WATER WORKSHOP 2025

The Water Workshop – School for Environmental Protection (Water Quality) has been held for decades as a seminar dedicated to environmental protection, with a special focus on water.

In 2025, the 28th Water Workshop took place under the title *"Water Quality."*

The event serves as an open platform for the exchange of scientific and professional knowledge, bringing together experts, industry representatives, and students to discuss the protection of water quality, sustainability, and the application of innovative solutions.

WW2025, 17-19. September 2025.

Organizers of the 28th Water Workshop

- EDEN – Educational Center for Environmental Protection
- University of Novi Sad, Faculty of Sciences, Department of Chemistry, Biochemistry and Environmental Protection
- Foundation *"Doc. dr. Milena Dalmacija"*
- Project *MICROPLASTIC*, Interreg VI-A of the Hungary–Serbia IPA Program 2021–2027

Interreg Co-funded by the European Union
IPA Hungary - Serbia
Microplastics

Presentation of the EU project "MInimizing CROssborder water contamination of microPLASTICS – MICROPLASTICS" at the 27th Water Workshop

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Keywords: microplastics, public health, water pollutants

Introduction

The Interreg IPA HUSRB/23R/12/089 project MICROPLASTICS has been approved within the Interreg VI-A IPA Hungary-Serbia Programme for the 2021-2027 EU financial framework, effective from 01.07.2024 to 30.06.2026. There are four project team members: IZJZV as the Lead Partner, ZZJZ SO (PP1), LUPS (PP2) and FEAD APV (PP3). The project's overall objective is to enhance environmental protection and reduce pollution by identifying sources and reducing microplastic pollution in the water ecosystem within the cross-border area of Bačka/Bács-Kiskun.

Method

The activities are achieved through:

- Sampling by Manta travel net and specially designed pump
- Identification of pollutants by FTIR-microscopy
- Modelling and developing measures and tools to reduce microplastic pollution in the water ecosystem
- Increasing public awareness on the problem and solutions developed

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Results

The realized activities included:

- Opening a conference
- Producing ecological promotion material
- Creating bilingual roll-ups
- Increasing visibility through social media
- Conducting three educational sessions for Serbian public health experts
- Providing education for elementary and high school children in Hungary

The sampling of open surface water, wastewater, and sediments is ongoing in Hungary and Serbia. The samples are being prepared for analysis of microplastics. A filter solution for eliminating microplastics from wastewater is being planned for two wastewater treatment plants and is currently in progress.

Future activities, in addition to ongoing sampling and analyses, will focus on:

- Validating the methods and laboratory techniques
- Developing a protocol
- Implementing the ICT solution for sharing project information
- Enhancing the capacity to reduce microplastics within local government

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Conclusion

The Interreg IPA project MICROPLASTICS enabled cross-border cooperation, built the technical and quality capacities within the team member organizations, and raised awareness of reducing microplastic pollution in the water ecosystem among children, students, decision-makers, and the global population.

Microplastic pollution: Environmental Pathways, Human Health Risks and the Role of Legislation

Keywords: microplastic pollution, environmental pathways, human health risks, legislation and policy, aquatic ecosystems

Abstract

Microplastics are emerging as a significant environmental pollutant with global implications. They originate from a variety of sources, including the degradation of larger plastic waste, synthetic textile fibers, personal care products, tire abrasion, and industrial processes. Once released, microplastics are transported through air, water, and soil, making their way into rivers, oceans, agricultural land, and even the atmosphere. Their persistence and small size allow them to accumulate in ecosystems and enter food chains, posing risks to aquatic organisms, wildlife, and humans. The environmental impact of microplastics is multifaceted. In aquatic environments, they can harm organisms through physical blockage, chemical toxicity, or as vectors for pathogens and pollutants. Human exposure occurs via ingestion (contaminated food and water), inhalation, and potentially through dermal contact, raising concerns about long-term health effects such as inflammation, endocrine disruption, and cellular toxicity. The research in this area is still developing. Addressing microplastic pollution requires coordinated international and national efforts. Several global frameworks, such as the EU's Plastics Strategy and UNEP initiatives, aim to reduce plastic waste and improve monitoring. At the national level, countries are adopting policies that ban or limit microplastic-containing products, improve waste management, and promote innovation in materials and product design. Tackling the microplastic crisis demands interdisciplinary collaboration across science, policy, and industry to better understand sources, transport mechanisms, impacts, and effective mitigation strategies.

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Sources and transport of microplastic in soil and freshwater systems

Keywords: microplastics, soil contamination, freshwater systems, urban ponds, land use impacts

Abstract

Soil and freshwater systems are exposed to significant human-induced pressures. Among these pressures, growing importance is being given to emerging contaminants, such as microplastics. Microplastics (MP) in soil and freshwater systems poses significant ecological risks as these persistent particles can adsorb harmful chemicals. Related to freshwater systems, our research focusing on urban ponds, acting as stormwater storage wetlands, where urban runoff is directly discharged through drainage channels. The aim is to analyse the MP load of these ponds and to explore how different land uses and precipitation variability influence microplastic concentrations. The monitoring of the lake's water and sediment was started in the autumn of 2024. In case of soils, the research focusing on agricultural areas influenced by sewage sludge disposal. The areas were initially treated with sewage sludge in April 2025 at a dose of 13 t/ha of raw sludge. The samples are currently being prepared and examined in order to reveal the horizontal and vertical distribution and migration of MPs in soil. Based on our results, the water and sediment of the lakes were characterized by high MP loads, which showed significant temporal variability average MP load in ranged from 14 to 40 pcs/L in the water and 2100 to 3000 pcs/kg in the sediment. In addition to temporal variability, we also observed significant spatial differences between the lakes (depending on the land uses) and within the lakes themselves (affected by morphology, or the location of drainage inflows). The research was funded by the PLAGROSYS 2024-1.2.3-HU-RIZONT-2024-00010 project financed from the NRDI Fund, Hungary.
https://u-szeged.hu/nanoplasthub/ongoing-and-completed/plagrosys-assessment-and

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The most effective tools for detecting micro – and nanoplastics in surface water

Keywords: microplastics, nanoplastics, surface water, sampling, analysis methods, FT-IR, MS

Abstract

Detecting the presence of micro- and nanoplastics in our environment has become increasingly important since we began to recognize their potential health and environmental impacts. Over the past two decades, a great deal of knowledge has been accumulated on this topic, and various methods have been developed for detecting the presence of micro- and nanoplastics particles and for their chemical analysis.

In my presentation, I will introduce the techniques and tools that are currently considered to be the most reliable and easiest practicable for the investivógation of surface waters both for micro- and nanoplastic particles. Most recent analytical techniques like pyrolysis-GC/MS, micro- and nano- FTIR, Raman scattering, SEM/TEM will be discussed and compared to find the most efficient methods for evaluation of samples containing micro- nanoplasic particles.

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Microplastic sampling and analysis in the MicroDrink and PlasticDustCloud project

Keywords: microplastics, drinking water, Danube, monitoring, deposition, polyethylene, polypropylene, tire particles.

Abstract

In the past years microplastics (MPs) were found in different environmental compartments, however, in contrast to well researched seawater, occurrence and effects of MP in surface water, groundwater and air are less investigated. Because of the lack of integrated MP management in water environment – especially those used for drinking water supply of the Danube River Basin (DRB) region –, effective monitoring tools, and improved policies to mitigate MP emission and reduce pollution are urgently needed. As a first step, EU Directive 2020/2184 identified MPs as potentially hazardous substances and issued sampling and analysis methodology in Commission Delegated Decision C(2024) 1459. To start collecting EU DWD harmonized data, during MicroDrink Danube Interreg Project, microplastics are monitored in 9 designated transboundary pilot sites equally distributed in 3 clusters (karst, intergranular, surface/bank filtration) representing the vast majority of DRB drinking water resource types. Sampling knowledge will be transferred to the partners during a joint sampling event and samples from the following one year-long monitoring campaign will be analyzed harmonized to the directive's strict quality assurance and quality control protocols. As an outcome of the project, a comprehensive online MicroDrink knowledge base, meanwhile relevant international stakeholders will be engaged via targeted meetings, workshops and events.

As potential source of MPs to water environment, air samples have been globally analysed during the PlasticDustCloud project launched by Eurofins. Sampling was conducted through a harmonised wet-dry deposition method using funnels with glass bottles. Samples were collected in parallel on each of the 12 sites in 9 countries on 3 continents during a week-long exposure period. Results revealed varying deposition rates depending on site and detection technology, ranging from 1,250 particles per square metre per day (with a median value of 143 particles per square metre per day) to 3,110 µg per square metre per day (with a median value of 19 µg per square metre per day), using vibrational spectroscopy and thermoanalytical technologies respectively.

The most frequently identified polymers were polyethylene (PE) and polypropylene (PP), reflecting global plastic production trends. In addition to plastics, tire wear particles (rubbers) were identified, with levels reaching up to 304 µg per square metre per day (median value of 2.4 µg per square metre per day), highlighting road traffic as an additional significant source of microplastics.

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Advancing Methodologies for Assessing Protein–Microplastic Interactions in Simulated Intestinal Environments

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Abstract

Microplastics (MPs) are now recognized as global pollutants present in nearly all ecosystems. [1,2] Humans are exposed to MPs through ingestion, inhalation, and skin contact. To assess potential health risks, we developed an experimental approach to monitor MP– protein interactions under simulated gastrointestinal (GIT) conditions. Simulated intestinal fluid was prepared following the INFOGEST protocol.[3] Enzymatic activities of commercial digestive enzymes—lipase, pepsin, and pancreatin—were experimentally validated, revealing significantly lower activity levels compared to manufacturer claims. This emphasizes the need for activity determination when aiming to faithfully replicate physiological conditions *in vitro*.

Post-incubation protocols were developed and optimized to remove residual organic materials from polyethylene terephthalate (PET) microplastics, ensuring sample purity for downstream analysis. A thin protein hard corona was observed around MPs, which did not interfere with ATR FTIR analysis. However, the effectiveness and aggressiveness of the clean-up steps influenced the removal of this corona. While strong alkaline treatments (e.g., KOH) ensured complete corona removal, they also increased polymer amorphousness and probably masked subtle surface changes induced by digestive enzymes.

Together, these findings support the need for methodological rigor and careful optimization of experimental steps when assessing microplastic–protein interactions in GIT-like environments.

Acknowledgments

This research was supported by the Science Fund of the Republic of Serbia, Grant No. 7275, Exploration of PETase side activity of digestive enzymes of human gastrointestinal tract acting on micro- and nanoplastics: mode of action and products characterization – XPACT.

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Monitoring of microplastics in water and sediments of the Danube - UPSTREAM and SUNDANSE project approach

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Abstract

The Danube is Europe's second-longest river, flowing over 2,800 km through 10 countries, from Germany to the Black Sea, making it one of the most international rivers in the world. It connects diverse cultures and supports industry, tourism, agriculture, and transportation, serving as a vital resource for regional cooperation and development.
Recognizing the Danube's importance and the growing threat of environmental pollution, numerous national and international projects have focused on preserving its ecosystem. Among the emerging concerns is microplastic pollution, which is receiving increasing attention from scientific and policy communities.
This paper presents activities from two projects funded under the Horizon Europe Mission Ocean program: UPSTREAM and SUNDANSE. Both projects aim to monitor and manage microplastic contamination in the Danube's water and sediment.
UPSTREAM focuses on implementing 15 innovative solutions targeting pollution across seven European rivers, structured around five pillars: monitoring, prevention, removal at wastewater plants, removal from rivers, and plastic reuse. In Serbia, microplastic remediation will use microfluidic technology, a portable tool that efficiently isolates particles based on size, shape, or density.

Analysis will be conducted using Py-GC-MS (to determine polymer type and quantity) and DART-MS (for rapid chemical identification without extensive preparation).
SUNDANSE aims to create a Sediment Management Handbook and a Sediment Prediction Tool. Its key resource, the REXDEN research vessel, acts as a mobile laboratory, enabling real-time sampling and analysis of microplastics along the Danube, ensuring fast, comparable data across all participating countries.

Acknowledgment:

The authors would like to acknowledge the financial support of Horizon Europe projects "*Circular and Bio-Based Solutions for the Ultimate Prevention of Plastics in Rivers Integrated with Elimination And Monitoring Technolo*gies" (UPSTREAM, GA 101112877) and "*Innovative sediment management framework for a SUstainNable DANube black Sea system (SUNDANSE, GA 101156533)*", co-funded by the European Union.

Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Climate, Infrastructure and Environment Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

Uncertainties in data interpretation and microplastics quantification in agricultural soil

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Abstract

With soil being recognized as the most prevalent depot of microplastic particles in the environment, it is notable that a major contributor to secondary microplastic formation and accumulation stems from agricultural practices, which often involve the use of polymers to enhance crop yield. This underlines the need for standardized quantification methods and the importance of reliable information on polymer type, size and number of particles as a foundation for developing containment and recovery strategies. During this pilot study, agricultural soil samples were extracted using an optimized protocol combining multiple density separation steps with Fenton's reagent digestion. Scans of samples were obtained with a µ-FTIR and further processed using the software *siMPle* for particle identification and quantification. While results confirmed the presence of 11 polymer types, the choice of data interpretation approach led to notable differences in reported particle counts and size distributions, even within the same software environment. This demonstrates how methodological variability can obscure comparability between studies and highlights the significance of detailed methodological reporting and the complete harmonization across all steps of analysis in order to advance microplastic research.

Acknowledgments: This research was funded by the European Union project Horizon Europe GREENLand - Twinning Microplastic-free Environment, within the grant agreement number 101079267, https://project-greenland.com/

Keywords: microplastics, agricultural soil, data interpretation, standardization.

AQUATIC PLASTIC and TIDY UP in the function of advancing knowledge on microplastics

Keywords: Microplastics, Danube River Basin, Plastic pollution

Abstract

Microplastic pollution has become a critical environmental challenge, particularly in large river basins where plastics are transported, fragmented, and eventually discharged into marine ecosystems. The projects *Tid(y)Up* and *AQUATIC PLASTIC (AQPLA)* address this issue in the Danube Region through complementary approaches that combine scientific research, technological innovation, and public engagement. The *Tid(y)Up* project concentrated on identifying hotspots of riverine litter, developing and harmonizing monitoring

methodologies, and engaging local communities in cleanup activities, which successfully prevented significant quantities of waste from entering aquatic ecosystems. It also fostered awareness of the sources and pathways of plastics and encouraged behavioral change through active citizen participation. The *AQPLA* project advances these efforts by introducing innovative technological solutions, and geospatial mapping tools to intercept and monitor plastic flows. It further integrates citizen science through campaigns involving schools, non-governmental organizations, and stakeholders, thereby strengthening education on the mobility, transformation, and impacts of microplastics. This dual focus on advanced monitoring and participatory approaches creates a strong platform for enhancing scientific knowledge while simultaneously promoting awareness among diverse societal groups. Taken together, *Tid(y)Up* and *AQPLA* represent a continuum from baseline assessment and awareness raising to the piloting of scalable and efficient solutions. Their synergy highlights the value of interdisciplinary research and transnational collaboration in expanding knowledge on microplastics, supporting evidence-based policymaking, and contributing to the long-term protection of aquatic ecosystems in the Danube Region and beyond.

Websites:
https://dtp.interreg-danube.eu/approved-projects/tid-y-up
https://interreg-danube.eu/projects/aquatic-plastic
https://www.linkedin.com/showcase/aqpla/posts/?feedView=all

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The problem of plastic pollution in aquatic ecosystems-the approach of the ADRIAPLAST project

Keywords: microplastic pollution; freshwater; water; sediment; biota

Abstract

The AdriPlast project will promote co-operation between six partner countries — Italy, Croatia, Slovenia, Serbia, Montenegro, and Albania, to develop sustainable solutions for the reduction of plastic waste. The aim of the project is to address the growing problem of plastic pollution in aquatic ecosystems, and its harmful effects on biodiversity, ecosystems, and human health. The main objectives of the project are: (1). facilitate transboundary cooperation to share best practises and strengthen regional efforts to combat plastic pollution; (2). conduct research and monitoring activities to gain a deeper understanding of plastic pollution in the aquatic environment and develop strategies to mitigate its impacts.
Methods: The project aims to improve transnational cooperation to understand and address plastic and microplastic pollution (PmPP) in aquatic ecosystems, from rivers to the sea. Water, sediment and biota samples (molluscs, fish) will be collected using a standardised sampling protocol. PmPP will be analysed using a stereomicroscope and the polymer type will be determined using microFTIR.
Results: With the aim of developing a comprehensive roadmap for pollution reduction, involving citizens more and proposing a standardised operational protocol (SOP) for monitoring, the main ideas are: (1) Source-to-Sea approach; (2) Standardised monitoring protocols (SOPs); (3) Pilot sites; (4) Citizen science and public awareness; (5) Bio-indicators; (6) Roadmap for plastic reduction.
Conclusion: AdriPlast aims to protect ecosystems and human health with effective, sustainable strategies against plastic pollution, by sharing knowledge among stakeholders and raising public awareness.

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The role and research work of the Hungarian partners in MICROPLASTICS project

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Keywords: microplastics, sampling, filtering technology

Abstract

The main sources of microplastics entering the aquatic ecosystem are synthetic fibers from households, packaging, and cosmetic debris that end up in the drain. Much of the microplastic dust generated along roads and sidewalks and is then washed into the soil and sewer system along with precipitation. Water, as a medium of transport, can carry microplastics virtually anywhere, which is why we consider this to be an issue of international importance. The estimated amount of microplastic pollution entering the Black Sea via the Danube is 1,533 tons per year. It is therefore obvious that cross-border cooperation is needed to deal with this problem effectively and efficiently.

Out of this reason, the Ludovika University of Public Service, led by the European Affairs Fund of the Autonomous Province of Vojvodina, the Vojvodina Institute of Public Health and the Institute of Public Health in Sombor formed a consortium and applied for the Interreg VI-A IPA Hungary-Serbia Program call for proposals. After winning the tender, the implementation of the project HUSRB/ 23R/12/089, entitled MICROPLASTICS, was launched on 1 July 2024. The project implementation period is from 1 July 2024 to 30 June 2026.

The main objective of the project is to reduce microplastic pollution in aquatic ecosystems in the border region by establishing more effective partnerships in the target area for the protection and conservation of nature.

On behalf of the Ludovika University of Public Service, the professional implementation is carried out by the Faculty of Water Sciences at Baja. As a result of the faculty's scientific research work within the project, it will be enriched with unique tools, such as a high-resolution spectrometer, which can detect even the smallest contaminants in water. A filtration system has been developed that is capable of removing microplastics from treated water discharged by wastewater treatment plants. Testing of the equipment under real-life conditions will begin in October. A sampling device has been developed, and based on the measurement results, a procedure will be developed for performing these tasks. This conference announcement will provide detailed information about these activities.

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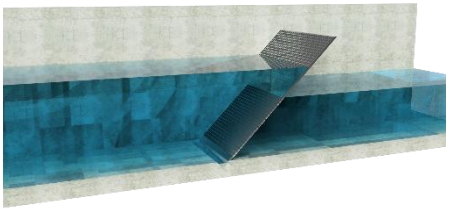

Applied sampling, preparation and determination protocol of microplastic contamination in MICROPLASTICS project

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Keywords: microplastics, sampling, Micro-FTIR,

Abstract

The primary pathways through which microplastics enter aquatic ecosystems include synthetic fibers released from households, packaging materials, and cosmetic residues that reach the sewage system. A considerable amount of microplastic particles is also generated from road and sidewalk abrasion, which precipitation subsequently carries into the soil and drainage networks. Since water serves as a global transport medium, microplastics can disperse practically without boundaries, making this a matter of international concern. For instance, it has been estimated that the Danube alone introduces around 1,533 tons of microplastic pollution into the Black Sea each year. This highlights the urgent need for cross-border cooperation to address the issue in a coordinated and effective manner. The presence of microplastics in aquatic ecosystems has received increasing attention over the past decade. Numerous studies have sought to shed light on the potential hazards of this type of pollution, as well as on possible removal strategies. However, standardized methodologies and universally accepted measurement protocols are still lacking worldwide. Within the framework of the MICROPLASTIC project, we aimed to apply a sampling and analytical approach that is widely represented in international scientific literature.

During the sampling campaigns, filtration was optimized to the size and hydromorphological characteristics of surface waters. All collected samples were processed using identical preparation methods and subsequently analyzed with Micro-FTIR technology. This technique not only enables the determination of particle size, size distribution, and morphology, but also provides insights into the material composition of the microplastics.

Measures proposed to reduce the amount of microplastic in the environment Do we have final solutions?

Keywords: microplastics, environment, mitigation, wastewater treatment, biodegradation

Abstract

From the ocean's depths to the mountain peaks, a ubiquitous and indestructible threat has appeared - one that is invisible to the naked eye - microplastics. Small pieces of microplastics are persistent, very mobile and hard to remove from nature. There are increasing concerns about the presence and impact of microplastics in environment, biodiversity and potentially human health. The EU encourages international action to set the global framework for plastics and microplastics and advocates for legal instruments that would minimize the risk of leakage of plastic, reducing the release of unintentional microplastics, restricting the intentional addition of microplastics to consumer products, improving collection and recycling of plastic waste, and promoting the use of biodegradable material. Some of existing solutions for microplastics mitigation are prevention of industrial emissions by eco-design of infrastructure, improving filtration devices, general waste management measures, advanced municipal and industrial wastewater treatment. Conventional wastewater treatments have limitations, including high energy demands, secondary pollution, and selectivity constraints. As part of the MICROPLASTICS project, pilot actions will be designed to test wastewater filtration solutions adapted to treatment and the flow of water, with the aim of reducing microplastics pollution. Recent research has turned towards innovative approaches suitable for different environmental conditions. Microbial enzymes degradation, bio-based adsorbents, and the use of artificial intelligence (particularly machine learning) present a promising alternative. The integration of multiple technologies may present a more holistic approach, exceed the limitations of individual methods while enhance overall performance.

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