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FRESHWATER BASED BIOECONOMY

FRESH WATER NET

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FRESHWATER STREAMS ARE CALLING

FOR MORE ATTENTION

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The Freshwater Clustering Event, held on March 6th during the Ocean & Water Week in Brussels, showcased the synergies among EU-funded projects addressing freshwater management challenges. The event brought together key stakeholders to discuss pressing issues, highlight demonstration sites, and promote collaborative efforts in improving freshwater governance. Organized by BIOEAST HUB CR, this second **FreshwaterNet** clustering event aimed to foster cooperation among projects tackling the Water-Energy-Food-Climate System nexus, circular bioeconomy, and water pollution, among other critical areas.

Ana Gavrilović, a member of the Water and Ocean Board of the EU Mission "Restore Our Ocean and Waters" and emphasized the significance of focusing on freshwater challenges. She urged participants to articulate the need for greater support to address these pressing issues. Ana Gavrilović also highlighted the necessity of improved coordination between public bodies and entities, which often hinder the implementation of a coherent approach. She pledged her support in advocating for tailored, holistic solutions to enhance freshwater management.

Marie Kubáňková, representing the BIOEAST Thematic Working Group on Freshwater-Based Bioeconomy (TWG Fresh Water BBE), **provided insights into key achievements in freshwater-related initiatives.** She underscored the importance of the water-soil-climate nexus in mitigating disasters - a concern that extends beyond the BIOEAST macro-region. Marie Kubáňková also referenced the BIOEAST **Stakeholder Manifesto**, which articulates a shared vision for sustainable freshwater management. A significant milestone was the Council's approval in November 2024, under the Hungarian Presidency, to explore a Research & Innovation initiative for sustainable freshwater management. Marie Kubáňková also invited participants to engage as experts and practitioners in advisory boards and networks, particularly within the BRILIAN and BBioNet projects.

Following the introductory speeches, the **Freshwater Clustering Event** featured presentations of innovative EU-funded projects aimed at addressing key challenges in **freshwater management, pollution reduction, ecosystem restoration, and climate resilience**. These projects represent a diverse array of solutions, from **policy development and governance** to **technological advancements and community-driven approaches**.

1) TACKLING WATER AND SOIL POLLUTION

The **Path4Med** project, presented by Dr. Konstantinos X. Soulis, Assistant Professor in Geoinformatics and Spatial Analysis at Agricultural University of Athens, **...**, focuses on combating **water and soil pollution** in **Mediterranean agro-hydro systems. By employing a triple-bottom-line approach, it balances economic, social, and environmental sustainability**, supporting decision-making at all levels—from farm-scale strategies to EU-wide policies. Additionally, the project educates citizens about pollution risks while delivering policy-enabling tools, innovative monitoring solutions, and sustainable agricultural practices. Jaume... presented the **NIAGARA project** that is dedicated to addressing **chemical, microbiological, and plastic pollution** in **Drinking Water Treatment Plants (DWTPs)**. **It integrates advanced monitoring and remediation technologies, such as multi-analyte nanophotonic biosensors, PMA-qPCR for Helicobacter pylori detection, enzymatic degradation systems, and UV/TiO_2 photocatalysis**. A major focus is scaling up photocatalysis for industrial applications and advancing digitization in water management.

2) STRENGTHENING GOVERNANCE AND REGIONAL COOPERATION

The **HarmonMissions project**, presented by **Erika Jankajová (SCSTI)**, seeks to **harmonize the implementation of European Missions** on a **regional level** in the **Danube area**. It has established the Danube Region Steering Committee and Advisory Groups, fostering transnational cooperation and enhancing governance for climate-oriented EU initiatives. The **DALIA project**, introduced by **Anastasia Perouli (BIOEAST HUB CR)**, focuses on **restoring the Danube River Basin**. It features **nine demonstration sites and ten pilot projects** aimed at **knowledge transfer, monitoring, and business case development**. The project also promotes **stakeholder engagement and policy recommendations**, ensuring the replicability of successful approaches across the EU.

3) RESTORING WETLANDS, RIVERS, AND COASTAL AREAS

The **DaWetRest project**, presented by **Viktória Csizmadiáné (University of Pannonia)**, is dedicated to **restoring the Danube Wetlands and floodplains**. **Using community-driven and innovative approaches, the project aligns with EU biodiversity and pollution prevention strategies while developing intelligent freshwater monitoring systems** and removing artificial barriers. A complementary effort, the **SeaCure project**, focuses on **preventing, reducing, and remediating nutrient pollution in the Mediterranean**. It combines nature-based and technology-driven solutions to scale up and replicate best practices in sustainable agriculture, soil and nutrient management, and regional policy engagement across six Mediterranean regions.

4) COMBATING PLASTIC AND MICROPOLLUTANT POLLUTION

The **REMEDIES project** tackles **macro and microplastic pollution** in **Mediterranean river and marine environments**. By collecting and valorizing over **400 tonnes of plastic waste**, the project has already engaged **1.5 million citizens**, far surpassing its initial goal of **250,000**. A flagship initiative, the River Cleaning System, has been successfully tested in Albania, offering an automated method for removing plastic waste from waterways. The **WSWS project** focuses on monitoring **organic micropollutants** in **surface waters, sediments, and biota**, particularly **illicit drugs and pharmaceutical residues**. It integrates data into the **Hungarian micropollutant database** and shares findings internationally via the **NORMAN Association**, using **advanced UPLC-MS analysis methods**. The **LIFE PRISTINE project**, presented by **Miriam Carolina**

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Pérez Cova (ACCIONA), aims to achieve a **Contaminants of Emerging Concern (CEC)-free environment**. By integrating tailored adsorbents, hollow fiber nanofiltration membranes, LED-UV advanced oxidation processes, and AI-driven soft sensors, LIFE PRISTINE removes over 80% of CECs from the water cycle.

5) INNOVATING IN SUSTAINABLE WATER AND NUTRIENT MANAGEMENT

The **GREENHOOD project** focuses on **achieving nutrient balance and resource optimization** within European ecosystems through **sustainable and zero-pollution solutions**. Demonstration sites in key European water basins—including the **Ebro (Spain), Rhine-Meuse-Scheldt (Belgium/Netherlands), Archipelago Sea (Finland), and Trondheim Fjord (Norway)**—are implementing **circular economy models, nutrient management strategies, and over 20 new measures aligned with EU environmental directives**.

6) ENHANCING WATER RESILIENCE AND CLIMATE ADAPTATION

The **SOS-Water project** aims to define a **"Safe Operating Space"** for water resources by integrating **climate change and socioeconomic impact assessments**. **It works on operationalizing freshwater sustainability indicators at local levels and developing comprehensive water system models through five case studies.** The **ACTFAST project** is dedicated to **climate change adaptation and mitigation in European aquaculture**. By leveraging AI-driven climate predictions, the project enhances sustainable production methods and explores innovations such as climate-adaptive winter feed, integrated multi-trophic aquaculture (IMTA), and biosensors for harmful algal blooms (HAB) detection. A major goal is to position European aquaculture as a global leader in sustainability while reducing its environmental footprint.

The afternoon session of the **Freshwater Clustering Event** was dedicated to four critical horizontal topics: **Policy Recommendations for Effective Water Management, Replicability, Stakeholder Engagement, and Water Clearing Challenges**. Each roundtable brought together experts, policymakers, and practitioners to discuss key challenges and propose actionable solutions to enhance freshwater governance and innovation.

Policy Recommendations for Effective Water Management

The roundtable discussion on policy recommendations emphasized the **need for improved monitoring systems and evidence-based policymaking**. Participants highlighted the **limitations in current monitoring and remote sensing technologies**, stressing that **existing data collection methods lack the precision, consistency, and coverage needed to inform effective policy decisions**. To address these gaps, participants called for **the design of more effective, integrated monitoring systems** that provide reliable data for decision-making. These systems should leverage advanced remote sensing technologies, in-situ measurements, and digital platforms to ensure real-time, high-quality data collection. Hereby policymakers can track environmental changes, evaluate interventions, and adjust policies accordingly. Additionally, a better connection between monitoring results and policy frameworks would ensure that scientific insights translate into actionable strategies.

The discussion also emphasized the **need for bottom-up designed interventions** that actively involve **practitioners, farmers, and local stakeholders**. Engaging practitioners in the **design and implementation of interventions** would **enhance relevance, foster local ownership, and increase policy effectiveness**. Such an approach would also **bridge the gap between research and practice**, ensuring that **innovative solutions are both feasible and impactful**.

Replicability

The Replicability roundtable discussion explored the **challenges municipalities face in adopting and replicating innovative solutions**, emphasizing **structural, political, financial, and regulatory barriers**. One of the main obstacles is **resistance to new ideas**, as innovation often disrupts established roles, creating internal competition and reluctance to change existing systems. **Political influence** also plays a significant role, with decision-making frequently driven by short-term electoral considerations rather than long-term sustainability. **Existing infrastructure and equipment investments** make it financially and logistically difficult for municipalities to introduce new solutions, particularly when previous expenditures still require justification.

Proposed solutions included **cross-municipality innovation networks**, **regulatory sandboxing**, and **flexible procurement models** to facilitate experimentation. Strengthening **public-private collaboration**, increasing **citizen engagement**, and aligning with **EU and national innovation agendas** were also identified as essential for overcoming barriers. To ensure successful replication, participants called for **clear replication metrics, structured knowledge transfer, and policy support** to drive widespread adoption of innovative solutions.

Beyond regulatory and financial adjustments, participants emphasized the need for stronger collaboration between municipalities, private sector actors, and research institutions. Citizen engagement was also identified as a critical factor in ensuring successful innovation adoption. Involving local communities in decision-making through participatory budgeting and structured consultation processes would enhance public support, increase awareness, and ensure that solutions align with local needs.

Another key takeaway from the discussion was the necessity of **policy prototyping and iterative legislation. Traditional regulatory frameworks are often too rigid to accommodate emerging technologies, creating barriers to innovation.** A more adaptive policy making approach, where municipalities implement temporary regulatory adjustments to test the feasibility of new solutions before formalizing them into law, was seen as a way to accelerate innovation adoption.

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To ensure structured replication of successful innovations, participants stressed the need for clear replication metrics that allow municipalities to measure success, scalability, and impact. Beyond individual projects, participants highlighted the importance of institutional collaboration, knowledge exchange, and structured policymaking. T**hink tank meetings bringing together policymakers, innovators, and municipal representatives would help address common replication barriers and foster dialogue on best practices. Pilot projects with built-in scalability mechanisms would ensure that replication is considered from the outset, increasing the likelihood of widespread adoption**.

Stakeholder Engagement

It is worth mentioning that the roundtable dedicated to **Stakeholder Engagement** included some really interesting perspectives with reference to a community-based methodology that organizes stakeholders using specific interaction methods based on their needs. During the discussion, four fundamental stakeholder groups which consist of **municipalities and farmers alongside SMEs and NGOs** were mentioned, as these entities directly influence the establishment of freshwater management policies along with cultural behavioral practices. It was mentioned that strategic steps should be implemented including field mapping and **field trips** before occupying space in related dialogue events, in order to engage with stakeholder groups effectively. **Accessible language combined with regular meetings** serve to produce meaningful discussions which prevent scientific terminology from becoming a communication barrier to stakeholders who are addressing local concerns.

The essential component of **stakeholder involvement** was highlighted, which includes developing customized **training programs** that emphasize limited group participation and community-level scientific projects. As it was pointed out, in order to successfully reach **isolated communities** it is necessary to assign a dedicated person from the region to increase understanding and foster trust. To fully understand challenges faced by stakeholders, fieldwork involvement and **event mapping** serve as essential methods for collecting suitable data. Priority-based collaboration and hands-on problem resolution through the project will create enduring relationships needed for successful policy execution at local communities.

Drinking and waste water treatment

During the discussion, the topic of global collaborations in water treatment was raised, focusing on several key initiatives. Global Omnium and the NIAGARA project, represented by Jaume Cotoli, introduced **drinking water treatment** insights and challenges. Hungary's University of Pannonia (Zita Zrinyi), along with its Research & Development Center, has been actively involved in fostering bilateral collaborations, particularly with Slovenian partners. A notable area of focus is the **treatment of macropollutants**. Matic Pavlin from the National Institute of Chemistry of Slovenia directs efforts toward advanced theoretical modeling of upstream processes, as demonstrated by Niagara projects work. Additionally, Jurica Jug-Dujakovic from MJD Consulting shared his experience on water treatment in agriculture and aquaculture from Zagreb and the U.S. In Zagreb, agricultural water treatment techniques are being explored, while in the U.S., aquaculture water treatment methods are being developed, with a specific interest in ozone as a potential treatment option. Other commonly used methods include chlorine and monochloramine for water purification.

An important point that emerged from the discussion was **the need to integrate water treatment into broader industrial and environmental processes**. Often, water treatment is handled as a separate issue, but in many cases, it needs to be embedded within the broader framework of industrial processes, particularly in sectors like agriculture and aquaculture.

One significant challenge highlighted was the **rising cost of water treatment.** As prices increase, there is growing frustration, especially regarding the expenses involved in maintaining quality water standards. The issue is further compounded by new regulations, such as Spain's strict rules regarding old infrastructure and the new directive on water treatment. These directives demand substantial investment to comply, which is a challenge given the current lack of investment in public infrastructure.

A key concern raised was the issue of water release. The goal is to ensure that water released into the environment is of the same quality as when it was originally used. Achieving this standard will require significant investment in both infrastructure and technology, particularly in light of the limitations placed on private companies by current contracting models. **The four-year contract cycle does not provide enough incentive for private companies to invest in long-term infrastructure, suggesting that public sector involvement is essential for achieving meaningful progress.**