STRATEGIC RESEARCH AND INNOVATION AGENDA

FRESH WATER BASED BIOECONOMY

THEMATIC WORKING GROUP OF THE BIOEAST INITIATIVE

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BIOEAST HUB CR

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MANAGERIAL EXECUTION

Fresh water is a vital element influencing the economies and social structure, of the Central and Eastern European countries; The BIOEAST Initiative of Central and Easter European countries defined fresh water as an important thematic area and the Thematic Working Group Fresh Water Based Bioeconomy was initiated by the Ministry of Agriculture of the Czech Republic in 2020. This Thematic Working Group is working on 11 countries priorities concerning the fresh water-based bioeconomy, and specifically on research and innovation agendas and from the very beginning members of the TWG Fresh Water BBE has been discussing priorities concerning the fresh water-based bioeconomy in the BIOEAST macro-region.

This document is identifying strategic thematic areas to tackle challenges and enhance the full potential of the fresh water-based bioeconomy in the BIOEAST macro-region. A study carried out in 2021 by the BIOEAST Initiative states that the majority of the water bodies of the 11 BIOEAST countries from the CEE microregion have worse than good status. **Thus, a further acceleration of action by Member States is urgently needed**. **The fragmentation in governance of the fresh water related issues in the BIOEAST macro-region needs to be urgently tackled to map and connect all relevant policy makers, align the existing structures, this can then enhance the eco-innovation system, facilitate the discussion among stakeholders about a common approach, long-term vision and subsequent research, development, and innovation needs.**

The development of this Thematic Strategic Research Innovation Agenda was developed in the life time of the BIOEASTsUP project, that started two months before the Green Deal Strategy was published, five months before the outbreak of the COVID-19 pandemic; as in the last year the war in Ukraine started. EU is currently facing a lot of challenges that may require rapid response in various policies, this Thematic SRIA is therefore designed as an open document that can reflect these changes.

FRESHWATER Based Bioeconomy

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INTRODUCTION

In the light of geopolitical and global challenges, the war in Ukraine, food, energy, self-sustainability, resilience and recovery are emerging challenges that the EU currently faces. At the same time, there is an urgent need to face risks of losing the heath of ecosystem after decades of intensive damage. A responsible smart transition process is needed that leads Europe to a knowledge-based society that is strongly oriented towards circularity and sustainability.

National assessments carried out under the Water Framework Directive (WFD) show that only 40% of Europe's surface water bodies achieve good ecological status. The European Environmental Agency's European Water Report showed that 62% are not in good chemical status. The Implementation Plan of the European Mission "Restore our Ocean and Waters by 2030" highlights that degradation of marine and freshwaters is threatening the EU's natural capital, the essential goods and services that the water system provides and is risking to unsettle the self-regulatory characteristics of the water system beyond the tipping point.

In Europe, there is a growing demand for water from various economic activities that is causing stress on natural water sources. To secure water for our society, there is therefore a need to better exploit water resources and all the valuable substances that could be obtained through the wastewater treatment and reuse process. The most forward-looking direction in the future is complex water related research, which does not solve individual issues, but interconnects them properly and could be as well linked with the bioeconomy issues. The very important direction is not only to keep enough water, but also to give more and more emphasis on its quality.

Another important area of prospective research is the issue of waste water treatment, including the development of new (nature based) technologies and the optimization of the processes already in use. By boosting the sustainable productivity, respecting the water reuse and through developing the conventional and innovative value chains, the preconditions will be ensured for a further step towards via a more comprehensive and sustainable model of water based bioeconomy. This inclusive growth model should use the best possible mix of public and private sources that form the quintuple helix of innovation: motivated industrial partners, capable knowledge institutions, governments acting as catalysts, society-oriented approach and the environmental protection and sustainability of a specific region(s).

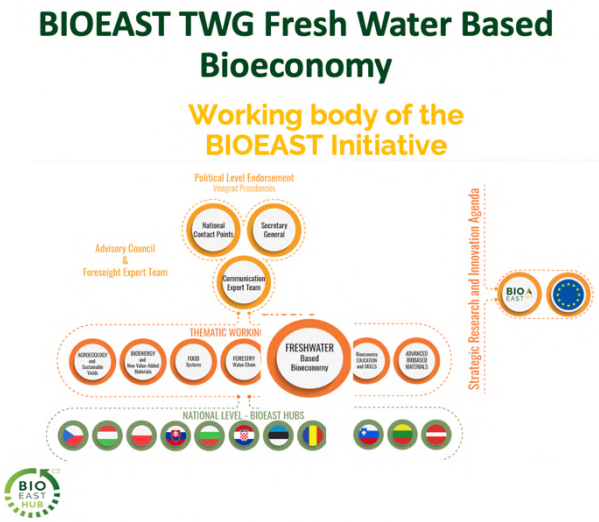
The related prospective activities include research into water resource planning and management, focusing on the monitoring and verification of anthropogenic impacts on the status of water bodies and protected areas, development of new tools and analytical procedures (hydrochemistry, radioecology, microbiology, hydrobiology, hydroecotoxicology) to monitor these effects including methods assessment of the status of water with a focus on new pollutants (micro-pollutants, microplasties, nanoparticles, etc.). This research also includes the creation and use of information and data bases of activities linked to the water planning process, including regular updates, with the link to bioeconomy and related end users, stakeholders and policymakers.

To secure water for the whole society and water-based bioeconomy activities, there is a need to make available alternative water resources of various qualities, and which are appropriate for different functions and multiple users, and to better exploit water resources and all the valuable substances that could be obtained through the wastewater treatment and reuse process. The participation of social sciences and humanities, also addressing the gender dimension, is considered crucial to properly address the complex challenges, as well as deployment of enabling digital solutions for the monitoring, control and optimisation of data and processes.

In order to overcome the fragmentation, respectively to ensure a coherent process when addressing the needs for research related to the water based bioeconomy, it is crucial to fully understand the implications of climate change and droughts that differ in many ways from the past. New demands towards international research collaboration, with standing new modes of competitiveness, and the requirements for enhanced stakeholder interaction and stakeholder research will be a major change in water based bioeconomy research and research management.

CHAPTER 1. THEMATIC WORKING GROUP FRESH WATER BASED BIOECONOMY

Fresh water is a vital element influencing the economies and social structure (among other hings), of the Central and Eastern European countries. **In countries located in the BIOEAST macro region the production lines have been built based on fresh water for many centuries, having a substantial input to their development and growth, therefore the current crisis (safety, climate, energy, food) create a pressure to ensure sustainable management of fresh water and bioeconomy deployment.**



The BIOEAST Initiative set the vision for 2030 to develop knowledge and cooperation based circular bioeconomies, which helps to enhance their inclusive growth and to create new value-added jobs especially in rural areas, while ensuring sustainability. Water based bioeconomy (namely related to the sectors like agriculture and fishery with linked industries providing biomass for production of biofuels, biochar, electricity/heat and water for reuse) is well linked with the concept of sustainability and there is an urgent need to further open towards a cross-sectoral, value-chain approach to be a proactive player in the bioeconomy. Therefore, the BIOEAST Initiative of Central and Easter European countries defined fresh water as an important thematic area and the Thematic Working Group Fresh Water Based Bioeconomy (hereinafter referred as "TWG Fresh Water BBE) was initiated by the Ministry of Agriculture of the Czech Republic in 2020.

The kick of meeting of TWG Fresh Water BBE took place during the high-level BIOEAST conference BIOEAST AS A DRIVING FORCE IN THE CONTEXT OF THE EUROPEAN GREEN DEAL in February 2020. TWG Fresh Water BBE is acting as a working body of the BIOEAST Initiative enhancing the dialog between policy makers and academia.

The TWG Fresh Water BBE is serving as a platform for open discussion between key persons in the field of fresh water-based bioeconomy in order to build knowledge and capacity, discuss good practice developed in the EU projects, providing an input in any planned and/or ongoing BIOEAST initiative related to freshwater issues and last but not least informing, inspiring, motivating and engaging regional and local actor and supporting the implementation of the EU Water Mission with a primary focus to the Danube Lighthouse. The TWG Fresh Water BBE has the potential to act as a macro regional network where different interests can be discussed.

From the very beginning members[1] of the TWG Fresh Water BBE has been discussing priorities concerning the fresh water-based bioeconomy in the BIOEAST macro-region and immersed developing

[1] There are currently representatives of the following governmental bodies and research institutions involved in the agenda: Ministry of Agriculture Czech Republic, Ministry of Agriculture Hungary, Ministry of Environment Estonia, Ministry of Rural Affairs

the Thematic Strategic and Research Agenda for the Fresh Water Based Bioeconomy of the BIOEAST macro-region (hereinafter referred as "Thematic SRIA Fresh Water BBE").

The following steps were determined and afterwards commenced in evolving Thematic SRIA Fresh Water BBE:

1) National priorities were expressed and assessed by TWG member in winter – spring 2020; the outline of the Thematic Study was formulated accordingly[2]
2) The informal meeting with the representative of the *EU Mission: To Restore our Oceans and Waters by 2030* took place in December 2021 a strong support for the implementation of the Danube Lighthouse was articulated. EU representatives suggested to organise a dedicated conference during the Czech Presidency of the EU (July – December 2022).
3) The Thematic Study of the BIOEAST macro-region was developed with the support of the BIOEASTsUP project in March 2022; the full study is available online, key findings are displayed in Chapter 3.
4) Strategic priorities related to fresh water were discussed among TWG members to provide an input for the BIOEAST SRIA.
5) TWG members' priorities were mapped in an on-line survey in summer 2022[3] and the following topics were identified as of a crucial importance:
    - closer collaboration with the Mission Water Danube Pilar, CBE – JU, Europa BIO
    - peer review of good fresh water-based bioeconomy examples
    - capacity building on innovative technologies and transition towards sustainable development
    - stakeholder engagement and networking

Estonia, Ministry of Agriculture and Rural Development Romania, Ruder Bošković Institute Croatia, Institut de Prognoza Economica, Romania, S. Sakowicz Inland Fisheries Institute Poland

[2] The TWG Fresh Water BBE was initiated right after the Green Deal Strategy was published and the kick off meeting took place only 2 weeks before the outbreak of the COVID-19 pandemic. Therefore, the launching phase lasted longer than expected, there were also several delays in the BIOEASTsUP project itself with the Thematic Study delivery.

[3] The unprecedent war conflict in Ukraine in February 2022 shaken the political and financial situation that was already jolted by nearly two years of lock downs of COVID-19, new crisis connected with security, energy joined the climate, sustainable and deepen the risk associated with social stability of the EU society. Therefore, current emerging demands were mapped.

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6) Policy representatives and TWG members clearly articulated the need to tackle the aqua culture topics, therefore a questionnaire mapping the aquaculture status, potential and needs was opened in summer 2022[4]; the results are provided in Chapter 3.
7) Strategic priorities of fresh water were updated with the reflection to the Ad 4) and Ad 5) and discussed on three validation workshops in Ljubljana, Tartu and Warsaw organised by the BIOEASTsUP project, outcomes are provided in Chapter 3. **The key finding was that fresh water related issues belong to the agenda of several ministries – agriculture, environment, research and innovation, transport and internal affairs, the dialog among policy makers is of a crucial importance to launch discussion of the emerging needs of the Danube region**, the high-level conference was organised by the BIOEAST Initiative and the BIOEAST HUB CZ – the Coordinator of the TWG Fresh Water BBE to launch the discussion.
8) High Level Conference *Involving the BIOEAST Initiative into the implementation of the EU Mission: To Restore Our Oceans and Waters by 2030 Preparing the Danube Lighthouse* was organised under the auspices of the Ministry of Agriculture Czech Republic, conference concept note, presentation and conference conclusion are available on the dedicated web page, key findings are summarized in Chapter 3.

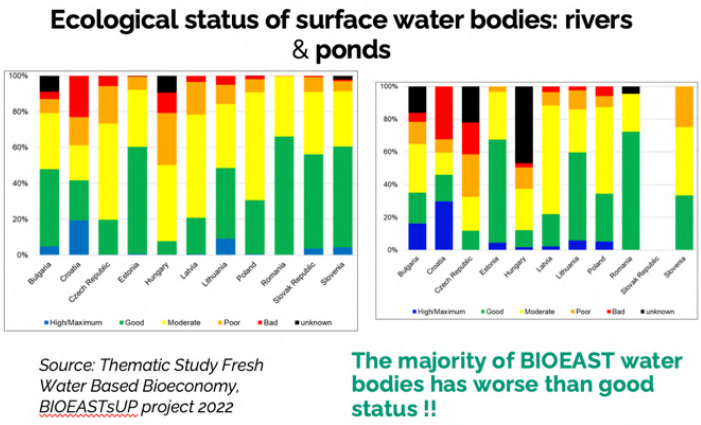
CHAPTER 3. BACKGROUND OF STRATEGIC PRIORITIES

This chapter is demonstrating the footing for strategic research priorities summarizing the key documents, surveys and events outlined in the Chapter 2.

Thematic study

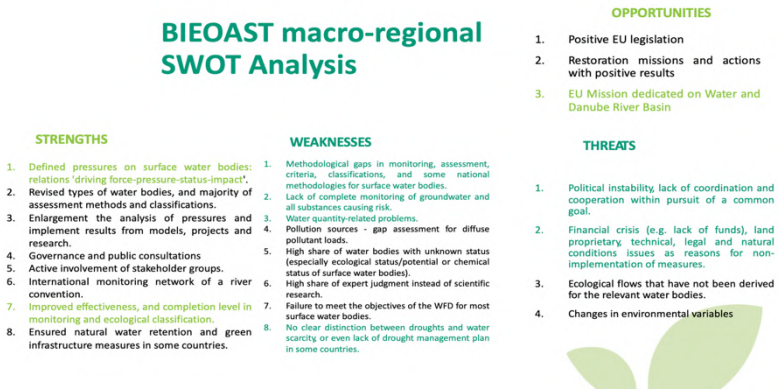
The Thematic Study provided an overview on freshwater ecosystems and available current legal documents related to the national and European Union levels, an overview of the main institutions and leaders and a SWOT analysis of SWOT for the BIOEAST region, to facilitate the transition from the stage of "Understanding the Nexus" to "Nexus Doing" in order to strengthen resilience, and as well maintain the good water quality status.

[4] The questionnaire was designed with a desire to have a brief overview, it was filled by some TWG Fresh Water BBE member on a voluntary basis, in some chases the data cannot be compared or are not comprehensive. However, it demonstrated the good will to solve this issues and demonstrate a way to develop further activities.



Source: Thematic Study Fresh Water Based Bioeconomy, BIOEASTsUP project 2022

Source: Thematic Study[5]



Source: Thematic Study[6]

SWOT analysis rooted the following recommendations:

- Establishment of Flood Risk Management Plans as integrated sub-plans to River Basin Management Plans.
- Implementation of new solutions based on the new EU Strategy on Adaptation to Climate Change[7], including especially recommendations of European Commission
- Implementation of an ecosystem-based approach[8] - navigating the course towards clean, healthy, and productive seas with the conclusions for current situation of water bodies in Europe: "*Our environment, our natural jewels, our seas and oceans, must be conserved and protected.*"
- Implementation of the environmental DNA (eDNA) based methods in biodiversity monitoring, conservation, and ecological status assessment for quick practitioners' adaption.

[5] https://bioeast.eu/download/5-study-freshwater-based-bioeconomy-pdf/
[6] https://bioeast.eu/download/5-study-freshwater-based-bioeconomy-pdf/
[7] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52021DC0082&from=EN
[8] https://www.eea.europa.eu/publications/marine-messages-2

Aquaculture

The aquaculture sector is rather affected by the climate changes, erosion of agricultural land, nutrient load from municipal wastewater. The aquaculture volume in the BIOEAST macro-region has been slowly growing, the most common production system is fishponds, the dominant species of pond aquaculture is common carp (of food fish production in ponds), followed by silver and bighead carps pike, pike-perch; salmonid fish salmonid fish breeding in flow-through farms (CZ). The share of intensive production in RAS and flow-through systems (tanks and raceways) is increasing. In Estonia there are net cages farms and one new mussle lines farm. In Bulgaria there are more than 20 farms with recirculation systems used for rearing of eel, coho salmon and sturgeon fish.

The survey indicated several topics that should be tackled on the macro-regional level, primarily:

- Development of rainbow trout lines that are more persistent to climate changes and higher water temperatures that could occur in the summer.
- Creating common bloodstock for the BIOEAST macro-region, where countries could get rainbow trout eggs for their fish farms.
- Minimising climate impact on aquaculture and contribution to aquaculture production with a reduced environmental footprint, advancing towards climate-neutrality, including diseases management of illness that can occur in the BIOEAST macro-region as an effect of climate changes.
- Development and implementation of aquaculture techniques with positive impact on environment and biodiversity; increasing aquaculture production in conditions of sustainable growth.
- Development and implementation of effective practices and forms of aquaculture with a focus on ones that reduce the nutrient pressure on water bodies, e.g. in free (semi-intensive to extensive), rear of polycultures of herbivorous fish species in small dams, which are subjected to significant pressure from agriculture and settlements
- Introduction of effective practices and forms of aquaculture, reducing the nutrient pressure on water bodies, e.g., in free (semi-intensive to extensive) rearing of polycultures of herbivorous fish species in small dams, which are subjected to significant pressure from agriculture and settlements.
- Develop compensation mechanisms assessing the eco system services

Workshops

The discussion on with stakeholder accentuated that freshwater issues has been rather neglected on the EU level until the European Missions Restore our

Ocean and Waters by 2030 and the Danube pilar was established. The objective of the Mission is to restore the health of the EU's Ocean and waters by 2030 by reaching the European Green Deal targets for biodiversity, zero pollution and decarbonisation with greenhouse gas emissions reduction for 2030, the Mission defines four lighthouses. The objective of Danube Lighthouse is to connect and structure existing activities, disseminate and upscale solutions and mobilise relevant actors to develop and deploy solutions to protect and restore the Danube River and its tributaries.

The involvement of the BIOEAST Initiative and alignment of the activities of the TWG Fresh Water BBE activities with this mission has a big potential as it can enhance R&D and innovation deployment in the BIOEAST macro-region and enable BIOEAST macro-region to clearly articulated its needs, specificities in the fresh water related issues to the European Commission.

There are already existing initiatives, strategies, programs, partnerships, projects, and national initiatives that should be involved; one session of the High-Level Conference *Involving the BIOEAST Initiative into the implementation of the EU Mission: To Restore Our Oceans and Waters by 2030 Preparing the Danube Lighthouse* provided a space for presentation of the whole existing initiatives, strategies, programs, partnerships, projects, and national initiatives

Danube Lighthouse Conference

The conference was structured into the three following sections: the presentation of the EU Mission: Restore our Ocean and Waters and Its 4 Pillars, including the Mission Charter, high-level discussions concerning the needs of the Danube region, and the third session focused on the presentation of already existing initiatives, strategies, programs, partnerships, projects and national initiatives.

Distinguished guests from the EU Commission the Missions Manager Mr Kestutis Sadauskas, Deputy Director-General DG MARE and Ms Elisabetta Balzi the Head of the Healthy Seas and Oceans Unit DG RTD highlighted the unique opportunity offered by the Mission to rethink our future in the Danube Region. **A clear message was communicated by the representatives of the EU Commission towards the BIOEAST Initiative - the new EU Mission to Restore our Ocean and Waters by 2030 will provide resources and political engagement as the EU Mission is targeting the goals of the Green Deal. The Danube Lighthouse is to provide solutions for fresh water that can be put in place to increase the quality of inland water bodies and rivers, the Danube Lighthouse** can tackle the climate change challenge and provide the solutions for both the drought season, storms, and floods. It has the potential for promoting aquaculture production, as a flagship for species migrations and a service for the interactive river - sea solutions and it is **designed to provide freshwater solutions that can be replicated elsewhere in the EU.**

The Mission is an excellent opportunity for the BIOEAST countries located in the Danube River basin the support to align different agendas is needed. The BIOEAST Initiative and its Thematic Working Group Fresh Water Based Bioeconomy has the potential to act as a macro regional network where different interests can be discussed. If connected with the national initiatives (such as national HUBs, clusters etc), they can act as the horizontal enablers of the EU Mission and engage citizens societies and businesses. In comparison with the activities in the Mediterranean, there is an evident need for more support actions to map all relevant actors, set proper systems of cooperation, to be able to bring to the table all interested groups and to be able to discuss a common long-term vision, define research needs and provide supportive tools for decision makers and evidence base policy. The digital twin in silico river model can speed up finding the optimal solutions for inland waters and rivers, support the promising freshwater aquaculture, and support the multi criterial impact analysis to both water and soil eco system.

CHAPTER 4. STRATEGIC CORE THEMES

The BIOEAST macro region needs to urgently mitigate impact of climate change on ecosystems, improve water management and develop applicable new solutions for the reduction of water use, proper management of rainwater and development of drought management plans. However, the implementation of any agenda related to these issues is scattered, while several ministries and entities are engaged. An additional challenge, closely associated with freshwater management mentioned above, is the cleaning of water bodies and maintaining their clean and safe conditions. The following four core themes were identified to tackle the above outlined challenges.

Core Theme 1 Protect and restore freshwater

A study carried out in 2021 by the BIOEAST Initiative states that most of the water bodies of the 11 BIOEAST countries from the CEE microregion have worse than good status; prompt common actions by Member States is urgently needed. New technologies are required to approach invasive species in freshwater; separate and utilise micro plastics, exploit sediment. There is a need to develop and implement a) wastewater treatment, including the development of new (nature based) technologies and the optimisation in the whole value chains (i.e. recycle of nutrients, sludge utilisation, bioenergy production), b) new technologies to approach invasive species in freshwater, c) new innovative solutions to utilise sediments, d) separate micro plastics and further utilise them, e) rainbow trout lines that are more persistent to climate changes, f) new species in aquaculture to mitigate the climate changes in the BIOEAST macro-region.

Core Theme 2 Prevent and eliminate pollution in freshwater

Fresh water is a key element influencing the economies and social structure in the BIOEAST macro region as the production lines have traditionally been based on fresh water and the current crisis are creating a pressure to ensure sustainable management of fresh water and bioeconomy deployment. The following key research topics were identified a) nature-based innovative solutions to mitigate impact of climate change on ecosystems, b) aquaculture techniques to mitigate climate change with positive impact on environment and biodiversity, reducing the nutrient pressure on water bodies and increasing aquaculture production in conditions of sustainable growth, c) new solutions for diseases management of illness that can occur in the BIOEAST macro-region as an effect of climate changes,

Core Theme 3 Make the fresh water-based bioeconomy carbon neutral and circular

The fragmentation in governance of the fresh water related issues needs to be urgently tackled to map and connect all relevant policy makers, align the existing structures, this can then enhance the eco-innovation system, facilitate the discussion among stakeholders about a common approach, long-term vision and subsequent research, development, and innovation needs. There is a need to for a coordination and support action to put in place an appropriate framework to enhance efficient cooperation between all relevant actors in the fresh water related topics in the Danube River basin to discuss a common long-term vision and defining common research and innovation agenda. It is vital to provide evidence-based solutions for policy makers to advocate for restauration of water bodies; monitor and improve water quality both in rivers and water areas and enhance the aquaculture on the macro-regional level. There is a demand to develop new business models and value chains based on freshwater to attract private investors. Additionally, since most fresh water sources (lakes or rivers) are shared by multiple countries, a cooperation and harmonization of the related regulations and approaches is mandatory. A digital twin in silico river model can speed up finding the optimal solutions for inland waters and rivers, support the promising freshwater aquaculture, and support the multi criterial impact analysis for decision making processes to both water and soil eco system.

Core Theme 4 Trade-offs and synergies

Trade-offs and synergies between water, soil, natural capital will enhance our understanding of the trade-offs support the evidence-based decision making. There is a need to develop a) and assessment system to provide an evidence-based solutions for policy makers to advocate for restauration of water bodies b) ecosystem-based approach for monitoring and improvement water quality both in rivers and water areas,

c) develop compensation mechanisms assessing the eco system services d) capacity building on innovative technologies and transition towards sustainable development of freshwater based solutions, e) new freshwater business, enhancement of the innovation ecosystem, peer review of good fresh water-based bioeconomy examples in the Danube River Basin to attract private investors, enhancement of R&D&I focused on new market opportunities for technologies and technology solutions for new fresh water-based bioeconomy value chains.

Outcomes

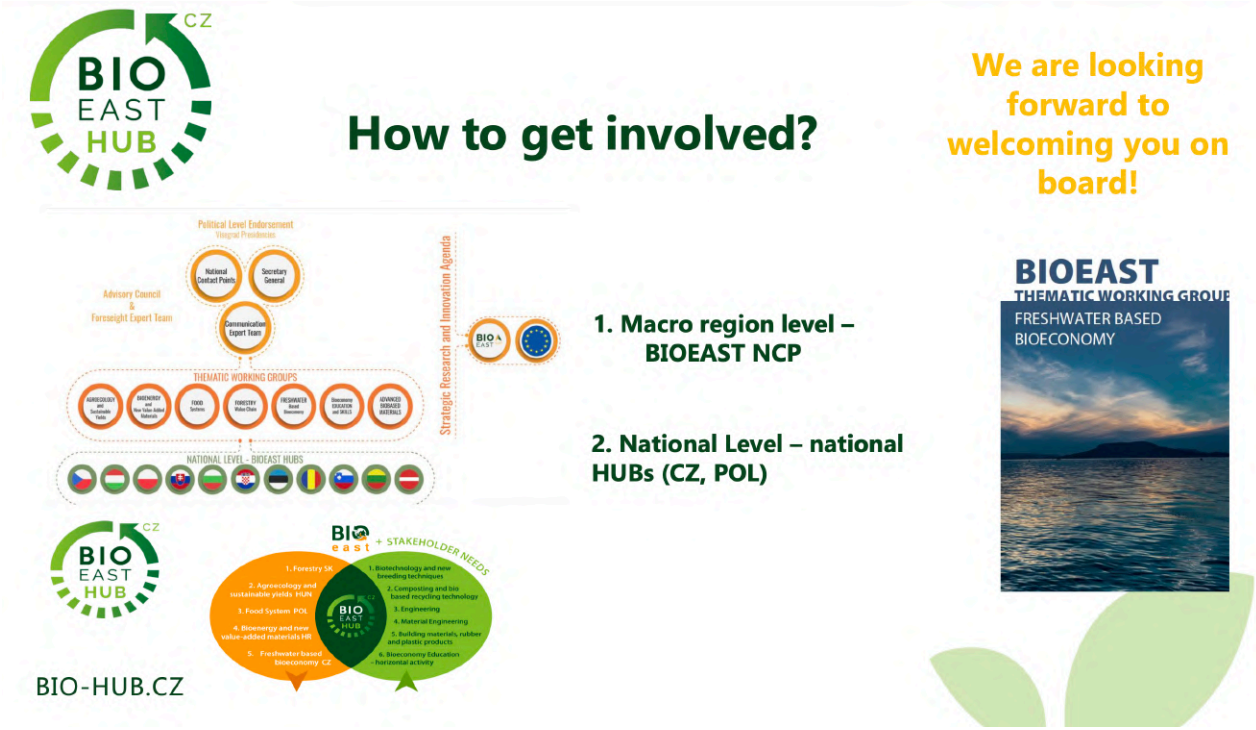
The implementation of the above-mentioned research topics will enhance achieving environmentally sustainable freshwater-based bioeconomy and will have positive impact on biodiversity. The deployment of the European Missions to Restore our Ocean and Waters by 2030 the Danube Lighthouse can provide solutions for fresh water that can be put in place to increase the quality of inland water bodies and rivers. BIOEAST Thematic Working Group Fresh Water Based Bioeconomy has the potential to act as a macro regional science-policy network where different interests can be discussed, and national initiatives can be networked so it can act as the horizontal enablers of the EU Mission.

ABBREVIATIONS

- BIOEAST Initiative - CENTRAL AND EASTERN EUROPEAN INITIATIVE FOR KNOWLEDGE-BASED AGRICULTURE, AQUACULTURE AND FORESTRY IN THE BIOECONOMY

- Thematic SRIA Fresh Water BBE - Thematic Strategic and Research Agenda for the Fresh Water Based Bioeconomy of the BIOEAST macro-region

- TWG Fresh Water BBE - Thematic Working Group Fresh Water Based Bioeconomy



Please get in touch with the TWG Leader - [BIOEAST HUB CZ](www.bio-hub.cz) (www.bio-hub.cz)