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Blue Economy: Sustainable Development Factor in the Regions Adjacent to the Danube

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Abstract: The blue economy is an essential pillar for the sustainable development of the Danube regions, capitalizing on the economic potential of the waters and associated ecosystems through practices that protect the environment. It stimulates the creation of green jobs, innovation and regional connectivity. The Danube Region integrates the principles of the blue economy through several strategic directions and concrete initiatives that will be analyzed in this research. The region benefits from strategic support and European funds dedicated to the Danube basin that can contribute to sustainable economic and social development and environmental protection. The work represents a continuation of previous research in this field, and the methods used lead to important results for investors, entrepreneurs and other stakeholders interested in prospecting the European blue economy.

Keywords: Strategy; Economic Development; Environmental Protection

1. Introduction

The blue economy is a model of economic development based on the sustainable use of aquatic resources, so that economic growth is compatible with environmental protection and the well-being of communities. In the case of the regions adjacent to the Danube, this concept has a particular importance, since the river constitutes one of the most important natural and economic resources of Europe.

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The Danube crosses ten states and represents a strategic corridor for transport, trade, biodiversity, tourism and the production of renewable energy. In Romania, the river influences the economic development of numerous counties: Caraș-Severin, Mehedinți, Dolj, Olt, Teleorman, Giurgiu, Călărași, Ialomița, Brăila, Galați, Tulcea and Constanța.

2. The Concept of Blue Economy

The concept of the blue economy was promoted in the early 2010s by the Belgian economist Gunter Pauli, through the work *The Blue Economy: 10 Years, 100 Innovations, 100 million Jobs* (2010), in which he proposed an economic model inspired by the functioning of natural ecosystems, based on the efficient use of resources and the elimination of waste. Subsequently, the concept was taken up and developed internationally, especially after the UN Conference Rio+20 (2012), being associated with the sustainable use of marine and aquatic resources for economic growth, job creation and ecosystem protection. Currently, the European Commission defines the blue economy as the set of economic activities directly or indirectly linked to the seas, oceans and coastal areas – such as maritime transport, fishing, aquaculture, port activities, shipbuilding, offshore renewable energy and marine biotechnologies – carried out in accordance with the principles of sustainable development and the European Green Deal.

3. The Importance of the Danube for Regional Development

The Danube is the second longest river in Europe and one of the most important natural corridors for transport, energy and economic cooperation, connecting Central Europe with the Black Sea. The Danube basin brings together over 100 million inhabitants from 14 countries and constitutes a strategic space for regional development, facilitating trade, mobility and European economic integration. By being included in the TEN-T trans-European transport network, the Danube contributes to the development of multimodal transport and the modernization of port infrastructure, playing an essential role in reducing logistics costs and emissions generated by road transport.

From a sustainable development perspective, the river offers important opportunities for the valorisation of natural resources through activities such as inland navigation, tourism, fishing, aquaculture and the production of renewable energy, all carried out

in compliance with the principles of environmental protection. At the same time, the Danube is a central element of the European Union Strategy for the Danube Region (EUSDR), which aims to strengthen cross-border cooperation in areas such as transport, environmental protection, economic development, innovation and increasing regional competitiveness. For Romania, the Danube is of particular importance through the development of the ports of Galați, Brăila and Tulcea, by connecting them to European markets and by its proximity to the Danube Delta, one of the most valuable biosphere reserves in the world, which provides premises for the development of a competitive and sustainable blue economy.

The Danube regions benefit from numerous advantages: international river transport; access to European markets; high tourism potential; fisheries resources; exceptional biodiversity; hydropower production; opportunities for investment and innovation.

4. Blue Economy Areas in the Danube Region

4.1. Water Transport

Water transport on the Danube is one of the pillars of the European blue economy, recognized for its ability to transport very large volumes of goods with low energy consumption and significantly lower greenhouse gas emissions than road transport. The river is part of the Rhine-Danube Corridor of the Trans-European Transport Network (TEN-T), facilitating the connection between Central and Eastern Europe and the Port of Constanta, one of the main access points to the Black Sea and international markets. According to the Danube Commission, the Romanian sector of the Danube records some of the highest traffic volumes in the Danube basin, and in 2023 the Danube-Black Sea Canal transported approximately 23.4 million tons of goods, while the Sulina Canal recorded approximately 16.4 million tons, values that highlight Romania's strategic role in European river transport.

At the European Union level, inland waterway transport experienced a recovery in 2024, with the volume of goods expressed in tonne-kilometres increasing by 4.5% compared to the previous year, after two consecutive years of decline, confirming the growing importance of this mode of transport for European logistics chains. Metal ores, agricultural products, cereals, construction materials and petroleum products are among the main categories of goods transported on the Danube.

In addition to the economic advantages, maritime transport contributes to reducing road infrastructure congestion, reducing logistics costs and lowering carbon

emissions, being considered one of the most sustainable modes of transport for bulk and container goods. At the same time, the development of port infrastructure and multimodal transport in Danube ports, such as Galați and Brăila, strengthens regional economic competitiveness and facilitates Romania's integration into European and international trade corridors.

4.2. Sustainable Tourism

Sustainable tourism is one of the main areas of the blue economy, aiming at the responsible exploitation of natural and cultural resources, without compromising the integrity of aquatic ecosystems. In the regions adjacent to the Danube, and especially in the Danube Delta, this type of tourism contributes to the economic development of local communities by promoting ecotourism, nautical tourism, wildlife observation and the cultural heritage specific to the area. According to data from the National Institute of Statistics (INS), in 2024, 14.26 million arrivals and 30.19 million overnight stays were recorded in tourist reception structures in Romania, up by 4.5% and 3.5% respectively compared to the previous year, which confirms the development trend of the tourism sector.

Regarding the Danube Delta, one of the most important objectives of the blue economy in Romania, tourism operators reported an increase of approximately 15% in the number of tourists for 2024 compared to 2023, with the average length of stay remaining at approximately three nights of accommodation. The most popular destinations were Sulina, Sfântu Gheorghe, Crișan, Mahmudia and Dunăvățu de Jos, where the development of accommodation units and leisure services directly contributes to job creation and the diversification of the local economy.

The development of sustainable tourism, however, requires maintaining a balance between increasing the number of visitors and preserving biodiversity, by limiting the impact on natural habitats, using low-emission means of transport and involving local communities in the provision of tourism services. In this way, tourism becomes not only a driver of regional economic development, but also a tool for protecting the natural and cultural heritage of the Danube region, in line with the objectives of the European Union Strategy for the Danube Region and the blue economy.

4.3. Aquaculture and Responsible Fishing

Aquaculture and responsible fishing are fundamental components of the blue economy, contributing to food security, the economic development of coastal communities and the conservation of aquatic resources. The basic principle of these activities is the sustainable exploitation of fish resources, so that current needs are met without compromising the capacity of ecosystems to support future generations. In Romania, aquaculture is almost exclusively based on freshwater production, the main species farmed being common carp, trout, redfish, bream and sturgeon. According to the European Market Observatory for Fisheries and Aquaculture Products (EUMOFA), Romania produced approximately 11,000 tonnes of aquaculture products and approximately 7,000 tonnes of capture fisheries in 2023, ranking 17th in the European Union in terms of aquaculture production.

According to the European Aquaculture Platform, the Romanian sector has approximately 48,300 tons of production capacity and is characterized by the predominance of extensive fish farms, which in recent years have diversified their activity by integrating ecotourism, recreational fishing and education programs for the protection of biodiversity. Responsible fishing involves the application of catch quotas, compliance with prohibition periods, combating illegal fishing and restoring aquatic habitats, essential measures for maintaining fish stocks in the Danube and the Danube Delta. The development of sustainable aquaculture reduces pressure on natural resources, creates jobs in rural areas and ensures a constant source of high-quality protein, thus contributing to the objectives of the blue economy and the European Union Strategy for the Danube Region.

4.4. Renewable Energy

Renewable energy is one of the key components of the blue economy, contributing to the reduction of greenhouse gas emissions and the sustainable use of the natural resources of the Danube basin. The Danube Region has a high potential for the production of energy from renewable sources, especially through hydropower, but also through the development of wind, photovoltaic and biomass energy. Hydropower remains the main renewable source in Romania, representing approximately 34% of the national electricity production, and at the European Union level it provided approximately 30% of the electricity produced from renewable sources in 2024, playing an important role in stabilizing the energy system and integrating wind and solar energy.

The European Union Strategy for the Danube Region promotes investments in cross-border projects based on hydropower, solar energy, wind energy and biomass, with the aim of increasing energy independence and achieving European climate objectives for 2030. In Romania, the share of energy from renewable sources in gross final energy consumption reached 25.8% in 2023, and the national objective is to reach a share of 30.7% by 2030, in accordance with the Integrated National Energy and Climate Change Plan. The development of renewable sources in the Danube regions contributes to the diversification of the local economy, the creation of jobs in the green energy sector and the increase of energy resilience, strengthening the role of the blue economy as a model of sustainable development.

4.5. Biodiversity Protection

Biodiversity protection is one of the fundamental pillars of the blue economy, as maintaining healthy aquatic ecosystems supports economic activities such as fishing, aquaculture, tourism and shipping. The Danube Delta, included in the UNESCO World Heritage, in the Ramsar network and designated as a Biosphere Reserve, extends over approximately 647,000 ha and is home to over 1,200 plant species, approximately 300 bird species and 45 freshwater fish species, being one of the most valuable wetlands in Europe.

Within the Danube Delta Biosphere Reserve, there are 20 strictly protected areas, totalling 50,904 ha (approximately 8.7% of the reserve's surface area), created for the conservation of natural habitats and rare species, such as the common pelican (*Pelecanus onocrotalus*), the Dalmatian pelican (*Pelecanus crispus*), the Danube sturgeon and the Letea subtropical forest. The conservation of these ecosystems directly contributes to the sustainable development of the region by supporting ecotourism, restoring fish resources and maintaining ecosystem services, such as natural water purification and reducing the effects of floods. Thus, the protection of biodiversity is not only an environmental obligation, but also an investment in the economic competitiveness and resilience of communities in the Danube region.

5. The Benefits of the Blue Economy in the Danube Region

The benefits of the Blue Economy in the Danube Region are presented below.



Figure 1. The Benefits of The Blue Economy in The Danube Region – Own Processing

6. Case Study – Blue Economy in the Galați–Brăila Region: A Model of Sustainable Development in the Danube Region

The Galați–Brăila region represents one of the most relevant examples in Romania regarding the application of the principles of the blue economy, due to its strategic position on the maritime sector of the Danube and the direct connection with the Black Sea through the Sulina Canal. The two municipalities form an important logistic, industrial and port pole, having an essential role in river and maritime transport, international trade, the naval industry and the development of related services. The ports of Galați and Brăila are managed by the National Company “Administration of the Danube Maritime Ports” (CN APDM SA Galați), the authority responsible for the port infrastructure on the river-maritime sector of the Danube. The Port of Galați is the largest river-maritime port on the Danube and the second largest in Romania, benefiting from a unique position through the existence of both the European railway gauge (1,435 mm) and the broad gauge (1,520 mm), which facilitates the transport of goods from the Republic of Moldova, Ukraine and the states in the Caspian Sea area to the European Union markets.

A defining element of the blue economy is the development of sustainable transport. Compared to road transport, river transport generates lower carbon dioxide emissions and has lower logistics costs for large volumes of goods. In this context, the modernization of the port infrastructure in Galați and Brăila contributes both to increasing regional economic competitiveness and to achieving European objectives regarding the decarbonization of transport.

In recent years, significant investments financed by European funds have been implemented. One example is the Galați Multimodal Platform – Stage I project, through which the port infrastructure, rail connections and logistics facilities are modernized, the investment exceeding 236 million lei. The project aims to develop a multimodal terminal capable of integrating naval, rail and road transport, reducing operating times and increasing the attractiveness of the port for international economic operators.

In parallel, the Port of Brăila benefits from a large project to modernize the operating front on the Danube, with a total value of over 126 million lei, financed by the Transport Program 2021–2027 and the Cohesion Fund. The investments aim to improve the port infrastructure, increase navigation safety and develop the logistics capacities necessary for regional trade.

The blue economy in the Galați–Brăila region is not limited to port activities, however. The area has an important shipbuilding sector, represented by the shipyards in Galați and Brăila, ship repair activities, logistics services, multimodal transport and related industries. These activities generate thousands of jobs and contribute to regional economic development, stimulating private investment and the transfer of modern technologies.

From a sustainable development perspective, the region also benefits from the proximity of the Danube Delta, one of the most valuable wetlands in Europe. This advantage creates opportunities for the development of ecotourism, nautical tourism and recreational fishing, while respecting the principles of biodiversity conservation. Thus, the blue economy promotes the balance between the valorization of natural resources and the protection of aquatic ecosystems.

Development prospects are also favored by the inclusion of the region in the European Union Strategy for the Danube Region (EUSDR) and in the European transport corridor TEN-T, which facilitates access to European funding and cross-border cooperation projects. The modernization of port infrastructure, the digitalization of logistics services, the development of multimodal transport and the use of green technologies can transform the Galați–Brăila region into one of the main logistics and economic hubs of the Danube basin, simultaneously contributing to economic competitiveness, environmental protection and increasing the quality of life of local communities.

7. Conclusion

The blue economy represents a strategic direction for the sustainable development of the regions adjacent to the Danube. The responsible exploitation of the river's resources can generate economic growth, jobs and investments, while contributing to protecting the environment and improving the quality of life. In the context of European policies regarding the Green Deal and the EU Strategy for the Danube Region, the implementation of the principles of the blue economy becomes an essential condition for the competitive and sustainable development of the riparian communities.

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