY IF THERE IS SOME FORM OF WATER RETENTION ON THE PLOT!

As sewerage charges are now calculated based on the amount of drinking water used, those who use piped water for irrigation and watering pay a much higher amount for sewerage than they use, as the water used for irrigation does not go down the drain. To address this, a watering rebate has been introduced, with a 10% flat-rate rebate on sewerage charges from May to September and the possibility of installing a water meter for watering, which means that only the water used for watering is charged for the whole year.

However, these options do not motivate users to use water sparingly. These benefits should, therefore, be combined with water retention measures. **Require water retention solutions to qualify for new irrigation rebates!**

THE PROPORTION OF PAVED SURFACES IN CITIES SHOULD NOT INCREASE!

The necessary expansion of urban paved surfaces in cities should not be limited, but their proportion to green areas should be controlled. To this end, **it should be compulsory for all new paved surfaces to be developed proportionally to the amount of green space developed or to have a paved area of the same size broken up and converted into permeable surfaces.**

INCREASE THE GREEN SPACE PER CAPITA RATIO IN THE CAPITAL TO 9 M^2!

The current per capita green space ratio in the capital is 6 m^2. **Increase this to 9 m^2 by 2030, as recommended by international recommendations.** This will require large-scale afforestation of disused areas, central districts and community spaces (parks, playgrounds) and the creation of new public green spaces such as urban parks, large parks, public gardens, green spaces and greenways, which help to retain water, among other positive effects. To protect and enhance privately owned green spaces, create a legislative environment that supports the protection of biologically active surfaces. Include regulation of biological activity at the forefront of building regulations. Let us promote this process not only through regulation but also through support instruments.

ROADSIDE TREE LINES SHOULD BE GIVEN THE SAME PROTECTION AS OTHER INFRASTRUCTURE!

Planting trees, especially along roads, is difficult, particularly because of the very strict utility regulations (buffer distances), and in some cases, it is even impossible, e.g., because of the high cost of replacing utilities. R**un utilities under the pavement in utility tunnels rather than in "spaghetti-like" tunnels where possible!** This would also leave space for tree lines and longitudinal rain gardens, which also help water retention and evaporation.

SUPPORT THE OPERATIONAL COSTS OF GREEN INFRASTRUCTURE ELEMENTS FROM SEPARATE MUNICIPAL FUNDS!

To ensure the success of green space development, the future operator must be involved alongside the contractor in the preparatory phase of infrastructure development projects. It should be compulsory to compare in advance the investment and maintenance requirements of a grey solution - i.e. one with less emphasis on sustainability - and a green solution. Green solutions tend to cost less to start with but are more expensive to run, which can be a significant challenge for the municipality concerned. To address this, **let's create a financial fund for municipalities to channel the difference between the cost of a grey and a green solution!** This fund could be drawn down for future operations.

3.4. DATA-BASED WATER MANAGEMENT

Today, we do not know precisely how much water is needed for irrigation in each part of the country, where and how much water could be retained in the surface, groundwater and soil, or what financial (agricultural) compensation these measures would entail. Effective interventions **require real-time, detailed data on the quantity and quality of groundwater across the country and the amount of water entering and leaving the country.** These must also be coupled with climatic data (temperature, precipitation, evaporation). Agricultural data should also be included to track where and how much water has been given to which crops. In addition, the water requirements of different types of habitats need to be clarified, and the water requirements of individual habitats need to be assessed.

These databases must be developed and made available as soon as possible, and existing databases that are difficult to find (such as the National Adaptation Geo-information System) need to be made available so that they can be combined with the current data from the monitoring network. Their day-to-day use should be complemented by cost data on damage prevention and cost data on repair so that the difference in resource requirements between the two is clear.

BOTH EXISTING AND NEW WELLS SHOULD BE REPORTED!

The state must know the exact number and location of wells to monitor the quantity and quality of our water resources. However, the reintroduction of mandatory notification of domestic wells has stalled several times in recent years. **The state should make notification of domestic wells mandatory again!** In the first instance, it is sufficient for the owner to declare the location and depth of the well, but the authorities should monitor this more closely and impose penalties if necessary.

It should be the responsibility of the driller to register new wells - the state should carry out random checks on the registration of wells and compliance with the technical requirements for drilling and **impose fines for non-compliance and failure to register!** Under the current rules, domestic wells less than 50 metres deep using groundwater in areas considered free of risk do not need to be reported or authorised. The risk is that the authority might be unaware of the existence of wells reaching deeper layers and is faced with a lack of data when it wants to see the extent of water abstraction.

For the sake of simplicity, **online registration should be possible for agricultural and domestic wells! This should be free of charge** so that the extra cost does not deter owners! The willingness to report will increase if there is a meaningful social dialogue beforehand on the importance of reporting wells. As a positive motivation, those who report their wells will get information about the state of water supply in their neighbourhood! Failure to report will be severely penalised by the authorities!

MAKE IT COMPULSORY TO MEASURE WATER USE!

The operator of the well should be required to measure the water and report the amount of water withdrawn. The authority should regularly check that the reports are accurate to prevent uncontrolled abstraction. The water meter, which enables the measurement, can be checked like piped drinking water. In fact, smart meters that automatically transmit metering data are also now used in water management.

ENSURE THAT AS MANY MONITORING WELLS AS POSSIBLE ARE TELEMETERED!

Given the pressure on groundwater, the network of some 2,800 monitoring wells is vital, providing the entire water monitoring system with essential data on the quantity and quality of our groundwater. Accelerate the modernisation of the groundwater monitoring well network that has already begun: **ensure that as many wells as possible can be telemetered.** This will allow the data received at the remote monitoring centre to be tabulated and plotted, compared and transmitted to other analysis centres. Regular sampling is required to ensure the availability of quality data!

ENSURE RESPONSIBLE MANAGEMENT OF PARTICULARLY VULNERABLE WATER BODIES THROUGH STRICT CONTROLS AND SANCTIONS!

Certain types of water require special management rules. These include water bodies in poor condition (where the status does not meet legal quality or quantity standards) or where water is abstracted more than recharge, for example, for agricultural, industrial or drinking water supply. **Ensure compliance with the quantitative abstraction limits for such water bodies through controls and strict sanctions.** This is the only way to ensure that the amount of water abstracted from a given water body does not cause damage to its status. **In addition to avoiding further damage, we should gradually introduce limits that allow the recharge of the water bodies!** The authorities should use these as a basis for deciding whether a particular abstraction is legal and whether to allow new well drilling or higher abstraction.

LET'S SET UP A WATER THINK TANK BRINGING TOGETHER ALL RELEVANT DISCIPLINES!

In light of the complex challenges of the decades ahead, **let us create an integrated water management think tank, a knowledge centre, channeling the perspectives of the relevant disciplines (hydrology, hydrobiology, environmental protection, etc.) in a unified way.** In most European countries, **some kind of background institution gathers the latest scientific knowledge and data and assists decision-makers:** the Ecological and Hydrological Centre in the UK, the Federal Hydrological Institute in Germany, the Slovak Hydrometeorological Institute in Slovakia. In Hungary, some of the databases can be found at the General Directorate of Water Management, but **the data and analyses describing the quantitative and qualitative characteristics of water should be complemented by meteorological, soil, cartographic, possibly plot-level agricultural, forestry and natural ecosystem data.** This work should also be complemented by 3D terrain modelling, remote sensing, and analysis of space imagery.

DRONE TECHNOLOGY, SATELLITE MONITORING, LASER SCANNING - LET'S USE STATE-OF-THE-ART MONITORING SYSTEMS!

Robotics, which has been gaining ground in environmental monitoring in recent years, can make the work of public authorities more efficient and cheaper. Flying and underwater drones, automatic measuring probes and laser scanning technology are now available. Artificial intelligence-based robots and flying and underwater drones are used to monitor water quality in large rivers and reservoirs in countries such as Australia and the US. These take samples of water and sediment from the bottom of the river or reservoir, which can be used to infer the condition of the river or reservoir. In our country, drone technology can be useful for official inspections and monitoring (e.g. mapping illegal water abstraction), as well as for damage assessment and pollution detection. Laser scanning can also be used to model the course of flash floods, which is a great help in prevention.

Let's use satellites to map illegal agricultural wells! (If an agricultural area is much greener in one patch than the rest of the surrounding area, it is being irrigated.) Data on water levels and volumes can also be collected from **lakes and groundwater monitoring wells.** Although such attempts have been made at Lake Balaton, the use of fixed automatic samplers, or probes, has not yet become widespread. The EU satellite system Copernicus can also help to collect data on water bodies and soils.

THE EQUILIBRIUM INSTITUTE'S POLICY PROPOSALS

AREA	PROPOSAL
WATER RETENTION IN THE LANDSCAPE	Restore the meandering of rivers!
	Utilize the storage capacity of groundwater reservoirs!
	Restore wetlands to allow water to stay in place!
	Let's set up regional pilot projects to retain water in the landscape!
MAKING AGRICULTURAL PRODUCTION SUSTAINABLE	Support water-saving agriculture instead of irrigation development!
	Promote precision agriculture and water retention adapted to the landscape!
	Create dual-use channels to raise groundwater levels!
	Establish water retention associations!
	Afforestation at the regional level, forest strips to protect fields!
	Map the territories suitable for water management and the areas proposed for afforestation.
WATER RETENTION IN CITIES	Blue and green roofs, rainwater harvesting tanks, rain gardens, drainage ditches, and reservoirs - let's help water get into the ground!
	Relieve the sewer network by increasing evaporation!
	Develop a sponge city concept!
	Continue to build rainwater drainage systems separated from the sewerage network!

FOR THE LONG-TERM CREATION OF WATER SECURITY IN HUNGARY

AREA	PROPOSAL
WATER RETENTION IN CITIES	Build more stormwater tanks to retain rainwater!
	Water retention should be mandatory from the planning stage of urban development projects!
	For new buildings, link connection to the combined system to stormwater retention measures!
	Stormwater drainage should be priced and municipalities should reward stormwater retention!
	Make an application for a new irrigation rebate possible only if there is some form of water retention on the plot!
	The proportion of paved surfaces in cities should not increase!
	Increase the green space per capita ratio in the capital to 9 m^2!
	Roadside tree lines should be given the same protection as other infrastructure!
	Support the operational costs of green infrastructure elements from separate municipal funds!
DATA-BASED WATER MANAGEMENT	Both existing and new wells should be reported!
	Make it compulsory to measure water use!
	Ensure that as many monitoring wells as possible are telemetered!
	Ensure responsible management of particularly vulnerable water bodies through strict controls and sanctions!
	Let's set up a water think tank bringing together all relevant disciplines!
	Drone technology, satellite monitoring, laser scanning - let's use state-of-the-art monitoring systems!

ABOUT US

The Equilibrium Institute is Hungary's independent think tank. In order to renew the political discourse in Hungary, we draft political, economic and cultural future visions and write detailed policy proposals and strategies based on these visions. We are engaged in an ongoing dialogue with the most important political, economic and cultural decision-makers. We persuade them of the importance of implementing our policy proposals, and we provide expert assistance in the process of policy implementation.

OUR VISION

The Equilibrium Institute believes in a Hungary in which public discourse is not dominated by political power struggles but by expert debates about the future of our country and the consensus that emerges from these debates. In 2020, the Equilibrium Institute published its political, economic, and social vision of Hungary entitled Hungary 2030 – A Future Vision for Hungarians. In this publication, we charted the path that we need to follow to make Hungary more prosperous and happier.

OUR MISSION

In line with the vision of Hungary's future presented in our publication, Hungary 2030, the Equilibrium Institute works on creating a smart, environmentally cleaner nation rooted in a strong community. To this end, we write widely appealing and practical policy proposals that serve the development of our country and discuss them jointly with the best domestic and international experts. Our goal is to ensure that current and future political and economic decision-makers understand, embrace, and implement these recommendations.

OUR CORE VALUES

The Equilibrium Institute is a future- and solution-oriented policy think tank. It is an autonomous institution independent of all domestic and foreign parties and political and economic interest groups. Its sole purpose is to contribute to the creation of a more prosperous and happier Hungary by presenting its work on the country's future vision, providing a forum for comparing and contrasting different visions and opinions, and drafting public policy recommendations. The Equilibrium Institute is happy to cooperate with any political, economic, and cultural stakeholders who can identify with the fundamental values expressed in the vision we outlined in our publication entitled Hungary 2030.

OUR TEAM

The staff and advisory board of the Equilibrium Institute comprise internationally acclaimed experts, renowned for their excellence in research and analysis across a range of disciplines. Our think tank is supported by more than 30 experts, including economists, sociologists, political scientists, international experts, urbanists and climate scientists.

OUR EXPERTS

TAMÁS BOROS

Executive director and co-founder of the Equilibrium Institute

Tamás Boros is the executive director and co-founder of the Equilibrium Institute. He was the co-founder and co-owner of Policy Solutions, a consultancy and research institute. He is a recurring guest on a variety of political talk shows and often comments about public affairs for leading international media. He previously worked for the European Commission and the Hungarian Ministry of Foreign Affairs as an expert on communication and EU affairs. His research focuses on Hungarian and EU political communication and populism.

DÓRA CSERNUS

Director of Climate, Energy and Environment

Dóra Csernus is the director of climate, energy and environment policies at the Equilibrium Institute. As an expert in environmental issues, she has worked for the Ministry of Environment and Water, the Office of the Parliamentary Commissioner for Future Generations and the Ministry of Public Administration and Justice, representing the Hungarian position in different EU, UN, and OECD fora. She later worked as Director for International Policy Development at Klímapolitika Research and Consultancy Ltd and as an independent expert in climate and environmental issues. Her main focus is on climate policy, air-quality control and water policy.

GÁBOR FILIPPOV

Director of Research

Gábor Filippov is the director of research at the Equilibrium Institute. Previously, he worked as an expert advisor in the Hungarian National Assembly and then as a political analyst and senior analyst at the Hungarian Progressive Institute. His analyses and op-eds have been published by numerous domestic and international media outlets, and he is frequently invited to talk about politics on television and radio shows. His research focuses on the European and the Hungarian far-right, on the histories of anti-Semitism and Islamophobia and their present-day manifestations, as well as the workings of contemporary authoritarian regimes.

ÁKOS KOZÁK

Director of Business Relations and co-founder of the Equilibrium Institute

Ákos Kozák is the director of business relations and co-founder of the Equilibrium Institute. Previously, he served as the director of the GfK Hungária Market Research Institute for nearly 30 years. He is the former president of the Hungarian Marketing Association. Formerly, he was also a lecturer at the Budapest Business School and is currently an academic research fellow at the Cyber Economics Research Centre. He is the author or co-author of numerous academic studies on market research. He is the 2008 recipient of the Gábor Klauzál Award (the most prestigious Hungarian state award in the area of trade). He is an expert in futures research and consumer studies and holds a PhD in the sociology of consumption.

BERTRAM MAREK

Chief Analyst

Bertram Marek is the chief analyst at the Equilibrium Institute. He holds a BA in Political Science from ELTE, an MA in Communication and Media Studies from BME and an MSc in Political Psychology from the University of Kent. He is currently pursuing his PhD at ELTE PPK. His research focuses on the relationship between nostalgia and system criticism. Previously, he worked as a junior analyst at NielsenIQ. He is a fellow of the Friedrich Ebert Stiftung.

Future for Hungary

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