

INTERREG MED Programme

2014-2020

BLUEfasma

*Empowering innovation capacity of SMEs, maritime clusters and networks
in MED islands and coastal areas to support blue circular economy growth
in fishing/aquaculture*

Deliverable 5.3.3 - BLUEfasma White Paper

Partner(s) responsible	IMC Foundation - International Marine Centre
Partner(s) involved/ revision	All Partners
Status: (draft, final, new, etc.)	final
Distribution: (internal, external)	internal

Date: 31/03/2022

BLUEfasma White Paper - Proposing solutions to overcome barriers and support blue Circular Economy in Mediterranean fishery and aquaculture sectors

Who we are:

BLUEfasma project is co-financed by the European Regional Development Fund through the Interreg MED Programme 2014-2020 in the framework of the third call for proposals for modular projects, under the Priority Axis 1.1 “To increase transnational activity of innovative clusters and networks of key sectors of the MED area”.

BLUEfasma integrates and implements Circular Economy (CE) principles in the key Blue Growth sectors of fishing and aquaculture to benefit Mediterranean insular and coastal areas in an innovative way. The project tackles the transnational challenge of the continual depletion of natural resources and the below-EU average of the Mediterranean Circular Economy innovation performance in fishing and aquaculture. Its overall objective is to empower innovation capacity of SMEs, maritime clusters, networks and protected areas to boost blue Circular Economy growth in insular and coastal areas.

Why a White Paper?

This White Paper presents the BLUEfasma Thematic Working Group’s (TWG) work in support of the transition towards a Circular Economy in fisheries and aquaculture in the Mediterranean area. This White Paper will be accompanied by a set of Policy Recommendations developed as a BLUEfasma Capitalization output. The document explores the relationship between the principles of Circular Economy, Blue Economy and Sustainable fisheries and aquaculture, through the analysis of relevant sources and dialogue between several players. The document has been drafted in a challenging context, especially for the fishery and aquaculture sectors, and it is intended as a contribution to ongoing reflections and barriers, as well as proposals for the transition to a sustainable, blue Circular Economy.

Table of contents

<i>Introduction</i>	<i>4</i>
<i>Towards a Sustainable Blue Circular Economy in EU fishery and aquaculture sectors .</i>	<i>6</i>
<i>The relevance of Circular Economy and Sustainable Blue Economy in the EU countries</i>	<i>8</i>
<i>A legislative overview on Circular Economy in the sustainable fishing and aquaculture sector</i>	<i>14</i>
<i>An analysis of barriers and drivers on Circular Economy in the sustainable fishing and aquaculture sector.....</i>	<i>19</i>
Cultural/Social elements	20
Institutional/Governance elements	21
Economic and Market elements	33
Technological (including Environmental)	34
<i>Proposals to foster CE in Sustainable fishing and aquaculture</i>	<i>35</i>
<i>References.....</i>	<i>38</i>

Introduction

Fisheries and aquaculture play an important role in achieving food security, livelihoods and economic development.

Overall, EU marine living resources - the sum of the primary sector, processing and distribution of fish products - generated a gross value added (GVA) of about €19.1 billion in 2018 (a 29% increase compared to 2009) and employed 538,350 people (EC, 2020).

The EU is the fifth-largest producer of fishery and aquaculture products (behind China, Indonesia, India and Vietnam), covering around 3% of the global production (EUMOFA, 2021).

The European Commission report on the Common Fishery Policy (2020) indicated that the average person living in the EU consumes 24.4 kg of fish or seafood per year (4 kg more than in the rest of the world), with a minimum in Hungary (4.8 kg per person per year) and a maximum in Portugal (56.9 kg per person per year).

Three quarters of the fish or seafood consumed in the EU countries come from wild fisheries, while the rest comes from aquaculture. Moreover, the EU is a net importer of fisheries and aquaculture products, with the fish-processing sector very dependent on the global fish market (EC, 2020). In 2019, the EU's self-sufficiency rate (the ratio between own production -catches plus aquaculture - and total apparent consumption) stood at 41.2%, reflecting a downward trend of EU catches and a subsequent increase in imports (EUMOFA, 2021).

The internal production of the EU covers more than two thirds of its consumption of pelagic fish and more than half of its consumption of molluscs. Meanwhile, EU countries are more dependent on external sourcing for salmonids, crustaceans and other fish (EC, 2020).

In addition to contributing an average of over € 1.4 billion annually to food and nutritional security, sustainable agriculture and fisheries, the EU is also the leading world trader of fisheries and aquaculture products in terms of value. In 2020, the EU trade in fisheries and aquaculture products (the combined amounts of imports and exports with third countries) totalled € 31.17 billion and 8.72 million tonnes (EUMOFA, 2021).

The counterpart of this situation is the overexploitation of some wild fish stocks whose catch exceeds the maximum sustainable yield and a generalised depletion of fish stocks (EC, 2020).

The overall demand for natural resources has increased dramatically and resource depletion is worsening, without any signs of trend inversion.

EU fisheries and aquaculture are facing particular challenges related to the overexploitation of wild fish stocks, the discarding of unwanted fish, the competition for space and markets, and administrative constraints for aquaculture (Bell et al., 2018).

Moreover, the growth of human population and the subsequent increase in seafood demand, as well as climate change, exacerbate the impacts and pressure on water resources, thus posing challenges to the sustainability of fisheries and aquaculture sectors.

Therefore, fishing and aquaculture operators must face multiple goals: decrease dependency on imports, reduce stock depletion and improve sustainability. It appears clear that the sector must simultaneously intensify its productivity as well as its environmental performance (Rigueiro et al., 2021).

The current challenges in terms of governance, spatial planning, economic and market issues, ecological and environmental concerns as well as the globalisation of the production market have highlighted the need for a holistic approach which ensures that fisheries and aquaculture are developed in a way that reconciles all the principles of sustainable development while taking into account the complexity and specificities of each single EU territory.

In this challenging framework, the Circular Economy model could respond to the growing need to move beyond the “take-make-consume and dispose” model, and at the same time bring enormous environmental and social benefits, as well as opportunities for business and economy.

In fact, our current economic model is based heavily on the extraction of natural resources for products which are used by the consumer and too often thrown away before necessary. This model is wasteful and depletes natural resources at a faster rate than they can be regenerated.

At the same time, this model produces large amounts of pollution from non-biodegradable materials such as plastics, to toxic liquids and greenhouse gases, known for their impact on climate change.

In contrast, the Circular Economy is a model of production and consumption which aims to move closer to the cyclical processes in nature where waste from one species is broken down, for example into nutrients, and used by another.

It prioritises the use of renewable and sustainably sourced materials, facilitating their post-use composting to regenerate the natural systems.

A Circular Economy model could thus be a reliable tool to improve environmental performance through an efficient use of resources and a reduction of the total amount of waste produced, especially in the aquaculture sector.

Despite several pieces of legislation and the economic support addressed at achieving sustainability in several sectors, various constraints inhibit sustainable development and the transition toward Circular Economy in the EU economic sectors, including those of fishing and aquaculture.

Towards a Sustainable Blue Circular Economy in EU fishery and aquaculture sectors

Despite the recent popularity of the two terms of “Circular Economy” and “(Sustainable) Blue Economy”, confusion remains due to the past use of these terms associated with other definitions with different relevant implications.

In her 2017 paper, Kirchherr analysed 114 definitions of **Circular Economy**. Several papers (i.e., Kirchherr et al., 2018; Khitous et al., 2020; Grafstrom and Aasma, 2021; Zarbà et al., 2021) highlighted the long elaboration process in the economic studies that led to the definition of the concept of Circular Economy. The first studies on the improvement of efficiency in the production system started in the '60s (Boulding, 1966) and the '70s (Commoner, 1971; Stahel and Ready-Mulvey, 1976) after the petrol crisis of 1973-1974. Pearce and Turner (1990) were the first to “underline the connection between economy and environment” (Zarba et al., 2021) using the term “Circular Economy”, attempting to model a closed-loop economy by applying a material balance model (Khitous et al., 2020).

The term “Circular Economy” reached its current popularity in 2011, when the Ellen Mac Arthur Foundation provided their definition of Circular Economy as a restorative and regenerative system where financial, manufactured, human, social or natural capitals are rebuilt through an enhanced and continuous flow of goods and services based on the regeneration of technical and biological materials. Providing an upgrade in the value of secondary raw materials implies a re-thinking and re-designing of the goods that could be repaired, reused, and remanufactured, therefore creating an economy based on the provision of services rather than the procurement of goods. As explained in the Ellen Mac Arthur Foundation website, a Circular Economy looks at “upstreaming solutions” to avoid or prevent the production of waste, aiming at reducing inefficiency in the use of resources, waste and pollution. In this perspective, recycling is an “end-of-pipe” activity that should be minimised as the economic system becomes fully circular rather than linear.

Throughout this document, we refer to the EU definitions. In the COM (2014)398 final, “Towards a Circular Economy: A zero waste programme for Europe”, Circular Economy systems are defined as “systems that keep the added value in products for as long as possible and eliminate waste. These systems keep resources within the economy when a product has reached the end of its life, so that they can be productively used again and again and hence create further value. Transition to a more Circular Economy requires changes throughout the value chains, from product design to new business and market models, from new ways of turning waste into a resource to new models of consumer behaviour. This implies full systemic change, and innovation not only in technology, but also in organisation, society, finance methods and policies. Even in a highly Circular Economy some elements of linearity will remain as virgin resources are required and residual waste is disposed of” (p.2).

In the COM (2021)98 “A New Circular Economy Action Plan”, additional details and more challenging elements are added, due to the development of research and technology, the strong ongoing digitalisation process, the growing awareness of the critical state of the environment: “For citizens, a Circular Economy will provide high-quality, functional and safe products which are efficient and affordable. These products will last longer and will be designed for reuse, repair,

and high-quality recycling. A whole new range of sustainable services, product-as-service models and digital solutions will bring about a better quality of life, innovative jobs and upgraded knowledge and skills (p.2)". On the other hand, "Building on the single market and the potential of digital technologies, the Circular Economy can strengthen the EU's industrial base and foster business creation and entrepreneurship among SMEs. Innovative models based on a closer relationship with customers, mass customisation, a sharing collaborative economy, and powered by digital technologies, (the internet, big data, blockchain and artificial intelligence), will accelerate both circularity and the dematerialisation of our economy and make Europe less dependent on primary materials. This process starts at the very beginning of a product's lifecycle: smart product design and production processes can help save resources, avoid inefficient waste management and create new business opportunities (p.2)".

The term "**Blue Economy**" appeared in the recent past decades, but this term has been used for several different concepts related to an economic system which is more compatible with the environment. In Wenhai et al. (2019), Blue Economy referred to the "economy coping with the global water crisis" (McGlade et al., 2012); Gunter Pauli (2009) adopted the term Blue Economy as a synonym of "innovative development economy", a sustainable business model living in harmony with nature. Behnam (2012) considers a Blue Economy as "the development of the marine economy", referring to a lifestyle that coexists with ocean, uses maritime resources and maintains a sustainable relationship with the ocean. The same authors reported that in some non-EU countries, Blue Economy is a synonym of "marine economy". In the report "Green Economy in the Blue World" (2012), UNEP and other international institutions consider the "Blue Economy" as a part of the "green economy". These institutions address reducing climate change with low-carbon technologies in shipping, fishing, marine tourism and other ocean-related economic activities. According to the World Bank and the United Nations Department of Economic and Social Affairs (2017), the Blue Economy includes "the range of economic sectors and related policies that together determine whether the use of ocean resources is sustainable". Furthermore, it "seeks to promote economic growth, social inclusion, and the preservation or improvement of livelihoods while at the same time ensuring environmental sustainability of the oceans and coastal areas" (p. IV). A Blue Economy has diverse components, including established traditional ocean industries such as fisheries, tourism and maritime transport. Moreover, a Blue Economy includes new and emerging activities, such as renewable offshore energy, aquaculture, extractive seabed activities, and marine biotechnology and bioprospecting" (p. IV).

As for the Circular Economy term, here we will refer to the EU definition of Sustainable Blue Economy. In the COM (2012) 494 final "Blue Growth opportunities for marine and maritime sustainable growth", the European Union considers Blue Growth as "an initiative to harness the untapped potential of Europe's oceans, seas and coasts for jobs and growth". All the economic activities related to the sea carried out in the EU member countries are included under the term "Blue Growth". Despite the similarity with the term "Green Economy" and the UNEP statement, "Blue Growth" focused only on economic aspects, with no specific attention given to environmental consequences. Only recently, after the adoption of the European Green Deal, the EU revised the concept of Blue Growth. With the COM (2021) 240 "Communication on a new

approach for a sustainable Blue Economy in the EU. Transforming the EU's Blue Economy for a Sustainable Future”, the EU defines the transition from “Blue Growth” to a “Sustainable Blue Economy” providing “a systemic view that integrates ocean policy into our new European economic policy”.

The relevance of Circular Economy and Sustainable Blue Economy in the EU countries

As previously defined, the **Blue Economy (BE)** refers to all activities that are based on, or related to, the oceans and seas. This label therefore includes activities linked to fishing and aquaculture (marine living resources) as well as those related to port activities, shipbuilding, maritime transport, coastal tourism and marine renewable energy.

In 2018, the contribution of the Blue Economy to the overall EU-27 economy was 1.5% in terms of **Gross Value Added (GVA)** and 2.3% in terms of employment, with a contribution that varies widely across countries. The BE sector Marine living resources generated GVA of about €19.1 billion, with a contribution of 10.8% on the EU Blue Economy GVA (European Commission. The EU Blue Economy Report. 2021).

The graph below shows the contribution of the Blue Economy and the share the sub-category Living Resources (fishing and aquaculture) in terms of **Gross Value Added (GVA)** on the National GDP of the EU-27 countries included in the Cooperation area of Interreg MED in 2018.

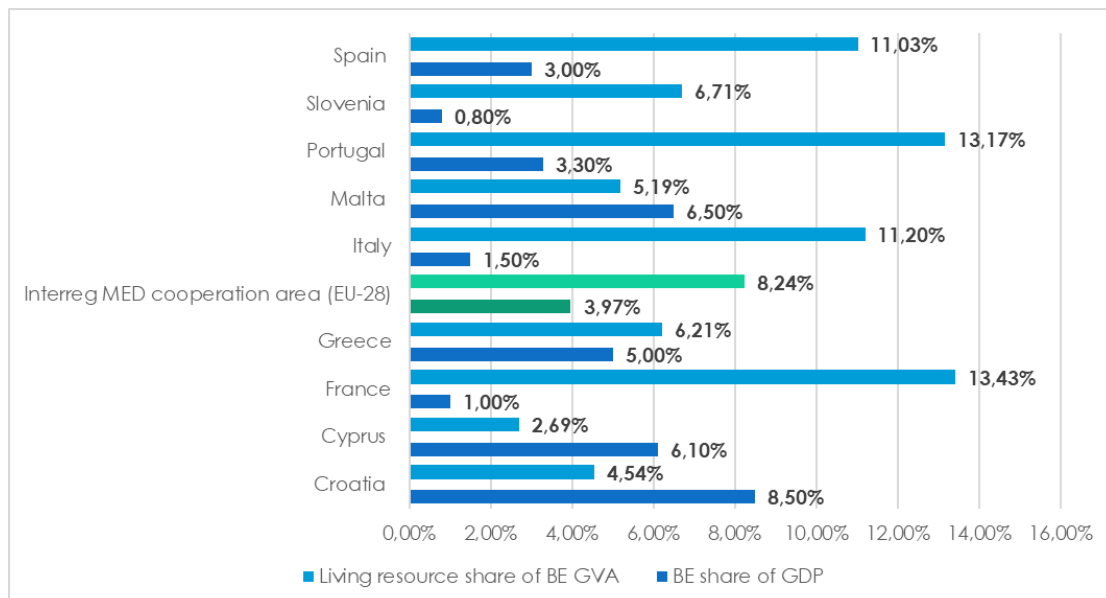


Image 1 Contribution of the Blue Economy in EU-27 Interreg MED area countries to national GVA and share of the Living Resource related activities (2018) (European Commission. The EU Blue Economy Report. 2021)

In those countries where the contribution of the BE to GDP is lower in relative terms, the weight of fishing and aquaculture activity is particularly important (Italy, Spain, Portugal, France among others).

It is interesting to observe the same scenario from the point of view of **those employed in the sector**.

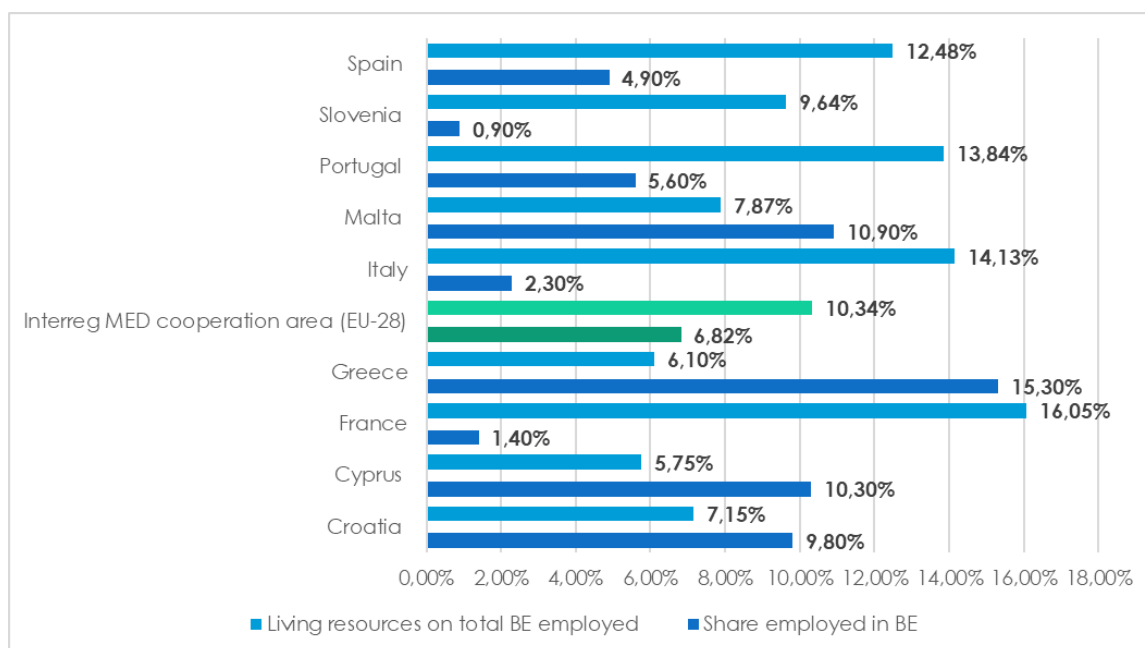


Image 2 Employed in Blue Economy in Eu-27 Interreg MED area countries and share of workers in Living Resource activities (2018) (European Commission. The EU Blue Economy Report. 2021)

In this second graph, the percentage of people employed in BE and the percentage of people working in fishing and aquaculture within the sector is analysed. The analysis shows a similar picture to the previous graph.

However, for the purposes of this document, it will be relevant to investigate the *Living Resources* category and thus **fisheries and aquaculture**.

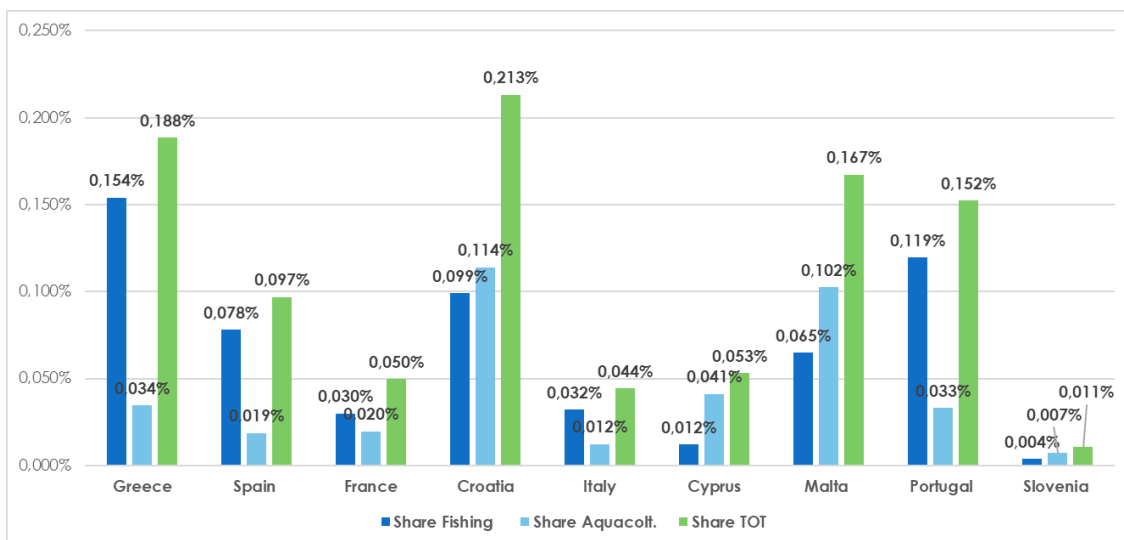


Image 3 Contribution of fisheries and aquaculture GVA to national GDP in EU-27 Interreg MED area countries (2018) (European Commission. The EU Blue Economy Report. 2021 and Eurostat)

The graph above shows the **contribution of the sectoral category to the national GDP of the EU-27 countries** of the Interreg MED cooperation area. In general, the contribution is not high in any case. To complete the analysis, however, some absolute values should also be taken into account:

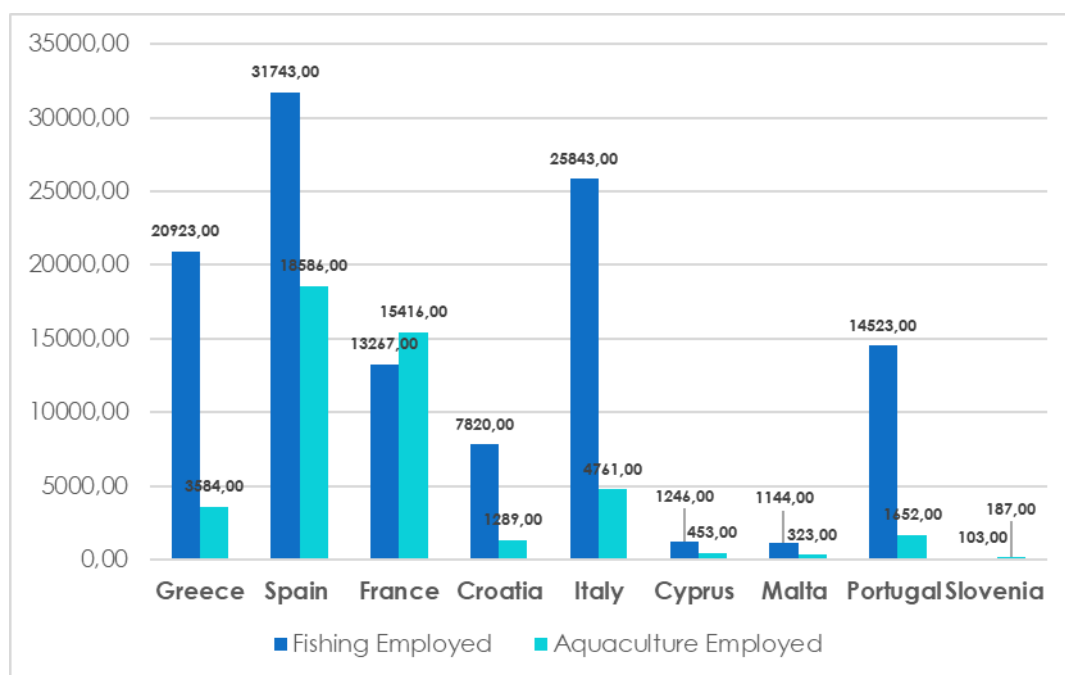


Image 4 Number of employed in fisheries and aquaculture in EU-27 Interreg MED area countries (2018) (European Commission. The EU Blue Economy Report. 2021)

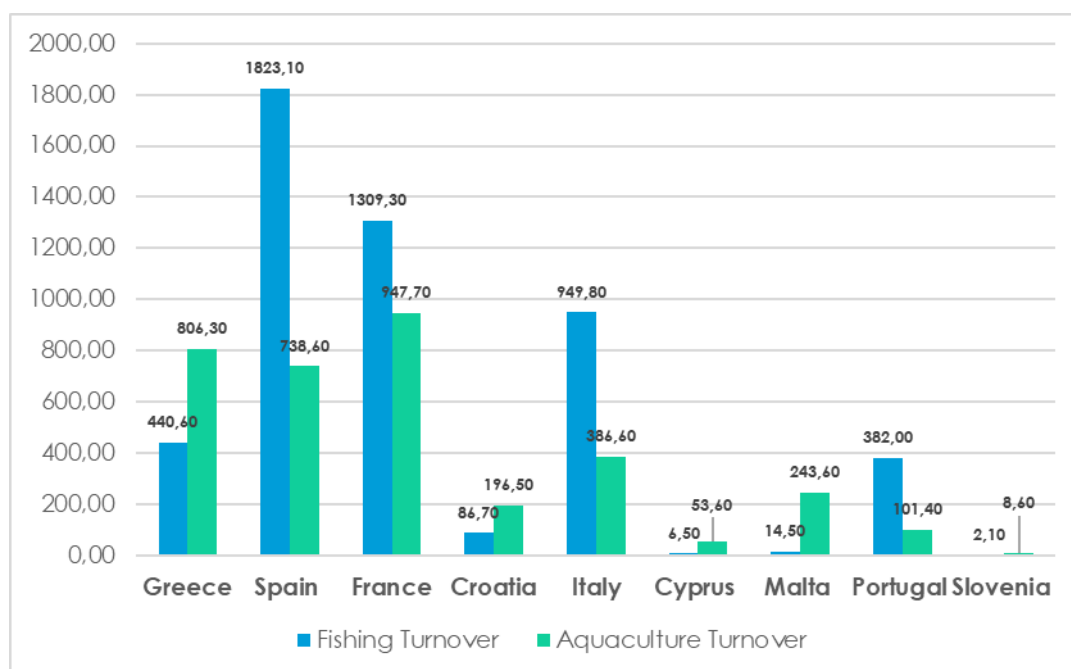


Image 5 Turnover of fisheries and aquaculture activities in EU-27 Interreg MED area countries (2018) (European Commission. The EU Blue Economy Report. 2021)

The first graph above shows the **number of employees** in the sectors in 2018, while the next graph shows their magnitude in terms of turnover.

What emerges is a picture of two sectors whose impact is undoubtedly minimal in relation to national income and to some extent also within the BE of individual countries. In the light of this, the graph below may be somewhat surprising:

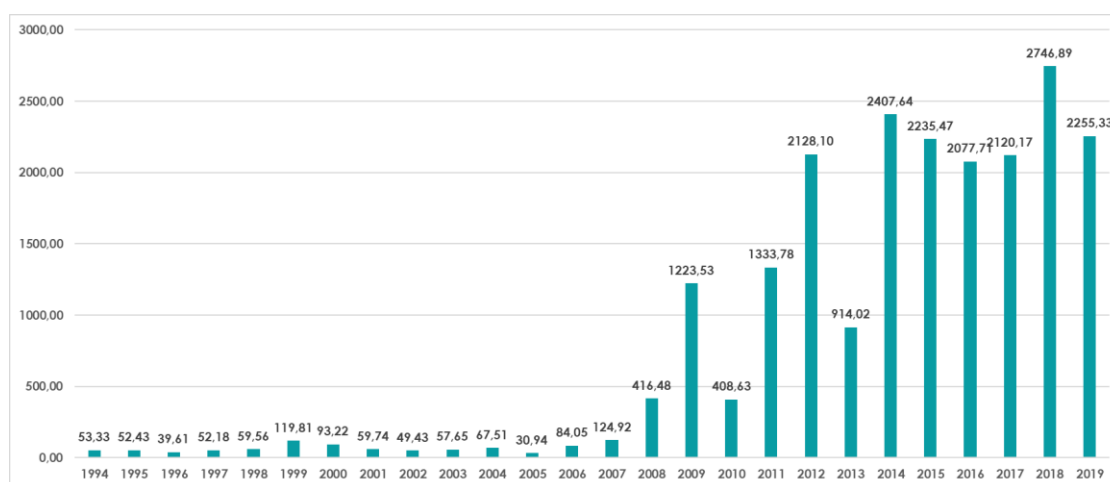


Image 6 Fish production (capture and aquaculture) in EU-27 Interreg MED cooperation area countries (mln tons) from 1994 to 2019 (Food and Agriculture Organization of the United Nations, online)

The figure shows the **trend in the production of fish** (expressed in millions of tonnes) **reared and caught** from 1994 to 2019. During the last decade or so, production has increased considerably within the countries of the Interreg MED area. An increase that can be justified by

various factors (cultural changes, increased demand for fish, the rise of aquaculture), however one looks at it, it necessarily translates into a greater impact on ecosystems.

How do these observations fit into a framework that takes into account the application of the circular economy in the sectors under investigation? Contrary to what can be said about the Blue economy as a whole, studies on the topic often focus on a qualitative rather than a quantitative approach, so the available data are insufficient to paint a clear picture of the implementation of Circular Economy practices in fisheries and aquaculture.

For the purpose of this document, which is intended to provide an overview of the main drivers and barriers to the implementation of CE, however, it may be useful to start by understanding how much and how the principles of the Circular Economy are transposed by individual countries. In other words, it is important to analyse the state of the art of the implementation of EC practices regardless of the sector. The chart below provides a good overview of this:

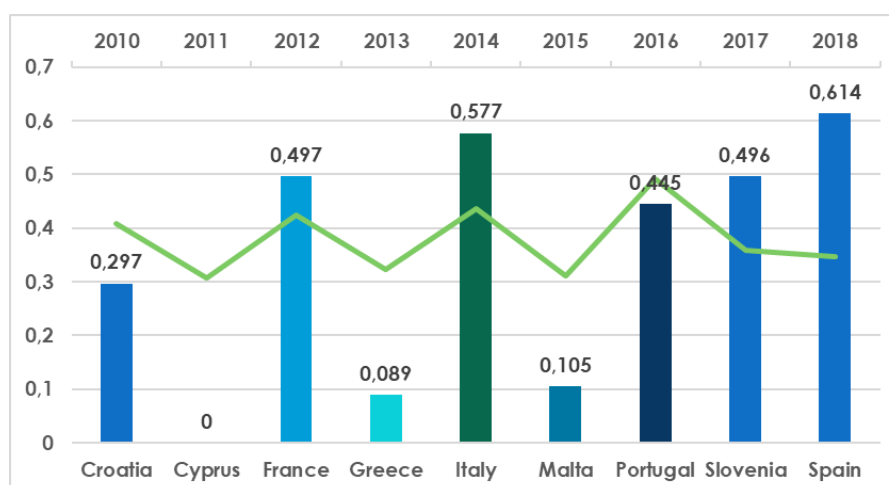
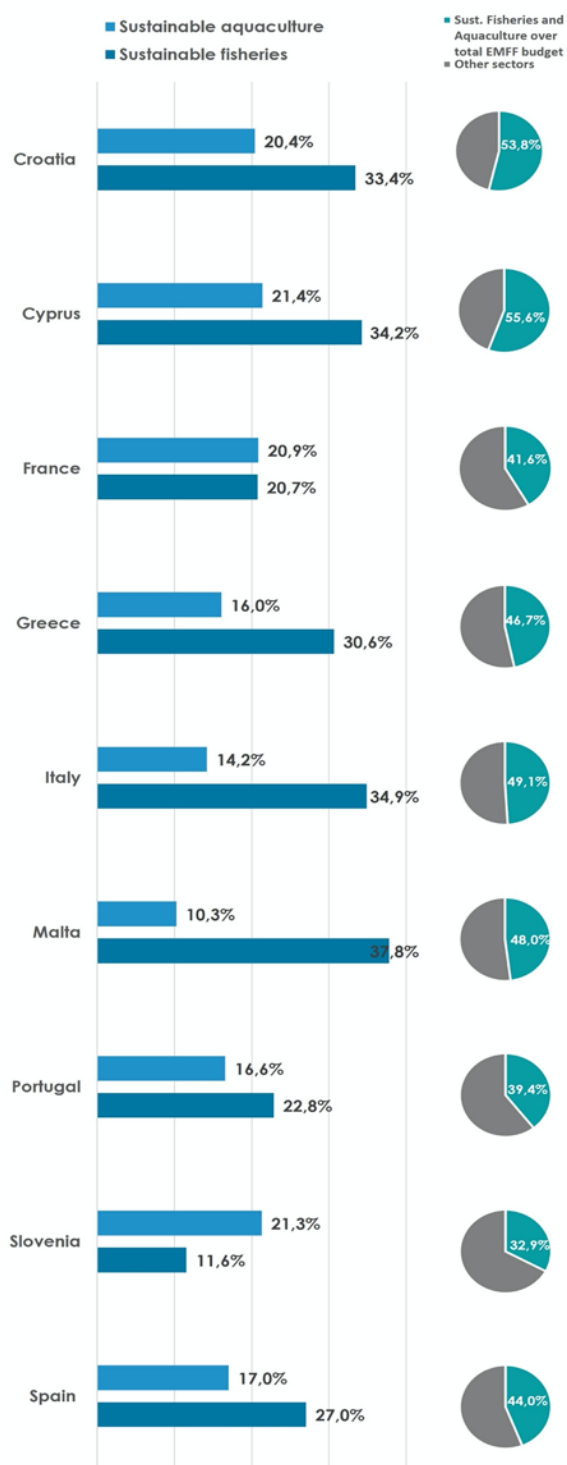


Image 7 EU-27 Interreg MED cooperation area countries' Index of development of circular economy in (2018) and average trend from 2010 to 2018 (Mazur-Wierzbicka, E. Towards Circular Economy—A Comparative Analysis of the Countries of the European Union. Resources 2021, 10, 49. <https://doi.org/10.3390/resources10050049>)

The figure compares the different countries in relation to their **own Index of Development of the Circular Economy (IDCE)**, a synthetic measure that, considering several sub-factors (generation of municipal waste per capita, recycling rate of municipal waste, recycling rate of packaging waste by type of packaging etc), provides a value with which to try to make some reasoning. Specifically, the graph compares the IDCE for 2018 in the countries of the cooperation area. At the same time, the trend from 2010 to 2018 of the average IDCE is shown. What is clear is that the picture is very uneven, with large differences between countries. But perhaps more importantly, the average IDCE is struggling to settle on an increasing trend.



Another aspect that can be analysed in order to try to explore which path is being followed, also from a quantitative point of view, is that concerning **investments in sustainable fishing and aquaculture**. This is where the figures on the spending priorities for the 2014-2020 programming cycle of the European Maritime and Fisheries Fund (EMFF), the structural fund directly dedicated to financing the development of the blue economy, come in handy. Of the six priorities, two are targeted at sustainable fisheries and aquaculture. Clearly, the data also includes activities that are not directly related to the circular economy, but they are a good compass for understanding the strategic importance of sustainability. The infographic on the left shows for each country the allocation of EMFF resources to the sustainable fisheries and aquaculture spending priorities and the contribution of the two joint priorities to the total EMFF budget allocated. What can be seen is that, on average, almost one half of the funds are allocated to sustainable fisheries and aquaculture, indicating a strategic importance for the EU. Furthermore, it can be noted that, with the exception of Slovenia and France (the latter distributing almost the same share between fisheries and aquaculture), all EU-27 countries in the Interreg cooperation area allocate more resources to sustainable fisheries.

Image 8 EMFF Contribution – 2014-2020 programming period – per sustainable fisheries and aquaculture priorities in EU-27 Interreg MED cooperation area countries (European Commission - Facts and Figures on the Common Fisheries Policy- Basic statistical data 2020)

A legislative overview on Circular Economy in the sustainable fishing and aquaculture sector

In order to understand how the European Union is promoting the adoption of greater circularity in the fishery and aquaculture sectors, it is necessary to make a comparative analysis of several documents. On the one hand, the circularity theme is part of a body of existing directives and regulations aimed at the environmental improvement of marine waters and of their management. On the other hand, the theme goes along with a series of measures that, under the impetus of the European Green Deal, see a greater integration of environmental issues and the reduction of climate-changing emissions within the EU economic system, both in terms of production and consumption.

Aquaculture plays a fundamental role in the EU strategies aiming at achieving independence in the production of raw materials, especially, the production of protein sources. However, there is a pressing demand to minimise or eliminate the impacts that aquaculture generates as it grows. Indeed, the growth of aquaculture is a way to compensate for the reduction in free fishing, especially for the edible species with the greatest market demand that registered a notable reduction of their stocks. Aquaculture should also reduce the side effects on other species.

The Water Framework Directive (2000/60) and the Marine Strategy Framework Directive (2008/56) aimed to promote the protection and preservation of marine ecosystems while promoting their sustainable use. These two directives require Member States to identify the set of measures to be taken to enable marine waters to achieve good quality status by reducing sources of pollution and managing human activities in an ecosystem-based approach. As a result of these measures, there has been an increased focus on reducing the environmental impacts of aquaculture activities, particularly those arising from fish excreta and associated wastewater. However, in order to achieve both the objective of progressively increasing the capacity of Member States to produce protein from fish, and to minimize the impacts of this activity, it is necessary to think about the physical space in which aquaculture and fishing take place. In light of these trends, and considering the need to reduce conflicts between different uses of maritime spaces, maritime spatial planning has emerged as a tool to address such challenges. The Maritime Spatial Planning Directive (COM 2014/89), asks Member States to regulate the spaces and uses of marine waters, considering economic, social and environmental aspects. This should contribute in particular to the sustainable development and to the “preservation, protection and improvement of the environment, including resilience to climate change impact”.

The Common Fisheries Policy is the main tool for supporting fishery policies and promoting sustainability. For example, in 2015 the landing obligation was introduced to eliminate discarding and to encourage fishermen to fish more selectively and to avoid unwanted catches. The measure has been fully in force since January 2019. The European Maritime and Fisheries Fund (EMFF) is the program fund for direct supporting sustainable aquaculture.

This is the background of the new EU policy on bio-economy (COM 2012/60). This economy refers to all production sectors based on bioresources. Bioeconomy includes both traditional sectors such as agriculture, fisheries and aquaculture as well as highly innovative sectors that rely on bio-based resources to replace the more traditional oil-based resources, for example in the production of plastics. With the 2018 update of the Bioeconomy Strategy and the related action plan, the underlying objectives of this measure are highlighted. An example is the need to secure food and reduce dependence on resources from outside the EU, through the valorisation of bio-based raw materials of EU origin. Last but not least, this measure aims to create new businesses and jobs in strategic sectors for the EU economy, while reducing the impact on the environment and climate. Among the various sectoral objectives included in the document, there is the reduction of waste in the fishery and aquaculture sector, along the entire production chain.

After having focused on the policies of reducing climate-altering emissions on the replacement of fossil fuels with renewable ones and on energy efficiency¹, the EU legislator saw the need to reduce the carbon and environmental footprint through an overall rethinking of the production and consumption system. This is how the first Circular Economy Package (COM/2015/0614) was implemented, aimed at promoting the minimisation of the use of fossil resources and virgin raw materials through an efficient use of secondary raw materials. These come from the recovery of energy and materials from waste, which in turn are minimised. The other aim is to reduce the EU's dependence on foreign countries for supplies of raw materials (including those needed to ensure food self-sufficiency) and to create new job opportunities and economic growth in environmentally friendly sectors.

The bio-economy sectors are very interested in the Circular Economy, since waste from animal production has numerous reuses both as a fertiliser and a biofuel. There are many points of contact between the two strategies.

With the release of the European Green Deal (COM 2019/640), many European policies are being revised, including those concerning fisheries and aquaculture or those that may have implications for these sectors such as the Common Agricultural Policy and the Common Fishery Policy. The European Green Deal aims to transform the European economy, making it more sustainable in environmental and social terms, through a more efficient use of resources and reduction of pollution. Another of its goals is to enable Europe to become the first climate neutral continent in 2050, using the key of sustainability to create value in an environmentally friendly way as a driver for the economic recovery of Member States.

The new Circular Economy Package (COM 2020/98) reinforces EU action in a number of strategic sectors, including those already included in the Bioeconomy Strategy and Action Plan. A strong commitment has been made to reduce food waste, to reduce the use of plastic and single-use

¹ An overview of the measures taken by the European Union to promote the reduction of waste through energy efficiency in consumption and production sectors as well as the correct use of renewable energy sources in order to achieve a reduction in climate emissions can be found here: <https://www.europarl.europa.eu/factsheets/en/sheet/68/energy-policy-general-principles>

items in the food sector, to promote greater sustainability in the application of nutrients and to stimulate the creation of a market for nutrients through a process of recovering waste from bioeconomy activities.

With the same purpose, several measures to exploit wastewater as a source of nutrients should be read. Some examples are the Water Reuse Regulation (2020/741) or the future Integrated Nutrient Management Plan. The first, aims at promoting the creation of unconventional water resources through the recovery and reuse of wastewater, and reducing the use of additional fertilisers through the exploitation of nutrients in wastewater. The second, aims at reducing nutrient losses by at least 50% and reducing fertiliser use by at least 20% by 2030. Furthermore, the revision of the Sewage Sludge Directive, which will promote the possibilities of phyto-purification and other natural means of nutrient removal (e.g. through algae), could be seen as a tool to promote bioeconomy activities.

Alongside these measures, a number of other documents review areas of Community policy with a view to increasing the link between environmental protection and economic growth. In all of these measures, there is a reference to the Circular Economy as a means of achieving efficient production – minimising the use of resources and maximising the recovery of resources from recovery and reuse – and low environmental impact, both in terms of emissions (climate-changing and otherwise) and waste production.

The Biodiversity Strategy 2030 (COM 2020/380), while aimed at nature conservation, has several chapters dedicated to productive activities, especially those of the bio-economy. Among the objectives, there is restoring marine ecosystems and ensuring appropriate protection, through greater control over the sustainability of fish and marine harvests and the introduction of zero tolerance towards illegal fishing practices. In the strategy it is highlighted that the full implementation of the Birds and Habitats Directives, the Marine Strategy Framework Directive and the Common Fisheries Policy is necessary, as well as the full adoption of maritime spatial plans at national and regional levels. The European Commission will propose a new action plan for the protection of fishery resources and marine ecosystems (planned for spring 2022), including the introduction of new limits on fishing gear and, in particular, on nets that are potentially harmful to marine ecosystems. This includes the introduction of measures to eliminate or reduce by-catches of endangered species. The protection of endangered species will be promoted beyond EU borders, through WTO negotiations to eliminate subsidies that encourage fishing techniques that are harmful to stocks and ecosystems. Appropriate fishery management measures will be adopted by marine-protected areas in accordance with conservation objectives and the best advice from research. The Biodiversity Strategy emphasises the need to apply the polluter-pays principle and to take into account measures of the product environmental footprint, calling for a single, international system of natural capital accounting.

The Farm-to-Fork strategy takes up and reinforces some of the points made earlier, with a focus inversion, starting from the need to promote greater sustainability in the core sectors of the bioeconomy, such as agriculture, livestock farming, fisheries and aquaculture. The aim is to ensure greater protection of the environment, product quality and consumer health through a

comprehensive approach that starts with production and ends with the consumer, with a strong circular approach aimed at reducing waste, particularly of food. This will ensure the food needs of EU citizens through a greater use of EU raw materials, at affordable prices, while ensuring a neutral or positive environmental impact. Farm-to-Fork stresses that not all the opportunities that the circular bio-based economy can bring to agriculture and related sectors have yet been exploited. This is particularly true in the production of biofertilizers, protein feed, bioenergy (i.e., in the production of renewable energy through anaerobic digestion,) and biochemical products. However, circular business models are needed, including those in food processing and retail. Also, the strategy stresses that aquaculture has a reduced carbon footprint compared to farming, but that it is necessary to accelerate the transition to sustainable aquaculture. This could be accomplished through the reform of the Common Fisheries Policy (including the development of producer organisations) and the implementation of advanced traceability systems, such as the use of digital catch certificates to strengthen measures preventing the marketing of illegal fish products. Similarly, it is important to invest in new products, such as seaweed, which could become an important source of sustainable protein.

Both the Biodiversity and Farm-to-Fork strategies emphasise the need to stimulate organic production, also in livestock farming, including aquaculture, while drawing attention to the importance of Green Public Procurement as a tool to promote the adoption of environmentally sustainable practices.

A key step for the implementation of these policies in the fisheries and aquaculture sectors is the transition from "Blue Growth" to a "sustainable Blue Economy" (COM 2021/240), focusing not only on the creation of new jobs linked to marine ecosystems, but also on their protection. In the strategy, ample space is given to the need to introduce a circularity approach in the various sectors of the Blue Economy and in particular in the blue bio-economy. In particular, the Circular Economy is called upon to reduce the impact of human activities on marine ecosystems due to plastic pollution, with clear reference to the Marine Strategy Framework Directive and the Single-Use Plastic Directive (2019/904). The European Commission is taking steps to develop standards for the circular design of fishing equipment to facilitate its reuse and recyclability when the equipment has reached the end of its life, along with measures to reduce the damage from abandoned or lost equipment that have been included in a Commission proposal for a revised Fisheries Control Regulation (COM 2018/368). The EU, through the current and the new European Maritime, Fisheries and Aquaculture Fund Regulation² will continue to provide financial support to fishermen to recover and collect marine litter and lost fishing nets and to finance adequate collection and disposal systems in ports and other areas as set out in the Port Reception Facilities Directive (COM 2019/223).

A close connection between Sustainable Blue Economy and Farm-to-Fork exists in the call for fisheries that act responsibly by maintaining fish stocks (including the use of selective fishing

² Proposal for a Regulation of the European Parliament and of the Council on the European Maritime and Fisheries and Aquaculture Fund and repealing Regulation (EU) No 508/2014 of the European Parliament and of the Council (EMFF) - political agreement from 3 December 2020

techniques that minimise unwanted catches and discards). These fisheries should also give a more important role to aquaculture as a complementary tool to harvesting wild stocks as well as being a source of new types of plant proteins, as an alternative to agricultural production. In line with Farm-to-Fork, strong requirements are underlined for sustainable food-labelling systems that inform consumers of the environmental impacts of their purchasing choices. The introduction of innovative tools and the digitisation of activities are essential for the effectiveness of these new measures. This can generate new jobs but requires investment in training and digital know-how in the fishing industry. The Common Fisheries Policy is being redefined to include input from the European Green Deal and other measures. The transition to a sustainable Blue Economy, however, requires further new tools. To monitor the progress of this policy, the need has arisen to create a user-friendly Blue Economy Indicator tool³. Ad hoc financial instruments have been created to support it, such as the Sustainable Blue Economy Finance Initiative⁴ and the Blue Invest fund⁵ within the Blue Invest Platform. Financial tools to support an ecological transition, and which can at the same time support the fisheries and aquaculture sector, are identifiable within the Invest EU programme and the Recovery and Resilience Facility.

The importance of aquaculture in future EU policies is well illustrated by the Communication on sustainable aquaculture (COM2021/236) for the promotion of competitive and low environmental impact aquaculture (e.g. combining certain types of farming to further reduce nutrient and organic matter emissions into the environment). These can enhance related ecosystem services, especially in protected areas (including Natura 2000 areas), while responding to the impact of climate change. Techniques include the identification of areas dedicated to sustainable aquaculture and to shellfish production. The Communication is in line with other documents produced by the EU, recalling the need for sufficient space and water quality to allow fish production, while also supporting product diversification (such as seaweed production and products with greater added value such as ready-to-cook products). It mentions the need for a transparent and efficient regulatory and administrative framework that would make it easier to obtain licences at a national level, avoiding uncertain times and inconsistent or unclear procedures. The aim is also to provide longer-lasting licences with regular checks and penalties in the event of failure to comply with requirements. In particular, the need to reduce infectious diseases is highlighted. These are the greatest constraints in increasing aquaculture productivity. Moreover, improved animal health and diversification of activities can increase the capacity of farms to provide climate mitigation services (such as carbon sequestration) and climate adaptation services (such as nature-based coastal protection), in accordance with the new EU Adaptation Strategy (COM 2021/82). Circular Economy plays a key role in the transition of aquaculture towards low-impact systems. Energy-efficient recirculating aquaculture systems, integrated multi-trophic aquaculture systems (IMTA) and diversification to lower-trophic species (molluscs and other invertebrates and algae and herbivore fish) are just some of the circular

³ <https://blueindicators.ec.europa.eu/>

⁴ [Sustainable Blue Finance – United Nations Environment – Finance Initiative \(unepfi.org\)](https://www.unepfi.org/)

⁵ <https://webgate.ec.europa.eu/maritimeforum/en/frontpage/1451>

tools that can give new impetus to aquaculture in EU countries, increasing productivity but reducing impact. In particular, shellfish farming offers the possibility of reducing the negative effects of fish farming, thanks to the ability of shellfish to purify water.

To achieve these results, the EU is focusing on strengthening producer organisations, including those in the field of aquaculture, and on reinforcing the traceability of products through compulsory systems. This can also reduce mistrust between consumers and aquaculture.

It should be noted that the body of Community legislation is constantly evolving, and new measures are expected in the coming years that will strengthen the policies described here. Among these, of particular interest, is a legislative proposal for a framework that will include fisheries and aquaculture products. This is a legislative proposal for modern, sustainable marketing standards for seafood and a dedicated initiative on algae.

An analysis of barriers and drivers on Circular Economy in the sustainable fishing and aquaculture sector

In order to understand how to promote actions which are useful in supporting the introduction of an innovative policy in a given context, intended as a territorial area or an economic sector, it is necessary to identify the elements that may hinder its adoption (**barriers**) and those that may favour it (**drivers**).

In general, both barriers and drivers can be categorised into four main categories:

1. **Cultural/Social barriers/drivers** refer to attitudes, perceptions, beliefs or preferences of all the relevant actors on the environmental footprint of fishing and aquaculture and their propensity to adopt innovation and Circular Economy;
2. **Institutional/Governance barriers/drivers** are related to all the elements created by the legislation and regulation that directly or indirectly influence the development of the Circular Economy in the fishing and aquaculture sectors;
3. **Economic/Market barriers/drivers** refer to two main issues: the elements that could influence the creation of a competitive market for secondary raw materials, and the marketability characteristics for CE materials and products;
4. **Technological (including Environmental) barriers/drivers** are mainly related to knowledge and the capacity to develop solutions for improving the reuse of materials, resource efficiency and eco-design.

Cultural/Social elements

There are two main types of stakeholders that influence the adoption of the Circular Economy in a productive sector, including fishing and aquaculture: consumers and company managers.

The consumerist culture which pushes people to purchase new commodities and goods is one of the main barriers to the diffusion of a Circular Economy approach based on an efficient consumption, reparability instead of substitution and waste reduction. Lack of societal pressure and/or low consumer awareness of product externalities, including food, is an additional obstacle to the diffusion of the Circular Economy. However, something is changing in European consumers' attitudes towards food. Recent Eurobarometers surveys⁶ show that European consumers are highly interested in food security, safety and quality and most consumers consider quality labels an important element, despite the lack of knowledge and awareness of EU quality labels. Especially for fish and seafood, the origin of the product is one of the most relevant choice elements, after freshness and price. More than half of the respondents recognised organic labels and most considered organic food more likely to comply with specific rules on pesticides, fertilisers and antibiotics, to be more environmentally friendly and to be produced with greater respect for animal welfare.

Despite being generally recognised that consumers have a low level of knowledge regarding the positive impact and (environmental, economic and healthy) advantages that might come from aquaculture, a third of respondents who eat and/or buy fishery and aquaculture products at least several times a year prefer wild products or have no preference regarding wild or farmed products. Their choice depends on the type of product, or that they do not know if the products they buy or eat are wild or farmed. Respondents aged 55 or older are more likely to prefer wild products than those who are aged 15-24. However, frozen products are the most commonly eaten products and are slightly ahead of fresh products (including live), and tinned products.

At least for agriculture, a wide majority of European consumers believe that farmers should play an important role in the food supply chain and half of the respondents stated that Common Agricultural Policy (CAP) should provide more support to farmers' incomes and living conditions. The need to maintain a good quality-price ratio of the (fishing and aquaculture) products and a suitable income is also an important element for fishermen.

A further barrier concerns the reduced willingness to pay for (and trust) secondary raw materials or second-hand market goods. This reduces companies' interest in investing in a Circular Economy. Conversely, mistrust in recycled materials or goods and in the reliability of their supply does not promote the Circular Economy product purchase by companies.

As far as companies are concerned, resistant company culture, used to operating in a linear system, and weak cooperation throughout the supply-chain hinders the adoption of a Circular

⁶ https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/cap-glance/eurobarometer_en - <https://refreshcoe.org/wp-content/uploads/2017/07/Flash-Eurobarometer-425.pdf> - <https://europa.eu/eurobarometer/api/deliverable/download/file?deliverableId=76466>

Economy approach. Moreover, lack of confidence in the processes and volumes of production hampers industrial cooperation and the exchange of by-products.

Concerning fishing and aquaculture, some constraints are related to the demographic characteristics of most of the fishermen (ageing and with little formal schooling) and the fishing cooperatives (small groups of fishermen in most cases, with a limited turnover, severely affected by weather, climate change and the pandemic). These conditions hinder innovation attitudes. Often, the operators lack knowledge about (new) technologies and need training to improve their digitalisation skills to obtain long-term profitability from sustainable aquaculture.

Local communities could play an important role in supporting sustainable fishing and aquaculture, especially in small communities where fishermen play an important role in the community. Effective communication could support community engagement to achieve acceptance by the consumer of sustainable aquaculture.

Consumers play a fundamental role in a Circular Economy, as the promotion of solutions to valorise the unused values is a basic element of the circularity. This means supporting the creation of a sharing economy and second-hand markets.

Institutional/Governance elements

Other relevant players in the circular transition of bioeconomy sectors, including fishing and aquaculture are legislators and governments. As far as the institutional/governance category goes, difficulties in integrating new concepts and tools into an old institutional framework is one of the main barriers.

The EU policies for Circular Economy and sustainable aquaculture have tried to overcome this issue and support companies and consumers in the transition towards a new economic system. EU policies are currently the main drivers in the adoption of a Circular Economy in fishing and aquaculture, as indicated in the previous paragraphs. For example, the landing obligation results in a reduction of food waste and in an increase of availability of feed resources for the production of fishmeal and fish oil through the use of catches that cannot be used for human consumption.

However, an analysis of the EU legislation reveals more detailed documents concerning agriculture than for fishing or aquaculture. For example, in the Circular Economy Action Plan and in other documents, there is little or no targeted indication for fisheries or aquaculture, while specific indications have been set for the management of agricultural waste. Indeed, the introduction of end-of-waste criteria simplified the creation of new values through the reuse of agricultural waste, such as manure from cattle breeding. The absence of end-of-waste criteria limited the reuse of waste from fishing, aquaculture (especially, mollusc-shell reuse, an inert material that could easily be recycled) and seafood canning. This is against the large opportunities for reuse in several economic sectors. From a more technical point of view, several opportunities have been developed in EU programmes for developing precision agriculture practices and technologies (a way to efficiently use raw resources and reduce pollution due to

an excessive use of primary inputs). Meanwhile, less attention has been dedicated to the diffusion of precision techniques in aquaculture.

In reality, some pieces of EU legislation have turned out to be constraints instead of drivers for the Circular Economy in fishing and aquaculture.

However, the revision of several pieces of legislation is creating new opportunities for side-streams (managed waste with no further use) and by-products used after processing activities. The updated legislation on fertilisers is an example - the [Regulation \(EU\) No. 2019/1009](#) harmonizes the requirement for fertilisers produced from organic primary or secondary raw materials. This could increase the interest in organic-rich side streams such as aquaculture sludges. An important reuse of the aquaculture sludge (along with its transformation into organic fertiliser) could be in anaerobic digesters to produce biogas and/or biomethane. However, there is still a lack of measures to regulate or incentivize the reinjection of other aquaculture side-streams into productive schemes. One example could be using the waste from fish mortality. Before the [Regulation \(EU\) No. 142/2011](#), only wild fish and related by-products could be used as fishfood in aquaculture structures. This regulation removed this constraint, permitting the use of aquaculture by-products, and establishing traceability and labelling measures for fishfood and aquaculture feeds to avoid intra-species feeding.

At any rate, the definition of traceability and labelling measures is still a weak point for the sustainable development of these sectors.

Some ongoing regulations inhibit the development of new aquaculture methods that could reduce the environmental impact of this sector through Circular Economy solutions.

Aquaponics systems integrate the Recirculating Aquaculture System (RAS) and hydroponic methods with remarkable advantages for minimising water and nutrient use. Nevertheless, its adoption is hampered by an absence of regulation at the EU level. Indeed, aquaponics has no clear legal status in the EU and, since it falls into both fish and plant-production frameworks, several elements of different policies need to be taken into account in order to regulate this activity.

Biofloc technology is adopted especially in developing countries for native species. Currently, it can only be used in Europe for the production of fish feed, as involved in an effective recycling of fish waste, but not for fish designated for human consumption. Aquamimicry, an alternative technique similar to biofloc is also hampered by current EU legislation.

Fishing and aquaculture waste is quite often used for pet and animal food production. Moreover, waste from fish mortality can only be used to feed fur animals. Several conditions exist in those uses that could create safety and health issues in food for human consumption, but Regulation 1069/2009 regulated other animal by-products used in pharmaceutical or cosmetics (and similar) industries.

Another legislative obstacle to promoting Circular Economy is the lack of heterogeneity in the national adoption of the EU legislation. For example, delays in the adoption of the Maritime

Spatial Planning regulation at national and regional levels is indicated in several EU documents as one of the first obstacles to overcome. Another problem is the length of the licensing and the complex procedure required in order to obtain it. A coherent legislative framework within the EU would be an important support for the creation of a market for Circular Economy products.

As far as plastic pollution due to fishing gear, several EU legislations underlined the necessity of promoting a targeted regulation to avoid abandonment, to foster collection and correct disposal and to create products and sorting systems that facilitate the collection and reuse of (secondary) raw materials. Promoting the adoption of return-deposit schemes could be a way to overcome this issue.

Governments could also support Circular Economy with non-legislative tools. For example, internalisation of (environmental) externalities through taxes (that could make waste less expensive) or economic incentives would support the ecological and circular transition in fishing and aquaculture.

Another constraint is limited circular procurement: public administrations need to strongly support transition using this tool.

An overview of the national legislation in some of the Interreg MED countries involved in the BLUEfasma project

CYPRUS - The Ministry of Agriculture, Rural Development & Environment has introduced Circular Economy into its national strategy, aimed at reducing emissions in the non-ETS33 sectors and developing a strategy according to the 2030 Energy & climate action plan. In 2015, both the Municipal Waste Management Plan and the National Waste Prevention Programme were adopted, with the main objectives being to achieve at least 50% recycling for paper, plastic, metal and glass, a collection rate of 15% for the organic content of municipal waste, and a 20% reduction in landfill. Recycling programs and infrastructures for collection and waste separation are still the main focus for environmental policies, since the targets set by the European union are far from being achieved. The main strategies of Cyprus that contribute to the transition to a circular, climate-neutral economy are: Cyprus' Integrated National Energy and Climate Plan under Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action; the Low-Carbon Development Strategy to 2050; the National Municipal Waste Management Plan 2015 - 2021; and the Cyprus New Industrial Policy 2019-2022.

CROATIA – The Act for Waste Management (July 2021) is the most important law in Croatia regarding Circular Economy and waste management. According to this law, several official regulations are in the process of development, so the Republic of Croatia will soon have specific regulations regarding waste from the fishing and aquaculture sector. The Management Plan for Sea Waste (May 2020) is a subdivision of the general Act on Waste

Management. This Plan has set four main strategic goals: to establish a system of sea waste management; to improve the information system regarding waste management; to lead continuous activities regarding education; and to improve international cooperation in resolving the problem of sea waste. All these strategic goals are directly connected to developing the general goals of the Waste Management plan of 2017 – 2022. The Regulation on Waste Management (July 2020) is a specific regulation for the process of waste management in Croatia, based on the Act on Waste Management. This regulation is divided into several parts, including the terms for waste management, the rules for the people responsible for managing the waste management, the financial parts, and permits for waste management. The Regulation on organic production in aquaculture (December 2011) is a specific regulation which is focused on sustainable energy and the reduction of waste production. The focus is placed mainly on the rules of organic production and the way that these rules are implemented on the production of all organisms which are used as food in organic production in aquaculture.

FRANCE (OCCITANIE) – In France, most of the relevant legislation is managed at the departmental level. National legislation relevant for Circular Economy is:

- Article L.541-1 of the Environment Code which states: "The national waste prevention and management policy is an essential lever in the transition to a Circular Economy. Its objectives, adopted in a way that respects the hierarchy of waste treatment methods defined in II are as follows:
 1. Give priority to the prevention and reduction of waste production
 2. Combat the programmed obsolescence of manufactured products through consumer information
 3. Develop, re-use and increase the quantity of waste being prepared for re-use, in particular of electrical and electronic equipment, textiles and furniture.
- The Law on energy transition and green growth (LTECV) of 18 August 2015, which devotes a chapter to Circular Economy. Article 70 states in particular: 'Public policies shall promote the development of industrial and territorial ecology. Sustainable public procurement is put at the service of the transition towards a Circular Economy and the achievement of the objectives mentioned. Furthermore, Article 78 states: Any person recovering waste for the realisation of development, rehabilitation or construction works must be able to justify to the competent authorities the nature of this waste and that their use is only for recovery purposes and not for disposal.
- The Law of 11 February 2016 on the fight against food waste defines the following objectives: the prioritisation of actions to combat food waste; the prohibition of denaturing foodstuffs that are still consumable; the impossibility of obstructing the donation of foodstuffs sold under a private label by an operator in the sector to an authorised association; the obligation of shops with a surface area of more than 400 m² to seek to set up a donation partnership with at least one association authorised to receive public subsidies for food aid food aid by 11 February 2017; information and

education in the fight against food waste in schools; and integration of the fight against food waste in the CSR of companies

- In terms of eco-design, the regulations impose a very precise framework particularly with regard to the danger of the components used in the manufacturing of a material or product to public health and to the environment. It also encourages companies and industrialists to put into place manufacturing and distribution of a product, not clear life cycle assessment procedures and to propose the implementation of compensatory measures for the protection of the environment and public health. The environmental footprint of a product offered for sale must be displayed.

Regarding the principles of prevention and reduction of waste production and reuse, the prioritisation of treatment methods can be found in several regulatory texts:

- The Consumer Law of 17 March 2014, known as the Hamon Law, provides for: "The obligation to inform the consumer of the availability of spare parts available within a period of 2 months" and "The extension of product guarantees up to 2 years instead of 6 months".
- Law No. 2015 - 992 of 17 August 2015 LTECV included repair as a priority.
- Decree No. 2016 - 703 of 30 May 2016 specifies the obligation to inform the consumer of the existence of spare parts from the Circular Economy when repairing or servicing a vehicle

The regional action plan (Occitanie) for a Circular Economy aims to implement the following actions:

- Implement territorial Circular Economy strategies at the “Schémas de cohérence territoriale” (SCoT) level
- In development projects, provide land for activities linked to the Circular Economy (waste management units, recycling centres, local composting, etc.)
- Encourage the grouping of businesses and the pooling of goods and services in economic development strategies, with a view to industrial and territorial industrial and territorial ecology
- Introduce flexibility in the design of buildings (reallocation of uses, elevation to increase reallocation of uses, elevation to increase density, etc.). A specific set of proposals refers to plastic streams from landfill sites, fishing nets and plastic pool covers as well as plastic swimming-pool covers.

Axis 5 of the shellfish sector contract (2021-2023) of the Occitania region foresees the development of sustainable aquaculture. Among the objectives indicated is also the development of a circular-economy approach, through the valorisation of waste from the chain.

GREECE - The Circular Economy concept is officially introduced in the National Circular Economy Strategy (2018), covering three strategic pillars for growth transformation:

- (1) Sustainable Resource Management
- (2) The Enhancement of Circular Entrepreneurship

(3) The Circular Consumption, which incorporates long-term goals to achieve the sustainable development of the UN 2030, especially Objective 12.

The implementation of public policy for Circular Economy is implemented at the inter-ministerial level, due to the cross-sectoral nature and institutional implications observed over time. The configuration policy focuses on

- finding financial tools, planning / enacting regulatory framework and regulations
- connecting SMEs entrepreneurship and social economy through technological innovation
- development and support of pilot / demonstration actions for a Circular Economy
- improvement of governance and networking, process acceleration and simplification of bureaucratic procedures.

At the operational level, planned actions compose the current four-year plan action for a Circular Economy. Other relevant legislation includes:

The Fisheries and Maritime Operational Program 2014-2020 ([Law 4314/2014](#)) on the management, control and implementation of developmental interventions for the programming period 2014-2020 (Government Gazette 265 / A / 23.12.2014);

The Fisheries, Aquaculture and Maritime Program 2021-2027, developed under the REGULATION (EU) 2021/1060. Greece will invest in a holistic approach in the fisheries, aquaculture and maritime sectors to enable the implementation of the Common Fisheries Policy, the European Green Deal, the EU Strategic Guidelines for sustainable and competitive EU aquaculture, and the EU Communication on Sustainable Blue Economy. In the context of the work for the preparation of the Fisheries, Aquaculture and Maritime Program 2021-2027, the Summary Text of the Program Plan was open to public consultation until 8/10/2021.

The National Strategic **objectives** of the new Fisheries, Aquaculture and Maritime Program 2021-2027 are in line with the EU strategy for a green transition:

- Modernisation of the fishing fleet and application of innovative methods and techniques for the collection of fishing gear
- The improvement of the quality of fishery products
- Modernisation and development of infrastructure to support fisheries and the?
- Management of unwanted catches and marine litter
- Development of innovation to reduce the environmental footprint of fisheries
- Protection and restoration of biodiversity and ecosystems
- Ensuring stock adequacy and maximum sustainable fisheries performance
- Improving data collection and processing to support decision-making based on knowledge of the sea and stocks, fleets and the impact of fishing activities
- Increasing the effectiveness of surveillance in the fight against illegal,
- unreported and unregulated fishing
- Reduction of the environmental impact of aquaculture activities
- Strengthening innovation in the aquaculture sector
- Implementation of complete spatial planning in aquaculture

The new Development Law L.4399 / 2016 is the institutional framework for the establishment of Private Investment Aid schemes for the regional and economic development of the country. The main objectives of the law are related to:

- the creation of new jobs with an emphasis on the employment of trained human resources
- promoting balanced and sustainable development with an emphasis on regional convergence
- supporting areas with reduced growth potential and reducing regional disparities
- the re-industrialization of the country
- increasing business extroversion and innovation
- a high added value
- improving the technological level and competitiveness of businesses
- saving natural resources
- the development of networks, synergies and cooperative initiatives
- supporting the social and solidarity economy
- the formation of a new extroverted national identity (branding)
- strengthening healthy and targeted entrepreneurship
- attracting direct foreign investment
- ensuring a better position of the country in the international division of labour

Reference to fisheries and aquaculture is in Chapter B (increased investments -investment plan bodies -eligible expenditure) at Article 7 (Subordinated and excluded investment plans) where a comma stated that: [...] 6b -aa) By joint decision of the Ministers of Economy, Development and Tourism and Rural Development and Food, they may be subject to aid scheme types of investment projects in the field:

aa. **fisheries and aquaculture**, as provided for in Regulation 1379/2013 of the European Parliament and of Council (OJ L 354) and with reservation is provided in the General State Archives and Commission Regulation (EU) No 1388/2014 (OJ L 369) of 16 December 2014.

ITALY – The 2019 release of the National Bioeconomy Strategy contained a chapter addressing the Blue Economy, especially in the fishing and aquaculture sectors. As far as fishing goes, the National Strategy aims at implementing specific national strategies to promote the development of sustainable fisheries. through new fishing and market ICT based technologies to achieve environmental objectives and to implement the Circular Economy. Concerning aquaculture, the objective is to increase resilience and recognize aquaculture as a full-fledged part of marine spatial plans. Moreover, incentives will be established to promote the cultivation of animal or vegetable species that could help to purify water. New tools will be introduced such as certification schemes of bio-based systems and smart solutions for the use of digital technologies to support sustainable production. Regarding Circular Economy, the Strategy aims at increasing the use of by-products from aquaculture by valorising both processed products and sludge. They will focus on creating “a scientific network for applied blue biotechnology, involved in designing and testing new technologies for the remediation of contaminated marine sites and tailored exploitation of national marine-based feedstock

(including by-products and wastes from sea products transformation). They will also identify new biobased products (i.e., functional cosmetics, foods/feeds nutraceuticals and functional foods) and biomaterials (i.e., natural polymers for packaging or the biomedical market)". National strategy for the Circular Economy is currently under review. There is a chapter on the Blue Economy in the text to be approved. The general objectives are as follows: Devise a new digital waste-traceability system to enable developing a market for secondary raw materials while enhancing control and prevention of illegal waste management; Develop tax incentive systems to support the use of materials from recycling chains; Revise the taxation system so as to make recycling more economically convenient than landfilling; Promote a right to reuse and repair; Reform the EPR (Extended Producer Responsibility) systems and Consortia to support EU targets; Strengthen the existing regulatory instruments (End-of-Waste legislation, Minimum Environmental Criteria (MEC), and apply them to strategic sectors such as construction, textiles, plastics, WEEE; Support industrial symbiosis projects, through regulatory and financial instruments. Indeed, a lack of end-of-waste criteria and a lack of regulation and costs for waste disposal are considered among the main obstacles for the development of a Circular Economy in the fishing and aquaculture sectors. This is despite the wide use of seafood canning waste as a secondary raw material in several industrial sectors. Another legislative block concerns the legislation for plastic marine litter collection. Currently, fishermen are not allowed to collect it or to dispose of it in existing or dedicated areas once back on land. A law to solve this issue, the so-called "Salvamare" (Save the sea), is under approval. However, in the past years, several laws to reduce the use of single-use plastic have been successfully introduced in Italy.

Another legislative barrier refers to food-safety regulations. Currently, norms to be respected for the disinfection of multi-use plastic containers have turned out to be too costly, especially for small fishing cooperatives, due to the compulsory bureaucratic procedures.

Law no. 166 of 19 August 2016 on 'Provisions concerning the donation and distribution of food and pharmaceutical products for purposes of social solidarity and limiting waste' has as some of its aims to help reduce waste production, promote reuse and recycling and contribute to the achievement of the general objectives set by the national waste-prevention programme. The law, which incorporates many elements of the national plan to combat food waste, aims at encouraging the recovery and donation of food and pharmaceutical products for social solidarity purposes. It defines "food waste" as all food products which are still edible and potentially fit for human or animal consumption discarded from the agri-food chain for commercial or aesthetic reasons or because they are close to their expiry date, and which, in the absence of a possible alternative use, are destined for disposal. Food-business operators can give surplus food to donors, free of charge. If the products are fit for human consumption these donors must then give it, free of charge, to those who are neediest. Otherwise, it will be given to animals or used for compost.

It should be noted that the high cost of waste management in Italy – due in part to the existing rules and norms for avoiding illegal disposal – could be a strong driver for developing Circular Economy circuits.

PORTUGAL - The National Sea Strategy 2021-2030, aims at enhancing the contribution of the sea to the country's economy, prosperity and well-being of all Portuguese people. The main drivers are: respond to the major challenges of the decade while strengthening the position and visibility of Portugal in the world as an eminently maritime nation. Among the several Strategic Objectives (SO), two of them concern Circular Economy: SO2 - Foster Employment and the Circular and Sustainable Blue Economy, and SO9 - Encourage Reindustrialisation and Productive Capacity and Digitalise the Ocean. SO2 indicates that the development of a Blue Economy should be based on the basic principles of healthy ecosystems and the protection of coastal communities, using principles of circularity, inclusiveness, equity and sustainability. This is because only in environmental, social, cultural and economic harmony can we truly prosper. It must also be inclusive, capable of creating skilled jobs to meet market needs and of maintaining employment in the primary sector, particularly in fisheries. In addition, it must highlight the need to clarify the role that local coastal communities can play in developing a circular, bio-based economy by harnessing marine resources. Moreover, it is essential to ensure a better balance along the value chain, while seeking to valorise the endogenous resources of coastal communities. This should be based on a sustainable integration of the industrial ecosystem that promotes the creation of value and the development of local economies which are traditionally more dependent on the sea, either directly or indirectly, by association with other activities such as tourism or fish processing. SO9 focused on reindustrialisation, based on the economy of the sea, to rediscover Portugal's maritime heritage. The goal is to be inclusive, able to integrate R&D, based on human capital of excellence, and aligned with environmental criteria, based on a Circular Economy and an efficient use of resources. Some specific outcomes of the development will be the modernisation of the fishing sector and the requalification of fishery operators while reducing the environmental impact of aquaculture through the promotion of integrated, multi-trophic aquaculture strategy.

Promoting the adoption of activities required to reach the targets set in the Sea National Strategy 2021-2030 for SO2, SO4 and SO9, and especially:

- Increase employment in the national Blue Economy by 30% by 2030,
- Ensure an average remuneration in the marine economy that is 8% above the current national average
- Increase the gross value-added of the marine economy by 30% by 2030,
- Increase the contribution of the marine economy to 7% of the GVA of the national economy
- Double the number of financing instruments dedicated to Blue Economy projects (including e.g., sustainable financing, crowdfunding, venture capital)
- Increase national aquaculture production to 25,000 tonnes per year
- Increase the contribution of seafood exports to 7% of the total national export
- Maintain 100% of fisheries management stocks within sustainable biological limits according to the parameters resulting from scientific evaluation (e.g. by ICES), adapt levels of fishing effort within those limits

- Increase by 20% the value of industrial production of the emerging sectors of economy of the sea
- Increase by 20% the value of industrial production of the emerging sectors of the marine economy,
- Increase by 20% the financial support for innovation, technology transfer and diversification of production models of the traditional sectors of marine economy.

SPAIN - In Spain, the main legislation that affects the Circular Economy in the fishing and aquaculture sector is:

- State Maritime Fishing Law 3/26/2001
- Approval of the First Circular Economy Action Plan 2021 - 2023 (5/25/2021)
- 6/1/2021, draft Law on Fisheries (pending)
- Law on State Ports and the Merchant Marine of 5/9/2011, (article 63, Reception of waste and residue from ships)

The Maritime Fishing Law states that all fishing facilities are located in ports which are either owned by the State or by Autonomous Communities. In most cases this leads to differences in management methods.

This conditioning means that any action or plan of the fishing sector concerning facilities or terrestrial fishing areas is subject to the authorization of the Port Authorities. This always results in administrative expenses and occupation or activity costs, as well as the costs of collection by the companies authorized by said administrations of the generated waste. These costs negatively incentivize the operators, with the result that they only carry out the basic actions necessary to develop their professional activity. As a consequence, there is no standardized collection of waste (with the exception of engine oil waste) and no statistical data on these.

It is important for the First Circular Economy Action Plan to implement a strategy for collecting these now non-existent data. They must ensure that it does not cause additional costs to a fishing sector that is already heavily penalized in all socio-economic aspects. Otherwise, this could lead to unrealistic data, given that their collection depends on a direct collaboration of fish operators, which is impossible if it leads to an economic loss and no practical and palpable benefit for them.

Promoting the adoption of activities required to reach the targets set in the National Sea Strategy 2021-2030 for SO2, SO4, SO9, and especially:

- Increase employment in the national Blue Economy by 30% by 2030,
- Ensure an average remuneration in the marine economy that is 8% above the national average
- Increase the gross value-added of the marine economy by 30% by 2030,
- Increase the contribution of the marine economy to 7% of the GVA of the national economy
- Double the number of financing instruments dedicated to Blue Economy projects (including e.g., sustainable financing, crowdfunding, venture capital)

- Increase national aquaculture production to 25,000 tonnes per year
- Increase the contribution of seafood exports to 7% of the total national export
- Maintain 100% of fishery management stocks within sustainable biological limits according to the parameters resulting from scientific evaluation (e.g. by ICES), adapting levels of fishing efforts within those limits
- Increase by 20% the value of industrial production of the emerging sectors of the marine economy
- Increase by 20% the financial support for innovation, technology transfer and diversification of production models of the traditional sectors of the marine economy.

MONTENEGRO – In Montenegro, one of the goals of the development policy is the sustainable use of available fish resources and the management of the fishing fleet in a manner that enables long-term and economically viable fisheries. The Government harmonizes the norms at the national level with the principles of the EU Common Fisheries Policy.

On June 25, 2015, the Government of Montenegro adopted the Fisheries Strategy of Montenegro 2015-2020 with an action plan for the transposition, implementation and enforcement of the EU *acquis*, thereby fulfilling the opening benchmark.

The Montenegrin Cabinet, at its 57th session held on 2 February 2022, chaired by the Prime Minister of Montenegro, adopted the Draft Law on structural policy and the allocation of state aid in fisheries and aquaculture sector. The adoption of this Law is necessary in order to harmonise it with the *acquis communautaire* and to implement supporting programmes for the fisheries. It was assessed that the proposed legal solutions will contribute to the development of the fisheries sector and create better conditions for the allocation of funds to beneficiaries.

The basic regulations that include biological resource management (i.e., fishing, farming and protection of fish and other organisms in sea and fresh water) on the principles of sustainable development, are the Law on Marine Fishery and Mariculture (Official Gazette of Montenegro 56/09) (Annex 49) and the Law on Freshwater Fishery (Official Gazette of Montenegro 11/07). The first one lays down the objectives and the principles for sustainable management of living marine resources and marine environment through implementation of measures for protection of biodiversity and the environmental conditions, as well as by laying down the procedures for development and adoption of management plans in the fishery sector.

For the purpose of sustainable use of fish stocks, the Law on Freshwater Fishery lays down the conditions and methods for use of all activities in the field of freshwater fishery (commercial, sports-recreational fishing and aquaculture), as well as measures for protection, development and conservation of the fish stocks.

The Montenegro's "Fisheries Development Strategy and Capacity Building for Implementation of the EU Common Fisheries Policy" is a project implemented in partnership between the Ministry of Agriculture, Forestry and Water Management of Montenegro and the European Agency for Reconstruction. Fisheries sector development focuses primarily, but not exclusively, on improving the efficiency in the aquaculture sector. This national strategy

focuses on the a) Protection and sustainable use of marine and freshwater fisheries; b) Protection of well-being of consumers; c) Promotion of exports; d) Diversification of markets; e) Improvement of traceability and quality of products; f) Expansion of production in the mussel and offshore nephrons fishery; g) Improvement of production efficiency in freshwater and marine aquaculture; h) Development of fisheries partnership agreements in the exploitation of pelagic species. Three national priorities are identified in the fishery sector: Institutional strengthening (staffing, training and equipping) - improving the capacity of domestic fisheries policy of Montenegro; Strengthening of legislation, institutions, laboratory capacity and industry standards to improve the health conditions of fisheries products in compliance with EU requirements; Design and implement delivery mechanisms to provide an enabling investment environment to the fisheries sector. Since November 2005, Montenegro has been negotiating with the European Union on the Stabilisation and Association Agreement. Introduction and implementation of the European norms and standards will require the development of Montenegro's administrative capacity to apply EU rules properly. The trade provisions will start to open up markets, and help Montenegro to develop a functioning market economy that has the capacity to cope with competitive pressures within the EU's internal market. A number of regulatory, policy and institutional changes are required in order to support the implementation of the strategy in Montenegro. In order to safeguard the sustainability of marine and freshwater fisheries, the state is required to amend its specific regulations and thus support the changes to the management and monitoring of catch resources. The core regulations and inspectorate structure are strong enough for implementation of adequate management and conservation rules.

Guided by the determination to establish an ecological state, Montenegro was among the first countries in the region of South-East Europe that defined the strategic and institutional framework for sustainable development, in accordance with the standards of the developed EU member states. In cooperation with the UN University for Peace, in 2001, Montenegro developed a comprehensive document "Directions for the development of Montenegro as an ecological state". Furthermore, the National Strategy for Sustainable Development until 2030 adopted on 7 July 2016 follows the UN Agenda 2030. By drafting the Smart Specialization Strategy, Montenegro has joined the initiative of the European Union that focuses on the new model of economic development at the national or regional level based on targeted support to scientific research activities and innovations.

The concept of Circular Economy is not included in many relevant national strategic and legal documents, and in the area where it is, it is only addressed in the context of waste management. However, the Chamber of Economy of Montenegro is working on the development of the first Roadmap Towards Circular Economy in Montenegro with the corresponding Action, Monitoring and Communication Plan, to be published on 21 April 2022. Furthermore, in the Workplan for 2022, the Government of Montenegro announced the adoption of the Circular Economy Strategy in Montenegro, building and developing further on the Roadmap document.

MALTA – The Circular Economy Malta (CEMalta) is the designated competent entity for the Circular Economy under the Environment Protection Act. CEMalta was established as an Agency through LN286 of 2018 under the Public Administration Act (CAP 497). Through this action plan, it aims to intensify efforts to align Malta to circular economy principles.

In 2014, the Ministry responsible for the aquaculture sector published a national aquaculture strategy titled ‘Aquaculture Strategy for the Maltese Islands: Towards Sustainability 2014-2025’, which presented the Government’s strategic direction for the future of the aquaculture industry in Malta. The Government’s vision for sustainable fisheries and aquaculture is based on four strategic objectives of development: improved regulation, improved operation, improved environmental monitoring and enhanced innovation.

In 2017, under the Malta MedFish4Ever Ministerial Declaration, Malta along with 15 other countries, took a decisive step to promote the sustainability of the Mediterranean and its fisheries. This declaration set forth the intent of Malta to improve its fisheries over the next decade, by taking into account and promoting blue economy, amongst other objectives.

Malta’s Sustainable Development Vision for 2050 sets out a long-term framework for the maximisation of the three pillars (environmental, economic and social) of sustainable development of the Maltese Islands. It aligns with the Agenda 2030 Sustainable Development Goals (SDGs) whilst also takes into account other developments at an international and EU level. It aims to attain sustainable consumption and production models in order to achieve a circular economy. Furthermore, other relevant legislation tackling circular economy at a national scale includes:

The European Maritime and Fisheries Fund (EMFF) for the period 2014-2020 which supports fishing communities by improving infrastructure and equipping fishermen with new skills and opportunities to help them diversify their business models. this programme represents the main funding arm for investment in the fisheries and aquaculture sectors in Malta.

The European Maritime, Fisheries and Aquaculture Fund (EMFAF) for the period 2021-2027 seeks to support investment in Malta’s Fisheries and Aquaculture Sectors by building upon the previous Programming period. A public consultation exercise on the EMFAF was carried out from September to October 2021, whereby interested parties were invited to put forward their views, suggestions and comments in reaction to the document. Investments supported under EMFAF shall particularly aim to foster sustainable fisheries and aquaculture, contribute to food security, restore and protect marine biodiversity whilst enabling the sustainable growth of the blue economy. The Programme will also focus on supporting the diversification of fishing activities to ensure the sustainable development of the sector. Interventions aimed at diversification of activities in the broader sustainable blue economy shall target the three pillars that form an integral part of Malta’s Sustainable Development Vision for 2050.

Economic and Market elements

Regarding the Economic and Market drivers, examples are limited availability of raw materials, dependence of other countries’ economies on the import of raw materials, price of raw materials, market volatility and, in some cases, political instability. These are all strong drivers in promoting Circular Economy in the EU. As outlined in the previous sections, one of the objectives that the EU aims at achieving through the Circular Economy is to increase the availability of internal raw materials. However, an inelastic supply of recycled materials could be a relevant hindrance for the diffusion of circularity in these sectors.

Unfortunately, lower prices for virgin materials than for secondary raw materials has hampered the creation of a market for the latter, especially when subsidies for virgin materials and a lack of incentives for secondary raw materials both exist. For that reason, it is very important to provide reliable business models for a Circular Economy and for secondary raw materials, especially in the fishing and aquaculture sectors when some of the most efficient and profitable circular solutions, such as IMTA, appear to be totally new to the EU countries.

The absence of business models for secondary raw materials and remanufactured goods is one of the main obstacles. However, a reliable business model should be able to take into account high up-front investment costs and lack of resources to support investments.

Additionally, the inconsistency of international policies on trade could hinder the profitability of new materials or products in some sectors.

Another gap to be filled regards the lack of eco-labelling, certification schemes, quality standards and product stewardship for secondary raw materials and by-products. This has been outlined in several EU legislative documents: providing information on the origin of raw materials and on the quality and safety standards of secondary raw materials is fundamental for promoting the marketability of fishing and aquaculture products in a circular-economy framework.

Technological (including Environmental)

As far as the technological drivers (including environmental ones), it is necessary to promote the eco-design of the whole aquaculture process from the initial phase of facility design to waste management, reuse and remanufacturing. Precision aquaculture could be a valuable tool to promote efficient use of energy, of raw resources (including fish feed) and reduce pollution, especially in the case of (waste) water reuse.

As it happens for several other sectors, the majority of attention is directed at the reuse of waste and its transformation into secondary raw materials. Less attention is paid to the efficient use of resources and the elimination of waste in other steps of the value-chain, despite the existence of interesting best practice examples. Adopting practices upstream of the value-chain - such as eco-design - implies, for example, the integration of methodologies that can evaluate their performance. Among these methodologies, one of the best known is the Life Cycle Assessment (LCA). However, the lack of LCA indicators for aquafeed manufacturing and aquaculture make it necessary to review and update them, in order to perform reliable and standardized performance evaluations.

Promoting CE in Sustainable Fishing and Aquaculture also includes the adoption of IMTA – Integrated Multi-Trophic Aquaculture, biofloc, aquaponics or aquamimicry, but it requires that legislation constraints be removed or regulated, and adequate business models be developed.

As for the reuse of waste, the different steps in the value chain have different characteristics. On one hand, fishing and aquaculture concerned with fish farming have a limited waste production - except for plastic in fishing gear, containers and other tools – as most of the waste

is produced by final consumers (families and restaurants) and sorted by waste-collection systems at a municipal level. Unfortunately, without end-of-waste criteria and business models for secondary raw materials it is difficult to promote a separate collection for mollusc shells, fish skins or other recyclable materials.

On a different note, shellfish farming and seafood canning industries have a large production of waste that are normally disposed of but that could be transformed into secondary raw materials and reused in different sectors. Examples of these sectors could be the agriculture and poultry sectors (mainly shells), the building sector, pharmaceutical and cosmetic sectors, the pet food, bioplastic production and fashion sectors. For example, in the fashion sector, fish skin could be used instead of other materials to produce bags and shoes. The fashion sector is also interested in the reuse of abandoned nets and their materials to produce new fabrics. End-of-waste criteria will facilitate the creation of more performant waste-separation systems and the reuse of fishing and aquaculture waste, especially when business models demonstrate economic sustainability of secondary raw materials. Sometimes separated materials can only be used for a specific transformation or goods and the resulting limit in the collection of materials could negatively affect the production of secondary raw materials. A high standardization is required for reducing mistrust in the quality of remanufactured products.

Despite all these obstacles, several examples indicate that EU researchers are interested in developing new materials and EU consumers are interested in the innovative new materials coming from Circular Economy circuits, including the fishing and aquaculture sectors. Unfortunately, a lack of communication results in an inability to disseminate information concerning the best practices and technologies (and related social, economic and environmental benefits) to other researchers, policy and decision makers and consumers.

Proposals to foster CE in Sustainable fishing and aquaculture

Different activities could be suggested to overcome barriers that negatively affect the development of a Circular Economy in sustainable fishing and aquaculture.

A review of the current legislation which aims to:

- a. Adopt end-of-waste criteria for promotion and easy re-use of fishing and aquaculture waste.
- b. Make IMTA (Integrated Multi-Trophic Aquaculture), biofloc, aquaponics and aquamimicry possible in EU countries and encourage related research and technology transfer.
- c. Adopt sectoral and targeted eco-labelling and certification schemes quality standards, and product stewardship for secondary raw materials to improve the marketability of the products.
- d. Promote a higher integration in the adoption of EU legislation and reduce heterogeneity among Member States' legislations.

- e. Support the adoption of the most relevant policies, especially the adoption of Maritime Spatial Planning in member countries and the related coastal regions.
- f. Introduce agri-environmental payments for the (positive) externalities provided by (sustainable) fishing or (sustainable and/or organic) aquaculture to effectively support ecological transition in the sector.
- g. Eliminate virgin material subsidies and introduce taxes or economic incentives to internalize externalization and make secondary raw materials more achievable.
- h. Promote measures to reduce marine litter and pollution related to fishing gear abandonment or losses through the application of existing legislation and the promotion of new circular tools (such as return deposit).
- i. Promote the adoption of Allocated Zones for Aquaculture (AZA) Plans with the aim to improve the integration of aquaculture with other coastal activities, thus reducing conflicts among stakeholders on the use of the marine resource. (BGC 2021).

Develop reliable and efficient economic tools by:

- a. Developing Circular Economy consistent business models for secondary raw materials and by-products to achieve more lucrative markets. It is a strong requirement for opening up these opportunities to the fishing and aquaculture sector.
- b. Promoting information on the benefits (savings) achievable by an efficient use of resources (energy efficiency and precision aquaculture).
- c. Promoting information on the benefits (additional earnings and reduced costs) of circular waste management (side streams and by-products) and secondary raw materials.
- d. Promoting circular (public) procurement to support secondary raw material and remanufactured product markets and low impact products.
- e. Design investments schemes to attract public/private funds towards high-value, sustainable, diverse aquaculture products in line with sub-regional specificities (BGC 2021)

Improve technological aspects through:

- a. Promoting the eco-design of the whole aquaculture processes from the initial phase of facility design to waste management, re-use and remanufacturing, including energy efficiency and precision aquaculture technologies and practices.
- b. Reviewing current LCA and other indicators in order to demonstrate the effective performance of secondary raw materials.
- c. Promoting the diffusion of new materials and tools to reduce the environmental impact related to fishing gear, especially plastic pollution.

Improve attitudes towards a circular fishing and aquaculture by:

- a. Promoting knowledge of circularity through a more integrated and collaborative production (and consumption) system to promote sharing economy and the valorisation of unused values (considering the possibility that more than one stakeholder uses the same good several times).
- b. Adopting a targeted communication strategy to inform other researchers, policy and decision makers and consumers about the best practices and technologies so that they will support the adoption of secondary raw materials and remanufactured goods.
- c. Upskilling the fishing and aquaculture workforce to be able to make the transition toward a sustainable and circular fishing and aquaculture effective through complete information on the environmental, social, and economic benefits that could be achieved, meanwhile increasing the digital and technical competences required to adopt the existing supportive tools (BGC 2021).
- d. Promote public awareness activities both for young and adult stakeholders towards the development of sustainable maritime aquaculture (BGC 2021).

References

1. Behnam, A. (2012). Building a Blue Economy: strategy, opportunities and partnerships in the seas of East Asia in The East Asian Seas Congress 2012, Changwon
2. Blue Growth Community (2021). Position Paper on How the Blue Growth Community can contribute to achieving the objectives set by the European Commission in the Communication on a Sustainable Blue Economy
3. Blue Growth Community (2021) Position on Maritime Spatial Planning
4. Boulding, K.E. The economics of the coming spaceship earth. In Environmental Quality in a Growing Economy; Jarrett, H., Ed.; Johns Hopkins University Press: Baltimore, MD, USA, 1966; pp. 3–14.
5. Commoner, B. The Closing Circle: Nature, Man and Technology; Dover Publications: Mineola, NY, USA, 2020 (Reprint of the Random House, 1971 edition)
6. European Commission (2021). The EU Blue Economy Report 2021. Available at: https://blueindicators.ec.europa.eu/published-reports_en
7. European Commission (2020). Facts and Figures on the Common Fisheries Policy Basic statistical data – 2020 edition. Available at: https://ec.europa.eu/oceans-and-fisheries/facts-and-figures/facts-and-figures-common-fisheries-policy_en
8. Galvao, G.D.A., et al. (2018). Circular Economy: Overview of Barriers. Procedia CIRP, 73, 79-85
9. Grafstrom, J., Aasma, S. (2021). Breaking Circular Economy barriers. Journal of Cleaner Production, 292, 126002
10. Khitous, F., et al. (2020). A Systematic Literature Network Analysis of Existing Themes and Emerging Research Trends in Circular Economy. Sustainability, 12, 1633
11. Kirchherr, J., Reike, D., Hekkert, M., 2017. Conceptualizing the Circular Economy: an analysis of 114 definitions. Resources, Conservation and Recycling 127, 221–232.
12. Kirchherr et al. (2021). Barriers to Circular Economy: Evidence from the European Union (EU). Ecological Economics, 150, 246-272
13. Kusumowardani, N., Tjahjono, B., Conceptualisation (2020). Circular Economy adoption in the aquafeed manufacturing industry. Procedia CIRP, 90, 43-48
14. Mazur-Wierzbicka, E. Towards Circular Economy—A Comparative Analysis of the Countries of the European Union. Resources 2021, 10, 49
15. McGlade, J., et al. (2012). Measuring Water Use in a Green Economy. A report of the working group on water efficiency to the International Resource Panel. Nairobi: UNEP. Available at: <https://www.resourcepanel.org/reports/measuring-water-use-green-economy>
16. Pauli, G. (2009). The Blue Economy – A Report to the Club of Rome, Nairobi: UNEP.
17. Pearce, D.W., Turner, R.K. (1990). Economics of Natural Resources and Environment, JHU Press, London, UK, 1990.
18. Rigueiro, L., et al. (2021). Opportunities and limitations for the introduction of Circular Economy principles in EU aquaculture based on the regulatory framework. Journal of Industrial Ecology, 1-12.

19. Ritzén, S., Sandstrom, G.O. (2017). Barrier to the Circular Economy – integration of perspectives and domains. *Procedia CIRP*, 64, 7-12
20. Stahel, W.R.; Reday-Mulvey, G. (1976). *Jobs for Tomorrow. The Potential for Substituting Manpower for Energy*; Vantage Press: New York, NY, USA
21. Wenhai, L., et al. (2019). Successful Blue Economy Examples with an Emphasis on International Perspectives. *Frontiers in Marine Science*, 6, 261
22. World Bank, United Nations Department of Economic and Social Affairs (2017). *The Potential of the Blue Economy : Increasing Long-term Benefits of the Sustainable Use of Marine Resources for Small Island Developing States and Coastal Least Developed Countries*. World Bank, Washington, DC. © World Bank. Available at: <https://openknowledge.worldbank.org/handle/10986/26843> License: CC BY 3.0 IGO.
23. UNEP et al., (2012) *Green Economy in the Blue World*. Nairobi : UNEP. Available at : https://wedocs.unep.org/bitstream/handle/20.500.11822/12499/RS.14_INF.1.RS.pdf?sequence=1&3BisAllowed=
24. Zarbà, C. et al., (2021). Regulatory Elements on the Circular Economy: Driving into the Agri-Food System. *Sustainability*, 13, 8350

European Union legislation

COM(2021) 240 final - Sustainable Blue Economy

COM(2021) 236 final - Sustainable and Competitive Aquaculture

COM(2021) 98 final - New Circular Economy Action Plan

COM(2020) 381 final - Farm To Fork

COM(2020) 380 final - Biodiversity Strategy 2030

COM(2014)398 final - Towards a Circular Economy: A zero waste programme for Europe

COM(2014) 89 final - Maritime Spatial Planning

COM (2012) 494 final - Blue Growth opportunities for marine and maritime sustainable growth

COM(2008) 56 final - Marine Strategy Framework

COM(2000) 60 final - Water Framework Directive

Statistics Data

[FIGIS - Fisheries Statistics - Production \(fao.org\)](https://www.fao.org/fishery-statistics/)

[Statistics | Eurostat \(europa.eu\)](https://ec.europa.eu/eurostat/)