

**BIOEAST SRIA (DRAFT):
section
CHALLENGES AND CORE THEMES**

**PREPARATION MATERIAL FOR THE BIOEAST SRIA VALIDATION
WORKSHOP
(LJUBLJANA, 26TH SEPTEMBER 2022)**

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1 BIOECONOMY RELATED RESEARCH AND INNOVATION SWOT FACTORS

Table 1 and Table 2 summarise the key SWOT factors related to bioeconomy research and innovations in the BIOEAST macro-region, based on the results of an analysis of SWOT factors in national countries performed by national experts and stakeholders during the BIOEASTsUP CSA project (Task 4.2 (Establishment of an evidence base for the SRIA)).



Table 1: **Key BIOEAST macro-region strengths and weaknesses related to bioeconomy research and innovations**

SWOT: Strengths		SWOT: Weaknesses	
	<ul style="list-style-type: none"> - Available biomass sources and side streams to develop a bioeconomy. - Bioeconomy related study programmes. - Total expenditure on R&D increases. - Available R&D personnel in the bioeconomy industries. - Highly qualified researchers in several areas of the bioeconomy. - Existence of well-known international-level research teams in several areas with immediate application potential. - Strong knowledge base for bioeconomy research. - Growing research activity in innovative food products and beverages, paper and pulp production, pharmaceuticals, bio-based chemicals, plastic and other areas. - Good R&D infrastructure in selected areas of the bioeconomy. - Growing cooperation in bioeconomy-related areas among the CEE countries. - Involvement in projects under the EU R&I framework programmes. - R&D&I cooperation between entrepreneurs and research institutions. - Growing small and medium-sized enterprise participation in Horizon 2020, EU networks and bioeconomy-related R&D. 		<ul style="list-style-type: none"> - Predominantly small enterprises in the bioeconomy, which in general are less innovative and productive than other firms. - Specialisation in low technology bioeconomy industries (i.e. food products, agriculture, forestry, wood and furniture, paper). - Low business activity in R&D and innovation. - Lack of qualified researchers in research institutions and business organisations. - Low attractiveness of research careers to domestic and abroad talents. - Lack of experience of research organizations in preparation and submission of national and international grant proposals. - Low participation in Joint Programming Initiatives, alliances, technological platforms, Horizon 2020, projects. - Insufficient cooperation between: <ul style="list-style-type: none"> (i) research institutions, the business sector and policy makers in the bioeconomy industries, especially in the field of commercialization of R&D results; (ii) ministries; (iii) researchers working in different sectors; (iv) researchers from the countries of the macro-region and foreign researchers; (v) R&D funders (funding fragmentation); (vi) value chain actors. - Insufficient funding from the government budget and the private sector for research and development. - Dependence of research and development on the availability of foreign (mainly EU) funding. - Poor correlation of public research with the needs of the private sector, giving priority to fundamental sciences over applied ones. - Insufficient skills and abilities in the management of created knowledge and commercialisation. - Inappropriate dissemination and transparency of research results, a lack of technology transfer and commercial acceptance of research and patents. - Lack of infrastructure for the development and scale-up of technologies in the bio-based industrial sector (pilot plants; open pilot facilities etc.).

Source: Report on the state-of-the-art innovation gaps and needs of bioeconomy-related R&I in the BIOEAST macro-region (Deliverable 4.2).



Table 2: **Key BIOEAST macro-region opportunities and threats related to bioeconomy research and innovations**

SWOT: Opportunities

- Globalization, climate change, biodiversity and ecosystem services, food and energy security, as well as strengthening the circular economy creates new research opportunities in the bioeconomy.
- Growth in demand (private & public) for bio-based products and technologies.
- New possibilities provided by the EU and national strategies and policies as well as the European Green Deal on the bioeconomy, the circular economy, renewable energy, on plastics, environmental sustainability, social cohesion.
- Better use of opportunities provided by the ERA to enhance research excellence, international collaboration, openness and inclusiveness.
- Regional and international integration to make better use of the bioeconomy's potential.
- Increase in the internationalisation of research.
- Opportunities to benefit further from HORIZON EUROPE, the European Structural and Investment Funds as well as the European Agricultural Fund for Rural Development and European Research Council grants.
- Tax incentives, InnoVouchers etc. for promotion of investments in R&D&I and technological renewal.
- Promotion of the development of bio-based industries through public procurement.
- Promotion and strengthening of business-science cooperation through platforms and networks.
- Provision of high-quality education services for the needs of bioeconomy industries.

SWOT: Threats

- The inadequate governance of R&D, a lack of a systematic and continuous assessment of possible scenarios for future development and research agendas.
- Lack of setting bioeconomy development as the main goal of strategic programming.
- Slow and long process to get to the results of R&I.
- Uncertain market demand as a barrier to innovation, increasingly high market requirements in terms of volume and continuity.
- Limited national budget for R&D&I and increasing the importance of international cooperation even more.
- Inability of the science field to adapt to the rapidly changing requirements.
- Low recognition of universities and research institutions in the international arena.
- Failure to increase the level of internationalisation of research and participation in research consortia.
- Insufficient generational change of scientific personnel.
- Due to the negative population growth and the demographic crisis, there will be a shortage of human resources.
- Outflow of labour and talented individuals to global development centres.
- Lack of integrated, comprehensive thinking.
- Insufficient stakeholder motivation and a lack of lifelong learning culture.
- Passive society not putting the pressure on governmental decisions.
- Poor awareness of the public regarding the importance of environmental protection and the bioeconomy.
- Strong negative influence of agricultural lobby organisations on political decisions.

Source: Report on the state-of-the-art innovation gaps and needs of bioeconomy-related R&I in the BIOEAST macro-region (Deliverable 4.2).



2 CHALLENGES FOR A CIRCULAR BIOECONOMY

Salvador et al. (2022) have identified several **challenges** (*forces that make the implementation of circular bioeconomy practices more difficult, making businesses spend more resources/ effort in overcoming them*) for a **circular bioeconomy** in Europe. They are as follows:

- **lack of adequate technology** –in Europe, there is a technology that already allows taking better advantage of available bio-resources and bio-waste; however, it seems that overall the technology might be immature yet, there is much more to be done in the short and in the long term for the bioeconomy to gain greater momentum. There is a need for adequate and economically feasible technologies;
- **need of investments to integrate biorefineries** – often, considerable investments are needed to integrate biorefineries and establish partnerships that would allow cleaner and higher value paths;
- **maintaining uniform products** – one of the risks of valorizing bioresources lies on their supply, which usually depends on the by-products or waste from other processes or industries. It is difficult to ensure a continuous flow or even the same mix and quality of bioresources, which might make it difficult to maintain product uniformity;
- **guaranteeing sustainability and security of biomass supply in the long term** – relying on by-products or wastes from other processes or industries might pose a threat to a continuous flow and sustainable procurement of certain resources or materials. Securing continuous and sustainable supply of bioresources, great involvement, engagement and proximity of biomass suppliers and/or other industries is needed;
- **collaboration** –for valorizing biomass, there is an increased need for cross-sector, private-private and public-private collaboration, e.g., for reaching new markets, joint investments, economies of scale, and knowledge exchange;
- **price competitiveness** – it is difficult to compete in markets with cheaper products based on fossil resources, especially fuels;
- **motivating production of low-priced products** – in a cascaded system, if one alternative use, even though lower in the value chain, seems achievable, it can avoid the production of an alternative product that is higher in the value chain but seems costlier;
- **quality or efficiency of final products** derived from bioresources might be perceived as lower than those of fossil/non-renewable resources, which can be the case of fuels. This might pose a challenge for society to switch to bio-based products altogether;
- **lack of knowledge/skills/competencies** – some industries are still very traditional, with a linear mindset, and there is a “need to change the mentality of the industry”. Companies might be reluctant to go into new business areas for valorization of waste because use or recovery of the resource/material is outside the company's core business. Moreover, and therefore, they might lack specific knowledge, or skills, or competency to manage related operations;
- **lack of public/consumer awareness** – in the market, lack of awareness is present both on the consumer and the producer side. From the market side, buyers (B2B and B2C) might not be willing to try out new products. From the supply chain side, there might be a lack of collaboration for solving problems, and difficulties in finding right partners, getting them onboard and working together;
- **finding/unveiling market demand for bio-based products** might sometimes require creating new market segments;
- **lack of incentives for upcycling** – there is a lack of specific incentives/policies promoting and sustaining the use of a resource, and economic incentives or opportunities, or support for pursuing more value-added alternatives instead of cascading down;
- **lack of regulations and policies to promote environmentally sound product design** – there appears to be little to no specific regulations or policies seeking to promote environmentally sound product design via bioeconomy;



- **company size** – on the one hand, large companies are not necessarily resistant to change, but they lack the required dynamic capability; they lack knowledge, most of the time, of the end user of their products, making their strategy definition difficult. Small companies, on the other hand, consider themselves too small to uptake the complications and costs of pursuing new paths;
- **scaling-up** – many bioeconomy products still lack sufficient value generation and thus large-scale commercialization, hence being only prototypes.

Challenges related to COVID-19 and war in Ukraine also call for **restructuring supply chains** (e.g., extraction/collection and transportation of resources) due to economic fallout (Salvador et al., 2022).

According to Ronzon et al. (2020) and Piotrowski (2018), the BIOEAST macro-region also faces the following challenges:

- **a productivity gap in agriculture,**
- **untapped potential of agricultural and forestry residues** for further generation of higher value-added biomass application,
- **lack of biorefineries** (except for some sugar-/starch-based cluster biorefineries),
- the macroeconomic significance of the bioeconomy – a significantly stronger representation of agriculture, particularly in employment,
- comparably high employment multipliers (for each million Euro invested in the national bioeconomy sector, up to 55 jobs could be created in these countries, mainly driven by primary agriculture).

The national experts from the BIOEAST Member States also stressed **climatic and ecological challenges** (impacts of climate change, desertification, appearance of new diseases and pests, biodiversity loss etc.) and the **weakness of the education system** in the BIOEAST Member States.

The BIOEAST initiative can contribute to solving the mentioned challenges by mobilizing **research and expanding cooperation between the stakeholders**. The following bioeconomy research and innovation related strengths of the BIOEAST macro-region:

- available R&D personnel in the bioeconomy industries,
- highly qualified researchers in several areas of the bioeconomy,
- strong knowledge base for bioeconomy research,
- growing research activity in innovative food products and beverages, paper and pulp production, pharmaceuticals, bio-based chemicals, plastic and other areas,

allow for more efficient use and up-building of research expertise, as well as to avoid duplication of research and prevent fragmentation. The joint research activities are going to reduce several weaknesses of the BIOEAST macro-region:

- lack of qualified researchers in research institutions and business organisations,
- low attractiveness of research careers to domestic and foreign talents,

as well as minimize the impact of several threats:

- inability of the science field to adapt to the rapidly changing requirements,
- insufficient generational change of scientific personnel.

However, a strength related to bioeconomy research and innovations – good R&D infrastructure in selected areas of the bioeconomy – allows to share the limited research infrastructure more efficiently and to take advantage of new opportunities (by improving current technological solutions and developing new techniques), thereby



reducing a weakness related to bioeconomy research and innovations – a lack of infrastructure for the development and scale-up of the technology in the bio-based industrial sector.

The following BIOEAST macro-region's strengths:

- availability of well-known international-level research teams in several areas with immediate application potential,
- growing cooperation in bioeconomy-related areas among the CEE countries,
- involvement in projects under the EU R&I framework programme,

indicate that the joint research activities of the BIOEAST initiative can facilitate the **participation of macro-region research groups in international projects**, thereby reducing the following weaknesses:

- lack of experience of research organizations in preparing and submitting national and international grant proposals,
- low participation in Joint Programming Initiatives, alliances, technological platforms, Horizon 2020, projects,

and minimizing the impacts of several threats:

- low recognition of universities and research institutions in the international arena,
- failure to increase the level of internationalisation of research and participation in research consortia.

The joint research activities in the BIOEAST macro-region would promote the attraction of additional funding, thereby on the one hand reducing the weakness – insufficient funding from the government budget and the private sector for research and development – and minimizing the impact of the threat – a limited national budget for R&D&I –, while on the other hand further increasing the weakness – the dependence of research and development on the availability of foreign (mainly EU) funding.

The joint research activities of the BIOEAST Member States can contribute to dealing with the following bioeconomy challenges:

- climatic and ecological challenges,
- lack of adequate technology,
- lack of biorefineries,
- a productivity gap in agriculture,
- untapped potential of agroforestry residues for further generation of higher value-added biomass application,
- finding/unveiling market demand for bio-based products,
- lack of knowledge/skills/competencies,
- weakness of the education system.

A bioeconomy challenge – **collaboration** –, as well as the nature and scope of other bioeconomy challenges and the macro-region's weakness– **insufficient cooperation** – determine the **need to expand cooperation** not only between researchers working in various fields and international cooperation between researchers but also **between other stakeholders**. The development of cooperation would contribute to reaching new markets, joint investments, economies of scale, knowledge exchange (Salvador et al., 2022) and other benefits. Therefore, using the BIOEAST macro-region's strengths:

- R&D&I cooperation between entrepreneurs and research institutions,
- growing small and medium-sized enterprise participation in Horizon 2020, EU networks and bioeconomy-related R&D,



to develop cooperation in the bioeconomy industries will reduce several weaknesses:

- insufficient skills and abilities in the management of created knowledge, commercialisation,
- inappropriate dissemination and transparency of research results, a lack of technology transfer and commercial acceptance of research and patents,
- low business activity in R&D and innovation,
- poor correlation of public research with the needs of the private sector, giving priority to fundamental sciences over applied ones,
- predominantly small enterprises in the bioeconomy, which in general are less innovative and productive than other firms,
- specialisation in low-technology bioeconomy industries (i.e. food products, agriculture, forestry, wood and furniture, paper),

and will also contribute to solving the following bioeconomy challenges:

- need of investments to integrate biorefineries,
- lack of biorefineries,
- price competitiveness,
- quality/efficiency of final products,
- guaranteeing sustainability and security of biomass supply in the long term,
- restructuring supply chains,
- maintaining a uniform product,
- untapped potential of agricultural and forestry residues for further generation of higher value-added biomass application,
- lack of knowledge/skills/competencies,
- lack of public/consumer awareness,
- lack of incentive for upcycling,
- lack of regulations and policies to promote environmentally sound product design,
- finding/unveiling market demand for bio-based products,
- scaling-up,
- weakness of the education system.

Expanding and strengthening cooperation and solving the above-mentioned bioeconomy challenges would minimize the impacts of several threats:

- uncertain market demand as a barrier to innovation, increasingly high market requirements in terms of volume and continuity,
- slow and long process to get to the results of R&I,
- inadequate governance of R&D, a lack of a systematic and continuous assessment of possible scenarios for future development and of research agendas,
- lack of setting bioeconomy development as the main goal of strategic programming,
- lack of integrated, comprehensive thinking,
- insufficient stakeholder motivation and a lack of lifelong learning culture,
- passive society not putting the pressure on governmental decisions,
- poor awareness of the public regarding the importance of environmental protection and the bioeconomy,
- strong negative influence of agricultural lobby organisations on political decisions.



Sharing knowledge and experience would also help to develop and implement the national and regional bioeconomy policies of the BIOEAST Member States, which could be a catalyst for attracting investments to the BIOEAST macro-region.

The BIOEAST SRIA has been designed to deal with **challenges to the bioeconomy**, eliminate the **weaknesses** of the BIOEAST macro-region and minimize the impact of the **threats**, consolidate the knowledge base, mobilize research and innovation, as well as expand cooperation and integration. The BIOEAST Member States have identified seven BIOEAST Core Themes (each BIOEAST TWG is assigned a Core Theme):

1. Agroecology and Sustainable Yields
2. Forestry Value Chains
3. Food Systems
4. Bioenergy and New Value-added Materials
5. Advanced Biochemical and Biomaterials
6. Freshwater-based Bioeconomy
7. Bioeconomy Education

A description of needs of each BIOEAST Core Theme has been structured into several Strategic Thematic Areas, while a description of each Strategic Thematic Area consists of 3 elements:

1. challenges in relation to the Strategic Thematic Area;
2. main research topics are listed in relation to the challenges. More detailed descriptions of the research topics are available in Thematic SRIAs;
3. an expected outcome and impact.

The descriptions of the BIOEAST core themes have been produced by BIOEAST TWGs. For more information about the Thematic Working Groups, see: <https://bioeast.eu/> → Bodies → Thematic Working Groups.



3 CORE THEMES

3.1 AGROECOLOGY AND SUSTAINABLE YIELDS



Core Theme 1: Agroecology and Sustainable Yields

Strategic Thematic Areas:

1. Soil management
2. Transition to pesticide-free agriculture
3. Genetic resources and agricultural diversification
4. Innovation, smart agriculture, digitalisation and knowledge sharing
5. Animal health and welfare
6. Short food supply chains and rural development

STRATEGIC THEMATIC AREA 1 (TA1): Soil management

Challenges (C):

In terms of **climate change**, the quantitative and temporal distribution of precipitation will become even more extreme whereupon the likelihood, frequency, duration and severity of extreme weather and soil moisture problems (e.g., droughts and inland inundation) resulting from climate change will increase. Soil is sensitive to environmental and anthropogenic stress and degradation processes, which endangers sustainable biomass production. **Soil degradation** in agricultural land is **caused by erosion and inappropriate land management** as well as physical degradation, chemical degradation and biological degradation. The extent of **contaminated, non-agricultural, and sealed soil** is also increasing. Although BIOEAST countries are both **socially and economically diverse**, they generally lag behind technologically (due to capital shortage). Their land and ownership structures are fragmented, cooperation is lacking, there is a high number of consumers on low incomes, there is only a low degree of cooperation among farmers, adaptation and knowledge transfer are slow, people have been alienated from the land and the environment and there is a general lack of knowledge about soil. Farmers are not sufficiently familiar with soil-friendly cultivation methods or sustainable farming and precision technologies nor do they often strive for quality and long-term sustainability enough either. The presence of well-functioning **soil monitoring systems** is at very different levels in different BIOEAST countries.



Main research topics (RT):

- RT1.1: Transition to environmentally sound, low emission, soil friendly agricultural technologies
- RT1.2: Restoring deteriorated water- holding capacity due to soil degradation through appropriate land use and agrotechnical methods
- RT1.3: Taking into account biological processes occurring in the soil in farming and in adaptation to climate change; research related to the rhizosphere
- RT1.4: Improving the carbon retention/carbon sequestration capacity of soils; preparation of forecasts
- RT1.5: Development of methods for sustainable organic matter management that determine soil fertility and health
- RT1.6: Establishment of scientific bases for soil advisory systems, aiming of soil conservation managements and sustainable land-use focused on erosion control
- RT1.7: Research related to reducing inputs of organic and inorganic materials in agri-, horti- and viticultural systems
- RT1.8: Development of technologies facilitating transition to circular economy in agriculture
- RT1.9: Social research, awareness-raising, education
- RT1.10: The long-term impact of irrigation on soils
- RT1.11: Halting land loss and the remediation and recultivation of damaged areas



	RT1.12: Identifying soil genetic processes, properties that indicate the soil improvement or degradation trends and design monitoring approaches
<p>Expected outcome and impact</p> <ul style="list-style-type: none"> – Proper management of soil moisture and the mitigation of excess water or lack of water in soil – Better understanding and management of soil organic matter content and its role in carbon sequestration and in reduction of soil-released greenhouse gases in the atmosphere – Contributing Circular bioeconomy and reduction of agricultural environmental pressures – Increased recultivation allowing the utilisation of degraded, damaged and contaminated land for biomass production; reducing soil sealing – Improved evidence-based policy making 	

Source: BIOEAST Agroecology and Sustainable Yields Thematic Working Group. 2022. Thematic Strategic Research and Innovation Agenda.



STRATEGIC THEMATIC AREA 2 (TA2): Transition to pesticide-free agriculture

Challenges (C):

Natural assets and biodiversity are declining and disappearing at a rapid rate because ecosystem services are not considered an integral part of production in the current (agricultural/economic) system. **The current straight-line farming model does not reward sustainability sufficiently**, and few farmers are encouraged to engage in chemical pesticide-free farming. Current practice where for the most part **sustainable food** (e.g., organic food) **comes with a heftier price tag, and an increasingly large sector of society cannot afford it** must be changed. There is a lack of consumer education about the quality of pesticide free products. There is a general **lack of a multidisciplinary and multi-actor approach in aspects of plant cultivation, also the lack of knowledge transfer** between scientists, advisors, and famers on the availability of alternative/new methods of crop protection. The proportion of **organic farming is well below 10% in the BIOEAST countries** and having new biological or organic plant protection products approved and marketed is very costly and, therefore, beyond small companies' reach. In the BIOEAST region, there are significant differences in land concentration and the size of holdings that can be operated economically compared to Western Europe and **the livelihood of small farms, and maintaining the living circumstances in the countryside are major challenges**. Climate change, changes in land use and global trade are all amplifying the **emergence of new diseases, pests and the invasion of alien species**. There is a lack of knowledge on changing communities of microorganisms and invertebrates in the context of changing environment (climate, plant communities, cultivation technologies) and the impact of these changes on agricultural crop cultivation and the production of food raw materials.



Main research topics (RT):

- RT2.1: Participatory technology development via the establishment of a Living Lab and Light Houses network for implementing agro-ecological transition and chemical pesticide-free agriculture
- RT2.2: Measurement of the ecosystem services of farming and monitoring of changes linked to farming practices
- RT2.3: Development of a policy framework for sustainable transition with economic support structures
- RT2.4: Adaptation to climate change – monitoring and forecasting of old and new pests, invasive species
- RT2.5: Creation of a biological basis for chemical pesticide-free agriculture; plant breeding for increase tolerance and resistance to biotic and abiotic stress
- RT2.6: Mapping of traditional farming and ecological knowledge in the BIOEAST region, possibilities for the adaptation of identified practices
- RT2.7: Digitisation in plant protection to prevent the use of chemical pesticides and reduce the current level of their application

Expected outcome and impact

- Widespread multidisciplinary and multi-actor approach in plant cultivation with less chemical pesticides
- Better understanding of the impact of farming methods on ecosystem-services
- Widespread use of proper agro-technical and storage practices
- Widespread use of IT and digital tools among agricultural producers in the BIOEAST region

Source: BIOEAST Agroecology and Sustainable Yields Thematic Working Group. 2022. Thematic Strategic Research and Innovation Agenda.



STRATEGIC THEMATIC AREA 3 (TA3): Genetic resources and agricultural diversification

Challenges (C):

Continuous loss of biodiversity (gene erosion), and the market-oriented concentration and the narrowing of available varieties. Concerning **climate change**, the prolongation of dry periods, the increase in the number of days affect this region, **increasing the unpredictability of farming**. Climate change is also setting the scene for the **appearance of unknown pests, pathogens and invasive alien weeds**, which threaten both farming and farmers' livelihoods. **Current farming technologies** and current **profitability expectations will make farming much more difficult** in the near future, which will also hinder seed and commodity production. **Farmers' lack of information** and adverse farming habits and the dominance of an attitude **focusing exclusively on short-term, immediate profits**. Farmers have **no basic expertise in the agro-technological knowledge of sustainable farming** methods and farmers' **lack of knowledge about suitable varieties and alternative species**. There is a significant number of currently **underutilised genetic resources** stored in gene banks, which, if involved in selection and farming, could produce varieties (and seeds) that are able to adapt to the effects of climate change. Several national Biodiversity and Gene Conservation Centres in the BIOEAST region store thousands of gene bank accessions, however, we have little information about them. **The regional organic seed market is under-represented** with a limited offer, organic plant breeding is not significant, and the demand for organic seed is low. **The prevalence of the monodisciplinary approach** in plant breeding, gene conservation and a strong 'top-down' approach are adopted **and insufficient public involvement** in the conservation and use of genetic diversity.



Main research topics (RT):

- RT3.1: Support for climate-adaptive agro-technologies and plant and animal breeding and launch of research aimed at the identification, collection and sharing of existing and/or functioning region-specific and climate-adaptive technologies.
- RT3.2: Spread of interdisciplinary and multi-stakeholder participatory plant breeding practices
- RT3.3: Boosting the organic seed sector with setting up research to determine the parameters of variety registration of cultivars bred for organic farming and the launch of comparative cultivar trials involving organic farmers
- RT3.4: Exploring the potential of agricultural diversification such as mixed cultivation of crops, and other solutions for crop diversification and study of consumer behaviour

Expected outcome and impact

- Improved and more sustainable gene conservation practice
- Plant cultivars (i.e. varieties and populations) adapted to the effects of climate change, which will increase the preparedness of farmers (resulting in balanced yields), and will result in an increase and spread of genetic diversity
- The spread of more sustainable production systems in the region, which promotes the transition to agro-ecological farming practices
- The development of diversified cultivation methods and crop combinations that reduce the risk posed by climate change and can generate more stable income for farmers
- The spread of a sustainable and circular economic approach among farmers

Source: BIOEAST Agroecology and Sustainable Yields Thematic Working Group. 2022. Thematic Strategic Research and Innovation Agenda.



STRATEGIC THEMATIC AREA 4 (TA4): Innovation, smart agriculture, digitalisation and knowledge sharing

Challenges (C):

Most farmers are still reluctant to embrace novelties, and their participation in the transfer of up-to-date knowledge is still limited. The innovation ecosystem in agriculture needs to be developed, as there is no coordination between the different types of actors taking part in the innovation process and different support programmes. **There is less focus on the usage of tools that would improve the environment or reduce the already negative impacts and emissions of agricultural production** in the BIOEAST countries. The link between basic and applied research which fundamentally determines the quality of multidisciplinary research and development and innovative activities is still tenuous. The lack of a concentrated R&D infrastructure, an outdated non-profit research network and ageing instrument infrastructure, **inertia, low productivity and efficiency in the use of resources, modern technologies and innovative solutions** all hold back the development of R&D and innovation in Europe. **There is also an absence of innovation capacity** - measured by innovation indicators - **through which the added value of agro/food/forestry in the primary production and production chain can be increased** and fair profit sharing (from primary producer to retailer) may occur. Also, the **current structure of the agro-food sector in the region creates problems in the innovation potential of primary production since input-intensive large farms typically have higher absorption capacity for innovation than small, family farms. The fear of transparency among certain actors in the food value chain** (input traders, farmers, purchasers, processing agents, sales persons) also poses an obstacle to the introduction of monitoring systems. The **active participation of consumers in the use of information gained** from production poses difficulties, and awareness characterises only a small number of consumers.



Main research topics (RT):

- RT4.1: Transfer of thematic knowledge and establishment of educational knowledge bases for advisors in identified agricultural shortage areas
- RT4.2: Identifying ICT solutions for and sharing them with agricultural producers
- RT4.3: Developing a system of incentives and motivation for agricultural operators to engage them in the transfer of general knowledge /voluntary data reporting
- RT4.4: Developing innovation ecosystems for actors in the agriculture sector through the better utilisation of the potential of innovation consultants/advisors

Expected outcome and impact

- The flow of up-to-date information will improve
- Wider use of ICT solutions for agriculture
- Broader distribution of processed farm data
- Needs-based and results-oriented R&D and innovation

Source: BIOEAST Agroecology and Sustainable Yields Thematic Working Group. 2022. Thematic Strategic Research and Innovation Agenda.



STRATEGIC THEMATIC AREA 5 (TA5): Animal health and welfare

Challenges (C):

Antimicrobial resistance (AMR) is one of the most important “One Health” challenges of our time, which affects human and animal health and environment protection. The **lack of application of novel medicinal agents** (e.g., phytotherapy) in order to minimize the impact of infections on animal health is apparent in the BIOEAST region. **Difficulties in complying with national and EU legislation**, differences in attitudes and scarcity of capital, significant even by international standards, are also likely to be an obstacle to innovation efforts. It is also a major challenge for farmers to comply with new legislation and **to meet conflicting and changing consumer needs**, especially when these external effects create development ‘pressure’ that affects the technologies used, and is often unprofitable and inefficient from an environmental and animal welfare point of view. Developments, e.g., price fluctuations, increases in imported goods and fewer export opportunities in the purchasing market may also present difficulties. There are a number of **agro-technical problems in the handling and processing of animal food** and the increase in GHG emissions as the result of the intensification of animal farming poses a threat. **Land shortage linked directly to livestock farming** also poses difficulties. **Numerous invasive interventions performed routinely**, close range animal husbandry failing to meet the ethological needs of animals and the lack of an animal health approach based on preventive methods also raise animal welfare issues. **The widespread use of animal species with high yields** for intensive production encourages production with an emphasis on quantity rather than high quality. Another problem is that currently **EU agricultural subsidies are not sufficiently subject to quality standards** and an increasingly acute shortage of skilled and reliable labour is a particular challenge in agriculture, especially in livestock breeding.



Main research topics (RT):

- R5.T1: Reduction in the use of antimicrobials using new diagnostic methods
- RT5.2: Production of quality agricultural products while reducing environmental pressure
- RT5.3: Facilitating the necessary technological shifts in order to reduce market pressure and ensure better animal welfare circumstances
- RT5.4: Reduction in the amount of slurry generated by close range animal husbandry and facilitating the landspreading of stable manure on arable land

Expected outcome and impact

- Reduction in the use of antimicrobials in animal husbandry
- Reduction in market pressure and facilitating technological changes to ensure improved animal welfare and animal husbandry conditions
- Reduction in the amount of slurry generated by close range animal husbandry, and facilitating the application of manure on arable land
- Promote the conservation of biodiversity, sustainable animal farming practices and the protection of genetic diversity among farm animals
- Development and upscaling of new diagnostic methods

Source: BIOEAST Agroecology and Sustainable Yields Thematic Working Group. 2022. Thematic Strategic Research and Innovation Agenda.



STRATEGIC THEMATIC AREA 6 (TA6): Short food supply chains and rural development

Challenges (C):

Some of the **impacts of climate change**, mainly desertification, shrinking surface and groundwater resources, increasingly lengthy dry periods, changes in the structure and species composition of forests affect the BIOEAST region more strongly. **Lack of adaptation strategies to emergent threats** (pests, diseases, invasive non-indigenous species, increase in mycotoxin infections) as a consequence of climate change. The **lack of modelling, data collection and impact assessments** in the area of local food supply chains and rural development, which could potentially support long-term, local and national decision-making. The role of **wildlife management** and hunting in the region is greater and more important than in Western Europe; however, it is underrepresented in EU programmes, as it is often excluded from strategic planning. In rural regions, **sufficient technological funding and access to related information is limited**, which also hinders rural competitiveness and modernisation, and restricts livelihoods in rural areas. Furthermore, **ecosystem-based, long-term planning (at local and national levels) in decision-making is also lacking**, as is better coordination between policies and regulation. A **widening technological gap between large-scale and small-scale farming** is a crucial issue in the region. **Small local producers face disadvantages in attracting financial resources and access to retail chains**. The **continuous decline in the agricultural workforce** has been a problem for decades, as has the increase in rural migration, resulting in the depopulation of the countryside. **Consumer awareness** and awareness in general are particularly **weak in terms of the quality, price, origin and sustainability parameters of food production**. Farmers who create additional benefits (incl. lower emissions, better habitat quality, less harmful water run-offs) do not have price advantages in comparison to environmentally less friendly producers. **The transfer and dissemination of new knowledge and the results of research and development to farmers are not efficient enough**.



Main research topics (RT):

- RT6.1: Launching research and projects specifically targeting the development, collection and dissemination of small-scale and family farming solutions and technologies, as well as research into the viability of the small-scale model
- RT6.2: Dissemination of good practices for sustainable agro-community adaptation to climate change
- RT6.3: Development of data-based decision support systems for climate adaptation in rural areas
- RT6.4: Placing wildlife management on a new footing by launching research and development programmes, partly to assess and forecast the local and regional impacts of landscape-wide programmes affecting habitats; partly to expand products related to wildlife management and partly to prevent and address wildlife conflict, all while developing policy objectives.
- RT6.5: Development of circular business models to strengthen local food supply chains

Expected outcome and impact

- Diversified rural production and increased self-sufficiency at local levels
- Strong rural and local communities, increased prestige of rural life
- Change of approach in wildlife management
- Create business solutions that meet the needs of stakeholders in local food supply chains

Source: BIOEAST Agroecology and Sustainable Yields Thematic Working Group. 2022. Thematic Strategic Research and Innovation Agenda.



3.2 FORESTRY VALUE CHAINS



<p>Core Theme 2: Forestry Value Chains</p>
<p>Strategic Thematic Areas:</p> <ol style="list-style-type: none"> 1. Forest resources in changing conditions 2. Sustainable wood production chains 3. Keeping and further strengthening of traditional and development of high-tech wood processing industries 4. Biomass and bioenergy 5. Paper-pulp technologies 6. Recycling and cascading system of wood and wood products use 7. Regional development 8. Forest services 9. Education and communication 10. Research and development

<p>STRATEGIC THEMATIC AREA (TA) 1: Forest resources in changing conditions</p>	
<p>Challenges Forest resources are under pressure of climate change, and a changing societal demand, which result in the changes of goods and services demanded from forest ecosystems. Severe impacts of climate change lead to the need to strengthen the capacity of forest to adapt to new conditions, including the change of tree species composition. To improve capacity of forests to tolerate ongoing climate change through purposefully differentiated forest management leading to conservation and enhancement of the biological diversity of forest ecosystems ensuring adequate timber production and other forest functions.</p>	
	<p>Main research topics (RT): RT1.1: Ecosystem dynamics inventory, monitoring, modelling and risk management RT1.2: Silvicultural systems supporting wood production</p>
<p>Expected outcome and impact</p> <ul style="list-style-type: none"> – Development and implementation of methods for effective forest inventory and monitoring, employing technological advances in remote sensing and field electronic tools for data collection – Forest modelling and decision support systems for climate change adaptation to support the sustainable forest management in changing conditions, including in small-scaled forests – Development of support schemes for climate change mitigation through carbon storage and water management in forests – Environmental chemistry and forest soil management - soil sustainability, nutrient balance; assessment of chemical stresses acting upon wood production – Monitoring and mapping of forest pests and advisory services in forest protection and risk management, including pest identification support – Extending wood production also through management of trees outside forests, implementing agroforestry systems and restoring forests at degraded forest land – Increasing the value production of broadleaved forests through the use of management systems supporting production of special, high-quality assortments – Development of cropping systems for fast growing tree species, and high-yield silvicultural systems and procedures – Breeding and testing of perspective native and introduced tree species aimed at higher quantity, better quality and stability of forest production, including conversion of unstable coniferous forests 	





STRATEGIC THEMATIC AREA (TA) 2: Sustainable wood production chains

Challenges

In sustainable wood production chains we should introduce new technologies and set-up an updated information technology support. Smart logistics is a crucial part of efficient supply chains and is closely connected with supply chain management and further smart manufacturing. Digital transformation is a foundation for further development of efficient forestry production chain that can support industries and secure the supply of wood.

Security of supply of wood to traditional, and new emerging industries and for bioenergy sector is a key for development of stable Bioeconomy sector. Moreover, the increased amounts of felling due to negative effects of climate change, result in the fall in prices of wood and increase of offer of wood assortments. To keep the wood market stable development of an international or regional platforms for exchange of information are needed. It is necessary to focus on the production of wooden products with higher added value in order to secure revenues for foresters and ensure the continuation of sustainable forest management.



Main research topics (RT):

- RT2.1: Sustainable wood market potentials and security of wood supply
- RT2.2: Planning of forest operations and harvesting infrastructure
- RT2.3: Forest economy & supply chain management
- RT2.4: New business models for private forest owners
- RT2.5: Digital transformation and smart logistics
- RT2.6: Development of regional/international market for round wood

Expected outcome and impact

- Forest road network planning and mapping using Lidar and Radar sensors
- Improvement of the technological processes in timber harvesting and processing according to quality properties of timber
- Assessed market potentials for planning of new investments in wood industry
- New models for economical evaluation of management measures from forest establishment to final harvest
- Forest Policy & Governance solving constraints of balance among wood production and other demands
- Decision support and prediction tools built on integrated knowledge base supporting forest management
- A quality assessment system for forest contractors – to assure quality and recording of forest operations
- Network of knowledge for forest professionals, advisors, owners, contractors, policy makers, researchers
- New markets and new business opportunities for forest owners
- Social-economic models of forest management – related to different forest owners’ groups
- Increase in efficiency of wood and forest services marketing
- New innovative pathways for efficient operations in private forests
- Schemes of innovation needs of labour market and forest entrepreneurs and good practice examples
- Integration of women into working places and decision-making processes in the forest sector
- Digital transformation, Smart logistics, online timber trading, marketing, procurement and auction

Source: BIOEAST Forestry Value Chain Thematic Working Group. 2022. Thematic Strategic Research and Innovation Agenda.



STRATEGIC THEMATIC AREA (TA) 3: Keeping and further strengthening of traditional and development of high-tech wood processing industries

Challenges

Create the conditions to support the increase of competitiveness and viability of the whole value chain based on forestry and domestic processing and use of wood. Fill the gaps in technologies and products of non-coniferous wood processing, use of small diameter wood, developing new products, and new markets.



Main research topics (RT):

- RT3.1: Development of high-tech technologies and increase processing of non-coniferous logs
- RT3.2: Development of regional/international market for primary wood products
- RT3.3: Organisation of international (for CEE region) network of wood processing industry and other connected stakeholder

Expected outcome and impact

- New hardwood products
- Detection of wood defects by 3D log scanning, optimizing of wood assortments and sawing, wood flow tracking, data connectivity and transfer using Internet of things in order to increase added value of the production
- Laser cutting of logs and wood
- Development of web-based platform to connect local/national markets of primary wood products
- Support for substituting non-renewable materials with wood in building sector, support for wooden buildings and standardization of processes for better recyclability of wood products

Source: BIOEAST Forestry Value Chain Thematic Working Group. 2022. *Thematic Strategic Research and Innovation Agenda*.



STRATEGIC THEMATIC AREA (TA) 4: Biomass and bioenergy

Challenges

At each wood processing level there are wood residues appropriate for bioenergy production. The challenge is to use timber efficiently, preferring products of higher added value, longer lifespan, facilitating cascading use of wood and integrating energy production, while considering renewable energy goals as well as carbon emissions reduction goals.



Main research topics (RT):

- RT4.1: Efficiency increase of the energy production from wood
- RT4.2: Transfer of advanced technologies for the wood biomass decomposition into practice
- RT4.3: Implementation of quality standards for wood fuels
- RT4.4: Promotion of modern district biomass heating systems (replacement of large number of individual heating systems)

Expected outcome and impact

- Setup of wood-energy chain - the production of energy wood in forestry, non-forest land and in wood processing industry and waste management: dimensional adjustment, high-efficiency combined heat and energy production, wood gasification and liquid fuel production
- Energy wood - maintaining quality: Protection against biological degradation and storage security
- QA/QC for wood fuels
- Wood ash utilization in the construction, production of building materials, fertilizers
- Liquid wood-based waste utilization
- New business models and partnerships for smart energy grids based on woody biomass
- Biomass pre-treatment and converting lingo-cellulosic feedstock into discrete fractions (lignin, cellulose and hemicelluloses) by progressive methods like the Steam Explosion, Ammonia Fibre Explosion, Ionic liquids, Ozonolysis
- Biochemical conversions: Yeast fermentation to ethanol and upgrading; Microbial Fermentation via Acetic Acid; Microbial Fermentation via Farnesene; Yeast Fermentation to Butanol; Microbial Fermentation of Gases
- Thermochemical conversion: Gasification of solid biomass; Flash pyrolysis and Torrefaction
- High-quality wood-based fuels and modern boilers for households and central heating systems

Source: BIOEAST Forestry Value Chain Thematic Working Group. 2022. Thematic Strategic Research and Innovation Agenda.



STRATEGIC THEMATIC AREA (TA) 5: Paper-pulp technologies

Challenges

Although paper life span is short and processing inputs are high, paper is produced from renewable resource and paper packaging and other products are recyclable and biodegradable, thus perspective from an environmental perspective.



Main research topics (RT):

- RT5.1: Special paper production and testing
- RT5.2: Functional fibres formation and paper surface treatment development

Expected outcome and impact

- Special papers development, testing and production - inorganic fibres, layered special papers, polymer reinforced paper, high precision paper
- Non-destructive testing methods developed, e.g. based on spectroscopy
- Paper surface treatment research: paper transmission parameters; structure and the anisotropy of the paper; properties of the fibres and the fibre network
- Paper surface treatment technology development for smart packaging solutions; antimicrobial, antibacterial and anticorrosion papers; barrier papers; active hygienic papers; mechanic-active papers and boards

Source: BIOEAST Forestry Value Chain Thematic Working Group. 2022. Thematic Strategic Research and Innovation Agenda.



STRATEGIC THEMATIC AREA (TA) 6: Recycling and cascading system of wood and wood products use

Challenge

The cascading use of wood represents efficient use of this renewable natural resource in the circular economy.



Main research topics (RT):

- RT6.1: Cascading use of wood in mechanical processing
- RT6.2: Increase of the wood products recycling
- RT6.3: Empower the position of all actors (including private forest owners, farmers and consumers) in the innovative value chains.

Expected outcome and impact

- Optimized models of technological chains of cascading use of wood for: Construction materials, Furniture industry; Pulp and paper industry; Agglomerated materials; Chemical industry (wood polymers, carbon fibres, composites, nanotechnologies); Energy Biofuels
- Variant chains of the technological procedures of cascade processing - wood utilization optimized
- Functionally and inter-operable prefabricated building construction assembly systems including their disassembly and reuse
- New wood based products from hardwood species
- Wood waste thermo-chemical recycling technology development included in decomposition and separating methods in a continuous process
- Analytical methods for chemical contamination and impurity determination in wasted wood and use of spectroscopy in wood waste recycled technologies
- Analysis of factors effecting energy wood production from private forests and short-rotation woody plantations
- Ecolabels (certification and product origin) impact on consumer choices
- Enhanced value chain networks and high quality of Non-Food Forest Products and Agroforestry products

Source: BIOEAST Forestry Value Chain Thematic Working Group. 2022. Thematic Strategic Research and Innovation Agenda.



STRATEGIC THEMATIC AREA (TA) 7: Regional development

Challenges

Considering trends of rural abandonment the role of forest sector in bioeconomy is also to support economic growth in rural areas and contribute to economic growth of the macro-region.

To support the employment of people from the region. Further simplify employment opportunities for workers, especially workers, including from outside the EU. Involve forest management in the network of local consultation centers for connecting local actors in order to support the entrepreneurship of local micro, small and medium-sized enterprises and strengthen access to activities related to forest management and social enterprises.



Main research topics (RT):

- RT7.1: Stimulation of interlinks within sustainable bioeconomy
- RT7.2: Support job creation in the regions
- RT7.3: Involve in the network of local consultation centres

Expected outcome and impact

- National bioeconomy strategies to tackle specific environmental and climatic challenges
- New value-chains and value-added jobs and competences to sustain viable rural society
- Developed agroforestry systems and procedures for optimization of biomass production
- Models of environmental, economic and social implications of Short Rotation Woody Crops
- Territorial (local/regional) bioeconomy systems to support regional development and sustainability

Source: BIOEAST Forestry Value Chain Thematic Working Group. 2022. Thematic Strategic Research and Innovation Agenda.

STRATEGIC THEMATIC AREA (TA) 8: Forest services

Challenges

Except production of wood and non-woody products, forests provide also ecosystem services for which payments may be considered and contribute to the resources available for forest management. For example, in Croatia, low-productivity forests in karst area with high risk of fires cover almost 40% of the total forest land. In such forests the greatest value is in the forest ecosystem services they provide.

Payments for the Ecosystem Services will be even more important in the future, due to climate change and the new challenges that forest ecosystems are facing. Level of public awareness to the results of works and projects financed with PES should be increased.



Main research topics (RT):

- RT8.1: Tools to support marketing of forest services
- RT8.2: New green touristic products connecting CEE region (hiking trails, ...)
- RT8.3: Development of local market for non-wood products from forests
- RT8.4: Identification of priorities in FES
- RT8.5: Setting national schemes for supporting of forest ecosystem services

Expected outcome and impact

- Assessment tools for country specific priorities in FES
- Tools to support specific forest management and marketing of forest services
- Local markets for FES and for non-wood products from forests
- New services and green products for environmental sustainability and for society
- Legislative environment for implementation of public supporting schemes for FES

Source: BIOEAST Forestry Value Chain Thematic Working Group. 2022. Thematic Strategic Research and Innovation Agenda.



STRATEGIC THEMATIC AREA (TA) 9: Education and communication

Challenges

Adapting the content of all levels of education (including lifelong learning) to the changing requirements of forestry practice and research so that graduates are able to respond to them in a timely and effective manner. Raise the awareness of (small) forest owners about the risks associated with climate change. In addition, education should also focus on the non-forest public in order to gain a deeper understanding of the importance of forests and forestry for the sustainability of society, for example through forest pedagogy. The role of forestry in the bioeconomy and its value chain approach could be part of forestry curricula.



Main research topics (RT):

- RT9.1: Update of forest related education curricula for secondary and university studies adapted to trends in circular bioeconomy
- RT9.2: Building tools, networks and infrastructures for knowledge transfer and motivation of stakeholders towards implementation of circular wood-products and services based circular bioeconomy

Expected outcome and impact

- Forest related education curricula for secondary and university studies adapted to trends in circular bioeconomy
- Tools, networks and infrastructures for knowledge transfer and motivation of stakeholders towards implementation of circular wood-products and services based circular bioeconomy

Source: BIOEAST Forestry Value Chain Thematic Working Group. 2022. Thematic Strategic Research and Innovation Agenda.

STRATEGIC THEMATIC AREA (TA) 10: Research and development

Challenge

Increase the efficiency of forestry research and innovation in the care of forest ecosystems by creating national priorities for science, research and innovation, focusing primarily on the impacts of climate change on forest ecosystems in the landscape, modern technologies and other areas under research in Europe.



Main research topics (RT):

- RT10.1: Updating of strategic research and innovation agenda of forestry research

Expected outcome and impact

- Up-to-date research and innovation agenda for forestry research and allocation of adequate resources

Source: BIOEAST Forestry Value Chain Thematic Working Group. 2022. Thematic Strategic Research and Innovation Agenda.



3.3 FOOD SYSTEMS



Core Theme 3: Food Systems

Strategic Thematic Areas:

1. Sustainable Food Production (PRODUCTION)
2. Power and information in the food system: strengthen the food environments and vulnerable actors in the food chains (FOOD CHAINS)
3. Research, innovation, technology and investments for future sustainable food systems (RESEARCH)
4. Promoting sustainable food consumption and the shift to healthy, sustainable diets (CONSUMER)

STRATEGIC THEMATIC AREA (TA) 1: Sustainable Food Production (PRODUCTION)

Challenges:

- Relatively low level of knowledge and technology transfer to primary producers compared to other European regions
- Traditional agricultural model based on increased use of chemical fertilisers
- Need for new management system for biomass collection and processing from primary producers
- The limited sources for sustainable transport and reusable packaging (avoiding non-renewable and fossil-derived plastics), optimising the preservation of nutritional quality in primary production, ensuring food safety
- New requirements about technical definitions, classification, presentation, marking and labelling, packaging, production method, conservation, storage, transport related administrative documents, certifications and time limits, restriction of use and disposal
- Crop safety in the context of sustainable use and utilization of plant protection products
- Increasing the share of organic and less intensive farming in the agricultural production and land use systems



Main research topics (RT):

- RT 1.1: Ensuring sustainable food production by human and financial investment – innovation, skills and technology shift
- RT 1.2: Stimulating reduction of use and risk and dependency on pesticides
- RT 1.3: Promoting measures for reducing biomass loss and waste in production
- RT 1.4: Optimization of harvest for the applied processing technologies to reduce food waste, finding the best use of the raw materials and by-products
- RT 1.5: Bring to the practice the state-of-the-art of the preservation technologies (with special emphasis to the environmentally friendly packaging, storage conditions etc.) to extend storability of raw materials and the shelf life of final products

Expected outcome and impact

- Increased investment in supporting farms of all sizes to take advantage of new technologies, vision and information flows
- Assess on-farm practices and equipment to use feedstuffs more efficiently (post-harvest technologies, crops mixture, foraging strategies, rangeland management)
- Optimisation of production techniques, raw material storage, transport and the creation of semi-finished products at primary producer level
- Optimal use of biomass based on market knowledge to maximise sustainability and zero-emission and loss-free production
- A significant shift away from the use of pesticides and towards alternative agricultural inputs
- Increasing the awareness of producers and consumers, sense of shared responsibility
- Increased knowledge on pro-health additives for feed containing active plant ingredients, a safe alternative to antibiotic growth stimulators in animal nutrition and foreign products



- Involvement of owners and managers of medium, large and very large farms in the conversion process.
- Limitation of losses of biomass during agricultural production
- Increased use of biomass raw materials and residues
- Pesticides consumption reduction. Sustainable food production, with less chemical use and less waste. Implementing and using the opportunities offered by digitalisation and automation in the food industry, agri- and horticulture sectors
- Improved labour productivity through innovation, digitalisation and eco-efficiency

Source: BIOEAST Food Systems Thematic Working Group. 2022. Thematic Strategic Research and Innovation Agenda.



STRATEGIC THEMATIC AREA (TA) 2: Power and information in the food system: strengthen the food environments and vulnerable actors in the food chains (FOOD CHAINS)

Challenges:

- Lack of systemic approach to boost the innovation and investment in short food chains and related new business models
- Integration of renewable energy sources and energy efficiency in farming practice, agro-food systems and logistics (transportation, storage)
- A strong deficit in trust, joint action both in horizontal and vertical collective actions by Future Horizon Europe calls
- Reducing dependence on non-renewable, unsustainable resources whether sourced domestically or from abroad
- Innovations on digitalisation (automation and artificial intelligence) in agriculture, digital development of agri-food value chains (productivity, efficiency, traceability). To strengthen the food environments is the proper connection of producers and consumers, supporting the digitalization of primary producers, developing fast and easy tool for the detection of food frauds and providing information hubs in order to help personalize producers (blockchains)
- A lack of data on food fraud in the food supply chain
- Strengthening the bargaining position of farmers and increasing their share in creating environment and economic added value in food supply chains, including their shortening



Main research topics (RT):

- RT 2.1: Promoting sustainable short food chains, initiatives and new green business models in food processing, wholesale, retail and food services
- RT 2.2: Cooperation of primary producers to support their position in the food chain and non-legislative initiatives to improve transparency
- RT 2.3: Tackling with food fraud along the food supply chain
- RT 2.4: Development of information hubs to connect farmers and primary producers with potential customers to promote the formation and consolidation of sustainable short food chains

Expected outcome and impact

- R&D&I projects shall propose tailor-made, adaptable regulatory or control solutions for decision makers
- cooperation models between farmers, collaboration models for consumers, farmers and intermediaries (like food hub managers, facilitators, chefs) shall be analysed and adapted according to the regional circumstances
- Horizon Europe calls should have a special focus on collaborative actions in the CEE countries where there is a strong deficit in trust, joint action both in horizontal and vertical collective actions
- A deeper knowledge to the actors of food chains of techniques and methods on how to shorten food supply chains. Establishing production and purchasing and sales cooperatives would give a proper surface for communication and connection of primary producers, farmers and consumers directly
- Full information to consumers that the food products they purchase are healthy, nutritious and meet all the necessary requirements, and how they can be protected from frauds
- Exchange of information will be achieved which is expected to help producers to understand consumers and to help consumers build trust towards local producers
- Increased farm incomes, promote sustainable farming systems and contribute to local economic development within SFSCs
- New innovative and digitized food chain model, beneficial for the environment and climate, as well as for the main participants, especially farmers and consumers

Source: BIOEAST Food Systems Thematic Working Group. 2022. Thematic Strategic Research and Innovation Agenda.



STRATEGIC THEMATIC AREA (TA) 3: Research, innovation, technology and investments for future sustainable food systems (RESEARCH)

Challenges:

- Lack of data gathering for food systems by agricultural census
- Modelling food system dynamics and risk management with multilevel territorial approach
- Increasing of the crop yield using biological method, with reduction of the chemicals used in the agriculture.
- Mapping the available database which can supply reliable data and evidence based results for further decision making processes
- Involving players from the food chain to the researches related to the Farm to Fork Strategy
- Lack of modern educational framework on sustainable food use and transition to sustainable food systems
- The monitoring of Antimicrobial resistance AMR in zoonotic and commensal bacteria both in the environment and in food products is a pre-requisite for understanding the development and diffusion of resistance, providing relevant risk assessment data, and evaluating targeted interventions
- Increasing the efficiency of the biological methods of control against the plant pest
- Stimulating the growth, plant defence system and biodiversity in agriculture by using the biological methods
- Research on the social, poverty and demographic problems related to food systems
- Synchronization of research in the scope of the most important issues describing sustainable food systems
- Environmental and climate innovations consistent with the current state of knowledge - combination of research and practical solutions
- The new solutions and use of digital technologies in food systems' research and practice



Main research topics (RT):

- RT 3.1: Environmental, biodiversity and natural capital observation (new statistics)
- RT 3.2: Food system dynamics modelling & risk management at local level
- RT 3.3: Future advisory services, data and knowledge transfer and skills for future sustainable food systems
- RT 3.4: Better understanding of planetary boundaries facilitates innovative solutions for sustainable and circular management and use of natural resources as well as prevention and removal of pollution
- RT 3.5: Improve the production with the help of digitalization in the agriculture and food sectors
- RT 3.6: Development of technologies for bio-based packaging, use of expired products, reuse of water in the food industry, use of waste and sludge as bio fertilizers

Expected outcome and impact

- New advantage of social media analysis as data source and platforms
- Increasing of the interest of industry in participation in research
- Building a national databases, statistical analysis of the data
- Better understanding of antimicrobial resistance and diffusion
- Institutional system and increased influence of scientific entities (universities, institutes) in creating of Bioeconomy Departments
- Increased multidisciplinary in education and training of specialists
- Complex analytical methods to demonstrate benefits in terms of "entity vs. value chain"
- Modern methods in supporting decisions on farming
- Research, technologies, innovations on improving soil fertility, their fertility, reducing the cost of crops, beneficial actions to improve biodiversity
- A knowledge and information transfer system that analyzes signals from the market and from the production of the agri-food sector on an ongoing basis, and then creates or adapts solutions to emerging problems and transfers them to economic practice

Source: BIOEAST Food Systems Thematic Working Group. 2022. Thematic Strategic Research and Innovation Agenda.



STRATEGIC THEMATIC AREA (TA) 4: Promoting sustainable food consumption and the shift to healthy, sustainable diets (CONSUMERS)

Challenges:

- Increase of consumer awareness of food quality, agroecology, organic farming and short value chains
- Lack of a comprehensive system of education and training of specialists in the field of sustainable food systems and the circular economy
- Increase public awareness of the need to reduce food waste and use by products made from waste biomass
- New industries for healthy life and food (new bio-technologies with direct application for a healthy lifestyle)
- Limited progress on collective knowledge on new paths for development: microbiome, food from the oceans, urban food systems, source of alternative proteins, meat substitutes
- Accessibility of sustainable healthy products and empowering consumers to be able to make healthy and sustainable choices
- Promoting the solutions in the lifestyle, supporting the shift to more healthy, and sustainable diet



Main research topics (RT):

- RT 4.1: Reformulation of processed food, including the setting of maximum levels for certain nutrients
- RT 4.2: Monitoring framework for responsible business and marketing conduct in the food supply chain
- RT 4.3: Revision of EU marketing standards for agricultural, fishery and aquaculture products to ensure the uptake and supply of sustainable products
- RT 4.4: Educational framework for sustainable food use and the shift to sustainable diets (eg. new nutrient profiles to restrict promotion of food high in salt, sugars and fat)

Expected outcome and impact

- Conducting further representative studies on what consumers perceptions regarding local, organic foods and alternative food chains
- New social innovative initiatives by flexible eligibility and control criterias
- The knowledge of digitization and technology, new trends and channels made available to local food system actors by establishing a rural facilitator network or knowledge hubs
- New analysis and mapping in the countries and regions, which tools address which specific topics and provide which kind of information and how adjacent tools and platforms could be better connected
- The application of cost effective tools for reducing biomass loss and waste which require a special focus from researchers and experts to be able to provide relevant information and to adapt new technologies for smaller actors of the system such as small scale manure management, sustainable using of by-products, food logistics, mobile and common food processing technologies etc.
- Replacement of meat with vegetable protein sources
- Longer shelf life of food products can help reduce food waste
- The decline in the proportion of obese population
- Increased share of domestically produced goods in the consumption
- Consumers with a healthier and more environmentally conscious attitude (verified by measurement!)
- Strategic planning, programs running with secured budget (at least mid-term). Regular program evaluation. To indicate the role of agricultural practices (organizational, technical, investments) in food production, that will stimulate the sustainable model of food consumption
- Strong evidence and information base for the regional/nationals strategies, the regulation set, that systematically, in a few-years horizon deadline, will eliminate or significantly reduce the consumption of the most resource demanding foods, like e.g. processed food

Source: BIOEAST Food Systems Thematic Working Group. 2022. Thematic Strategic Research and Innovation Agenda.



3.4 BIOENERGY AND NEW VALUE – ADDED MATERIALS



Core Theme 4: Bioenergy and New Value – added Materials

Strategic Thematic Area:

1. Bioenergy and New Value – added Materials

STRATEGIC THEMATIC AREA 1 (TA1): Bioenergy and New Value – added Materials

Challenges:

Use of biomass for bioenergy is the only mandated share of bioeconomy by quantity by 2030 as a mandated share of renewable energy in transport: biofuels. The main challenge is to harmonize that demand with biomass supply to other bioeconomy sectors as well as to secure cascading use of biomass. Biomass supply is either affordable as a by-product but scattered and heterogeneous across the area, or is available and stable as dedicated crops but with high costs of production. Biomass supplied has to be sourced sustainably. Biomass for bioenergy is challenged for its sustainability in terms of CO₂ neutrality. Yet, that controversy is much related to forest-based biomass than to agricultural biomass that is either a by-product (e.g. manure, straw), waste (e.g. potato peel, abattoir waste) or dedicated crop (e.g. Miscanthus, SRC, Siberian dandelion etc.). The main challenge for bioenergy is to ensure its sustainability in terms of sourcing, soil health and carbon neutrality. On the other hand, bioenergy is the most expensive renewable source of electricity but also the largest employer among the renewable energy sources.



Main research topics (RT):

- RT 1.1: Transitioning the existing bioenergy plants to small-scale biorefineries
- RT 1.2: Anaerobic digestion linked with livestock production
- RT 1.3: Create industrial symbiosis of bioenergy plants with agri-food players to achieve circularity
- RT 1.4: Securing stable biomass supply with ensured quality, quantity and certified sustainability

Expected outcome and impact

Proposed measures will aid to achieve concerted policy between energy, food, agriculture, science and climate policy domains. Existing bioenergy CHP plants will continue to work without needing governmental subsidies, by transitioning to biorefineries. Dairy, meat and egg products of BIOEAST countries achieve carbon neutrality and expand their markets to high purchasing power countries. Agri-food industry achieves circularity by creating industrial symbiosis with bioenergy plants. Biomass supply is stabilized for bioenergy within broader bioeconomy while farmers’ income is diversified by turning post-harvest facilities into bio-hubs.

Source: BIOEAST Thematic Working Group Bioenergy and New Value-added Materials. 2022. Thematic Strategic Research and Innovation Agenda.



3.5 ADVANCED BIOCHEMICAL AND BIOMATERIALS



Core Theme 5: Advanced Biochemical and Biomaterials

Strategic Thematic Areas:

1. Availability of sustainable feedstocks from agricultural residues and food industry
2. Chemical and enzymatic transformation of biomass
3. Production of bioactive compounds
4. Production of bio-based chemicals and materials
5. Innovative high-value biobased products
6. Blue economy in sustainable biochemical production

STRATEGIC THEMATIC AREA 1 (TA1): Availability of sustainable feedstocks from agricultural residues and food industry

Challenges

The bioeconomy is a broad concept focusing on utilizing biobased resources in every way possible. In the CEE region both agriculture and forestry provide large amount of biomass as a raw material, however the value chains of these resources are not yet completely developed. The use of biomass is crucial for the successful implementation of the bioeconomy concept, however the raw materials should be carefully chosen for the chemical industry not to compete with possible food or feed application. In order to shift the chemical industry from fossil-based resources to biobased ones, several challenges need to be addressed both in the field of biomass and waste streams availability and also on the technological side.



Main research topics (RT)

- RT 1.1: Measuring the current state and availability of the biomass supply
- RT 1.2: Identifying promising regional biomass resources and value chains to guide the establishment of bioeconomy clusters
- RT 1.3: Identifying generation of food waste along the value chain from production to processing to retail and consumption at the household level and by the food industry
- RT 1.4: Development of new varieties of fiber and oil plants for industrial purposes
- RT 1.5: Implementation of effective microorganisms for stimulation of growth of industrially important plants
- RT 1.6: Value chains on forest non-wood products (resins, fruits, medicine plants, etc.)

Expected outcome and impact

Sustainable indicators and monitoring system for the whole biomass value chain would be developed and implemented. Currently available biomass value chains would be improved while also new, effective value chains would be created with engaging and establishing relevant industrial actors. Those biomass or waste streams which cannot be picked up by the food or feed sector would be channelled to other relevant actors in the field of industrial biotechnology and the chemical industry. Enhanced biodiversity and more sustainable industrial plant growth would be achieved by new plants and microbial help.

Source: BIOEAST Thematic Working Group Advanced Bio-based Chemicals and Materials. 2022. Thematic Strategic Research and Innovation Agenda.



STRATEGIC THEMATIC AREA 2 (TA2): Chemical and enzymatic transformation of biomass

Challenges

Biomass in itself is very hard to utilize, so its breakdown to crucial elements is necessary. The processing of the biomass depends on several aspects such as origin and composition of biomass, needed end-product for further utilization, technological background etc. In order to be able to utilize the biomass to the fullest of its potential several chemical and enzymatic process is needed, however these technological areas still need major development. Unfortunately, the CEE region lacks crucial infrastructure in the field of industrial biotechnology, however the available expertise and needs promote the improvement of existing technological solutions and also the development of novel methods.



Main research topics (RT)

- RT 2.1: Biorefinery pilot/demo plant, producing high quality cellulose/lignin
- RT 2.2: Biomass utilization for the production of biopolymers and natural polymers
- RT 2.3: Production of high-value bioproducts in advanced biorefineries based on enzymatic and fermentative processes
- RT 2.4: Identifying the potential of existing technologies for production of biobased chemicals and materials from agricultural and food residues using the feedstocks available in CEECs

Expected outcome and impact

Small-scale biorefineries would be established in the CEE region which can be utilized by the academic and the industrial sector. Novel technologies would be developed that are tailored for the utilization of local biomass sources. With that new value chains would be created and the current value networks would be reorganized. First stage producers e.g. farmers would be integrated in the bioeconomy as raw material suppliers. Biobased alternatives for fossil-based platform chemicals would be available.

Source: BIOEAST Thematic Working Group Advanced Bio-based Chemicals and Materials. 2022. Thematic Strategic Research and Innovation Agenda.



STRATEGIC THEMATIC AREA 3 (TA3): Production of bioactive compounds

Challenges

There are several valuable ingredients available in a large quantity in the available plant-based biomass besides the main building blocks (cellulose, hemicellulose and lignin). For example, in residues of herbs and spices several bioactive ingredients can be found which substances are valuable for e.g. medical, pharmaceutical, and cosmetic industry. There are still unknown bioactive substances, and the extraction and separation of such molecules are not perfected, not even on a research skill not to mention the industrial scale.



Main research topics (RT):

- RT 3.1: Bioactive compounds from agro-wastes and wastes from the food processing industry
- RT 3.2: Development of bioadditives based on natural resources for plastics
- RT 3.3: Extraction, characterization, identification and implementation of new bioactive substances from medicinal plants for pharmaceutical and industrial purposes
- RT 3.4: Improved medicinal plant varieties for production of bioactive compounds
- RT 3.5: Valorization of lignin: production of antioxidants, food additives, and glues for plywood and OSB

Expected outcome and impact

By improving several areas in the field of bioactive molecules, it is expected to achieve a circular biobased solutions, especially at fields where the substitution of traditional agents is challenging, such as pharmaceutical industry, cosmetics and other fine chemicals. Due to the target sources it is expected that new solutions can be found to utilize food, feed and floral waste, extracting a small amount of molecules with one of the highest added value. By studying these molecules and utilizing new materials, it is expected to help the chemicals industry switch from fossil-based chemicals to bio-based ones at fields where it is most challenging.

Source: BIOEAST Thematic Working Group Advanced Bio-based Chemicals and Materials. 2022. Thematic Strategic Research and Innovation Agenda.



STRATEGIC THEMATIC AREA 4 (TA4): Production of bio-based chemicals and materials

Challenges

The available amount of biomass is limited, although the bioeconomy is built upon this raw material. That is why it's crucial to properly utilize it with a special focus on the side streams. There are lots of plant-based fibre and protein sources which utilization is not addressed at all, and these valuable potential resources are thrown away at the end of currently existing value chains. With the growing societal urge and pressure to create more sustainable and biobased products, novel, biobased material solutions need to be developed in accordance with utilizing the currently untapped potential of biomass.



Main research topics (RT):

- RT 4.1: Improving the production and properties of microbial polyesters as a sustainable solution for the plastic industry
- RT 4.2: Scientific investigation and exploration of new technologies for the fiber plant waste for the production of materials and chemicals
- RT 4.3: The versatile platform for a transformation of glycerol formed during biodiesel production
- RT 4.4: Valorization of waste streams of plywood factories. Betulin and suberin as high added value product from birch bark
- RT 4.5: High-value biobased products from Mediterranean plants
- RT 4.6: Holistic utilization of fiber plants to obtain an added value products in agriculture and in the industry, as an example of bio-based green deal chemistry approach

Expected outcome and impact

By improving several areas in the field of biobased materials and chemicals, it is expected to achieve a circular bioeconomy where all waste streams are utilized up to their potential in a way that they can substitute and complement adequate fossil-based raw material streams. With the development of novel materials and solutions the chemical industry can contribute to the sustainable development goals, and create new industries and new jobs within while simultaneously addressing the current societal and consumer needs.

Source: BIOEAST Thematic Working Group Advanced Bio-based Chemicals and Materials. 2022. Thematic Strategic Research and Innovation Agenda.



STRATEGIC THEMATIC AREA 5 (TA5): Innovative high-value biobased products

Challenges

With the improvement of life circumstances several specific areas arose, where targeted solutions are required. These fields are for example: targeted medicine, personal medicine, nanotechnology, space technology etc. On these fields there are a few, if any “traditional” solutions, because the issues are quite new as well. Researchers soon realised that in order to have long-term solutions sustainability is a key, thus biobased materials play an essential role in designing solutions. In some fields e.g. healthcare, biobased building blocks are the only feasible choice due their unique properties. However, there are always some negatives next to the positives and more research is needed in order to overcome the difficulties these materials face during application.



Main research topics (RT):

- RT 5.1: Biodegradable systems for medical applications with the incorporation of bioactive nanomaterials
- RT 5.2: Polyurethane (PUR) materials as thermal insulation from renewable resources
- RT 5.3: Biobased rigid polyurethane foams as cryogenic insulation material, also for space applications
- RT 5.4: Biobased activated carbon for supercapacitors
- RT 5.5: Micro and nano-cellulose as building blocks for bioactive materials and as full or partial replacement of synthetic polymers

Expected outcome and impact

By introducing biobased materials to novel product development at the very beginning of the design phase, it is expected to have long-term sustainable solutions in emerging markets and industrial segments. By utilizing the unique characteristics only biobased materials have, it is expected that new technology will emerge which will create sustainable solutions for the society in addition to more workplaces and revenues. With focusing on emerging segments we can ensure that sustainable solutions become the norm, setting good examples for future developments.

Source: BIOEAST Thematic Working Group Advanced Bio-based Chemicals and Materials. 2022. Thematic Strategic Research and Innovation Agenda.



STRATEGIC THEMATIC AREA 6 (TA6): Blue economy in sustainable biochemical production

Challenges

The blue economy has its origins in the concept of the green economy, which focuses on the sustainable management of "blue" resources. The blue economy is also associated with the use of renewable aquatic and marine biological resources to produce valuable chemicals. Examples of such products include novel foods and food additives, animal feeds, dietary supplements, pharmaceuticals, cosmetics, and materials (e.g., clothing and building materials). The use of such new and unexplored bioresources or existing species may well offer significant opportunities for the development of new processes, products and markets using the by-products or wastes. As the Blue Economy is generally not yet developed in CEE countries, there are many challenges that need to be addressed, and this affects all sectors of the economy, from the private sector to research and development to government policy. The complexity mentioned above presents both opportunities and obstacles.



Main research topics (RT):

- RT 6.1: Identifying the potential for blue bioeconomy in CEE region
- RT 6.2: Exploring the waste management options in aquaculture systems and symbiotic (plant/fish) production systems
- RT 6.3: Analysis the potential opportunities from management of by-products and co-products generated along national fisheries and aquaculture
- RT 6.4: Developing the strategy for valorization of aquaculture waste through the production of biobased chemicals and materials

Expected outcome and impact

Identifying waste streams of aquatic biomass and promising raw materials to be utilized. Widening the range of available biobased raw materials for the chemical industry. Promoting future aquaculture growth in a sustainable way which will give opportunities for new jobs and businesses. Aiding businesses to shift their portfolio towards biobased, more sustainable products. Offering new revenue for fisheries and other first stage aquatic biomass producers along with the chance to widen their portfolio.

Source: BIOEAST Thematic Working Group Advanced Bio-based Chemicals and Materials. 2022. Thematic Strategic Research and Innovation Agenda.



3.6 FRESHWATER BASED BIOECONOMY



Core Theme 6: Freshwater based Bioeconomy

Strategic Thematic Area:

1. Freshwater based Bioeconomy

STRATEGIC THEMATIC AREA 1 (TA1): Freshwater based Bioeconomy

Challenges

The EU faces emerging geopolitical and global challenges, war in Ukraine, food, energy, self-sustainability, resilience and recovery, at the same time there is an urgent need to face risks of losing the health of ecosystem after decades of intensive damaging. A responsible smart transition process is needed that leads Europe to a knowledge-based society that is strongly oriented towards circularity and sustainability. Fresh water is a vital element influencing the economies and social structure of certain regions in the EU. The last European Water Report showed that around 60% of European surface waters (rivers, lakes and transitional and coastal waters) are not in good ecological status and 62 % are not in good chemical status. The majority of BIOEAST water bodies has worse than good status, thus, a further acceleration of action by Member States is urgently needed. The BIOEAST macro region needs to urgently tackle the following issues damming of water bodies and change in hydromorphology; agricultural diffuse pollution, application of nature-based solutions reducing water use, promoting a wider use of drought management plans.



Main research topics (RT)

- RT 1.1: Nature-based innovative solutions to mitigate impact of climate change on ecosystems and improvement of water management.
- RT 1.2. Ecosystem-based approach for improvement water quality
- RT 1.3. New business models and value chains based on freshwater
- RT 1.4. Innovative solutions and support of the innovation ecosystem in the Danube River Basin

Expected outcome and impact

Improvement of supplying clean freshwater, mitigation of the impact of climate changes, and reducing the risk of flooding through nature-based solutions with restoration techniques.
Closer attention to the above mentioned research topics can enhance the implementation of environmentally sustainable freshwater based bioeconomy.

Source: BIOEAST Thematic Working Group Fresh Water Based Bioeconomy. 2022. Thematic Strategic Research and Innovation Agenda.



3.7 BIOECONOMY EDUCATION



Core Theme 7: Bioeconomy Education

Strategic Thematic Area:

1. Bioeconomy Education

STRATEGIC THEMATIC AREA 1 (TA1): Bioeconomy Education

Challenges

The New European Economic strength and growth are building based on a new concept including the valorisation of natural resources and human manpower in a sustainable way. Those are the concepts of Bioeconomy, Biobased Economy and Circular Economy, which they become substantial elements for the future development. In the forthcoming years more and more processes will be designed on these principles. The current challenge the EU faces, climate, energy, safety, food crisis put an additional pressure to business and the need to look for alternative solutions. Likewise, policy makers are facing new decision-making tasks. Therefore, it is demanded training modules for professionals, public bodies likewise to reflect these changes in systemic changes to prepare new generation of entrepreneurs and skilled working force.

The role of the industry can be catalytic. For an effective educational frame, it is necessary the engagement of the industry into the programs and the increase of student's accessibility. It will therefore guarantee a robust pipeline among industry, faculty staff and students. Our objective is to penetrate new markets: The final goal is to enhance the opportunities for penetrating into the market for the newly educated staff. For achieving this goal, issues like technology forecasting, market requirements, international competitiveness, mobility in transnational and trans-sectorial levels, cooperation with non-European markets etc. should be analysed and incorporated into the educational mechanisms.



Main research topics (RT)

- RT 1.1: Mapping the Bioeconomy Education Landscape in the CEE macro-region
- RT 1.2: Identifying Regional Priorities
- RT 1.3: Developing Relevant Curricula
- RT 1.4: Emphasizing on Vocational Training
- RT 1.5: Innovative Governance on Bioeconomy Education

Expected outcome and impact

The BIOEAST Foresight exercise in 2021 has detected an asynchronous development in structuring Bioeconomy education, capable to effectively implement the Green Deal and other EU strategies. Alignment of the educational perspective with European practices, re-organization of the curricula and prioritizing the regional needs and expectations and selecting specific target groups, will offer a good potential for improvement in all levels (technological, economic social and regulatory), the educational curricula should consider the development of soft skills in addition to disciplinary knowledge. Further Education and Lifelong Learning must be considered for the educators according to the new requirements.

Additionally, including the educational perspective in a concrete regional planning with a specific governance might enhance the perspective of a strategy adoption on National level.

In a mid-long term coordinated actions on regional basis (e.g. co-organized vocational training or the creation of a Regional Institution) could be a goal.

Source: BIOEAST Thematic Working Group on Bioeconomy Education. 2022. Thematic Strategic Research and Innovation Agenda.



4 THE EU'S ADDED VALUE

The successful implementation of the BIOEAST SRIA will provide the following benefits to the European Union:

- consolidated human capital in research and innovation,
- a stronger research and innovation system,
- targeted and more competitive research,
- cooperation, exchange, networks,
- new high-quality knowledge,
- EU policy priorities implemented (Table 7),
- a small gap between the BIOEAST Member States and the EU innovation leaders,
- unlocked sustainable circular bioeconomy potential.

The BIOEAST Foresight Exercise (2021) pointed out that the circular bioeconomy is an enormous opportunity for the growth of the BIOEAST region and forecasted that the adoption of a fully Sustainable and Circular Bioeconomy Model with value added for the Region would make the following impacts.

Impact on Economic Development and Growth Levels

In general, the adoption of bioeconomy principles will have a direct impact on economic development and growth in both the short- and mid-terms. Besides this, the potential investments will be observed, and an alignment to common European practices and an attempt at the synchronization of the BIOEAST countries are required. Direct impact will be achieved through various means of funding, exploration of specific investments, participation in related projects and consortia, and so on. Indirect economic impact will be achieved by adopting practices such as biomass valorization, enabling new value chains, circularity, sustainable production lines, and the cooperation of various sectors, among others. (BIOEAST Foresight Exercise, 2021)

Impact on Competitiveness

Given that sustainability is a key element in all bioeconomy practices, sustainable development will become a mandatory path and will support practices and actions involving it in all domains. Sustainability will make the regional economy more competitive by supporting not only bioeconomy-related pathways but also lateral actions in totally different businesses and domains. Another parameter influencing competitiveness is the regional character of the bioeconomy. New technologies and innovations are expected to have an applicability to the whole CEE macro-region, exploring the regional advantages such as natural resources, the size of the market, the alternativity of value chains, complementarity, competitiveness, and homogeneity of attitudes and perceptions, as well as development and growth. The opinion is that the CEE region should reach the standards of Northern and Western Europe in terms of competitiveness, market exploration, growth and attracting investments. For the implementation of circular and bioeconomy business models, collaboration is essential. Instead of competing in the traditional way, radical collaboration must be encouraged. The goal of increasing know-how and knowledge of modern cooperation is a challenge. Cooperatives can be helpful in moving towards various circular bioeconomy objectives, especially when cooperatives themselves cooperate (policy measures aimed at cooperatives have the potential to reach a large proportion of agricultural producers, for example). But this is not a given – overcoming trust and transparency issues is problematic without appropriate know-how. (BIOEAST Foresight Exercise, 2021)

Impact on Societal Level

Job creation is one of the main societal impacts that a bioeconomy provides. Additionally, and in the same context, the bioeconomy will also enable investments and development in lateral or related domains, which will result in indirect job creation. An additional aspect is an increase in awareness and understanding. Adoption of



the circular bioeconomy requires a high level of awareness. Vocational education or case-by-case training are processes adding to this perspective.

Citizens are changing their behaviour patterns regarding purchasing and consumption, becoming more engaged in co-creation of circular bioeconomy solutions and better connected. The sense of community and interdependency is getting stronger. (BIOEAST Foresight Exercise, 2021)

Environmental impact

A bioeconomy approach is based on sustainability, so the environmental impact of full implementation is definitely positive. The circular character of the process further enhances this positive impact (BIOEAST Foresight Exercise, 2021).

After summarizing the expected outcomes designed by the Thematic Working Groups and the impacts of Strategic Thematic Areas (Table 8), we can forecast that implementing the BIOEAST SRIA would contribute to achieving:

- the BIOEAST Initiative long-term goals,
- several BIOEAST Initiative general objectives,
- as well as the BIOEAST's Vision 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, maintaining or even strengthening environmental sustainability.*

The Strategic Thematic Areas of the BIOEAST SRIA are quite broad; therefore, multiple partnerships and missions may be in the focus of the Thematic Working Groups. According to the Strategic Thematic Areas identified, the Thematic Working Groups have links to the following European Partnerships and HE Missions (Table 9):

- Circular Bio-based Europe Joint Undertaking (the CBE JU Partnership),
- European Biodiversity Partnership: Biodiversa+,
- European Partnership Accelerating Farming Systems Transition: agroecology living labs and research infrastructures,
- European Partnership for Animal Health and Welfare,
- European Partnership for Agriculture of Data,
- European Partnership for Rescuing Biodiversity to Safeguard Life on Earth,
- European Partnership for A Climate Neutral, Sustainable and Productive Blue Economy,
- European Partnership for Safe and Sustainable Food Systems for People, Planet & Climate,
- European Partnership for Water Security for the Planet (Water4All),
- the HE missions: Adaptation to Climate Change,
- the HE missions: Healthy Oceans, Seas, Coastal and Inland Waters,
- the HE missions: Soil Health and Food.

Figure 16 shows the Monitoring Framework for the BIOEAST SRIA and interconnections between the expected benefits that indicate which elements of the monitoring framework relate to the benefits for the European Union.

The link of monitoring framework elements with the BIOEAST Initiative objectives is shown Annex 3 (column 1).

Based on the identified complementarity and interaction of:

- the BIOEAST Vision for 2030 and long-term goals with the EU's main strategies and action plans
- the Strategic Thematic Areas with the EU's aims and strategies



one can expect that implementing the BIOEAT SRIA, seeking to achieve the BIOEAST vision for 2030, will add value to the EU's aims and strategies.

A comparative analysis between the goals of the European Union's policies and promotional measures and Strategic Thematic Areas of the BIOEAST SRIA found complementarity and interaction (Table 7). **This means that the BIOEAST SRIA establishes links between several strategies of the EU** (Sustainable bioeconomy for Europe, Farm to Fork Strategy, EU Biodiversity Strategy for 2030, New EU Forest Strategy for 2030, New Industrial Strategy for Europe, An EU Strategy for Energy System Integration, The new EU Strategy on Adaptation to Climate Change, 2030 Climate Target Plan) **and the New Circular Economy Action Plan. Since the EU's strategies** (Sustainable bioeconomy for Europe, Farm to Fork Strategy, EU Biodiversity Strategy for 2030, New EU Forest Strategy for 2030, New Industrial Strategy for Europe, An EU Strategy for Energy System Integration, the new EU Strategy on Adaptation to Climate Change, 2030 Climate Target Plan) **and the New Circular Economy Action Plan** are subordinate to the European Green Deal, the **BIOEAST SRIA establishes links with the European Green Deal** as well.



Table 3: Complementarity and interaction of the BIOEAST Core Themes with the EU’s strategies and action plans

Strategic Thematic Areas/ Core Themes	EU’s Strategies and action plans							
	European Green Deal							
	↑	↑	↑	↑	↑	↑	↑	↑
	Sustainable bioeconomy for Europe	New Circular Economy Action Plan	Farm to Fork Strategy	EU Biodiversity Strategy for 2030	New EU Forest Strategy for 2030	New Industrial Strategy for Europe	An EU Strategy for Energy System Integration	The new EU Strategy on Adaptation to Climate Change
	Core theme: Agroecology and Sustainable Yields							
TA 1: Soil management	x	x	x	x		x	x	x
TA 2: Transition to Chemical Pesticide-free Agriculture	x	x	x	x		x		x
TA 3: Genetic Resources and Agricultural Diversification	x	x	x	x		x		x
TA4: Innovation, Smart Agriculture, Digitalisation and Knowledge Sharing	x	x	x			x	x	x
TA 5: Animal Health and Welfare	x		x	x				x
TA 6: Local Food Systems and Rural Development	x	x	x	x				x
	Core theme: Forestry Value Chains							
TA 1: Forest resources	x			x	x			x
TA 2: Sustainable wood production chains	x				x			
TA 3: Keeping and further straightening of traditional and development of high-tech wood processing industries					x			
TA 4: Biomass and bioenergy	x			x	x		x	
TA 5: Paper-pulp technologies	x				x			
TA 6: Recycling and cascading system of wood and wood products use		x			x			
TA 7: Regional development	x				x			
TA 8: Forest services					x			

Strategic Thematic Areas/ Core Themes	EU's Strategies and action plans							
	European Green Deal							
	↑	↑	↑	↑	↑	↑	↑	↑
	Sustainable bioeconomy for Europe	New Circular Economy Action Plan	Farm to Fork Strategy	EU Biodiversity Strategy for 2030	New EU Forest Strategy for 2030	New Industrial Strategy for Europe	An EU Strategy for Energy System Integration	The new EU Strategy on Adaptation to Climate Change
	Core theme: Food Systems							
TA 1: Sustainable Food Production (PRODUCTION)	x	x	x					
TA 2: Power and information in the food system: strengthen the food environments and vulnerable actors in the food chains (FOOD CHAINS)	x		x					
TA 3: Research, innovation, technology and investments for future sustainable food systems (RESEARCH)	x	x	x	x				
TA 4: Promoting sustainable food consumption and the shift to healthy, sustainable diets (CONSUMERS)			x					
	Core theme: Bioenergy and New Value-added Materials							
TA 1: Bioenergy and New Value-added Materials	x	x	x	x		x	x	x
	Core theme: Advanced biochemical and biomaterials							
TA 1: Availability of sustainable feedstocks from agricultural residues and food industry	x	x	x		x			x
TA 2: Chemical and enzymatic transformation of biomass	x	x	x	x	x	x		x
TA 3: Production of bioactive compounds	x	x	x	x	x	x		x
TA4: Production of bio-based chemicals and materials	x	x	x	x	x	x	x	
TA 5: Innovative high-value biobased products	x	x			x	x		

Strategic Thematic Areas/ Core Themes	EU's Strategies and action plans							
	European Green Deal							
	↑	↑	↑	↑	↑	↑	↑	↑
	Sustainable bioeconomy for Europe	New Circular Economy Action Plan	Farm to Fork Strategy	EU Biodiversity Strategy for 2030	New EU Forest Strategy for 2030	New Industrial Strategy for Europe	An EU Strategy for Energy System Integration	The new EU Strategy on Adaptation to Climate Change
TA 6: Blue economy in sustainable biochemical production	x	x	x	x				
	Core theme: Freshwater-based Bioeconomy							
TA 1: Freshwater-based Bioeconomy	x	x	x	x				x
	Core theme: Bioeconomy Education							
TA 1: Bioeconomy Education	x	x	x	x	x	x		x

Legend: x complementarity and interaction none

Source: author's construction.