TO: HELLENIC REPUBLIC
MINISTRY OF DEVELOPMENT AND INVESTMENTS
GENERAL SECRETARIAT FOR PUBLIC INVESTMENTS-NSRF
NATIONAL COORDINATION AUTHORITY

«EUSAIR FACILITY POINT
(European Strategy for the Adriatic-Ionian Region)**»**

CONTRACT:

Technical support for the development of a roadmap for improving the capacity and effectiveness of selected stakeholders and beneficiaries and the identification of actions for strengthening their capacities

Thematic Paper

Strengthening of innovation related capacities:

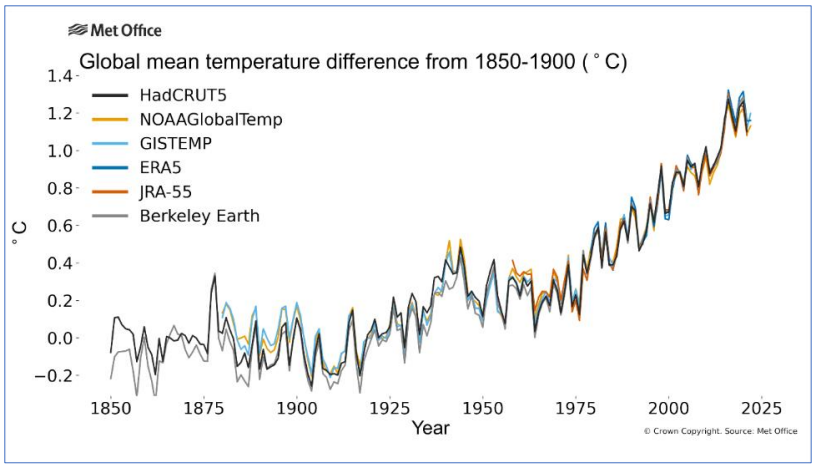
Cross-border monitoring and recording. Development of transnational monitoring/recording network for early detection of climate changes in the maritime and coastal area of the Region

CONSULTANTS ENGINEERS AND PLANNERS S.A.
Off 21, Thivaidos Str
145 64 Kifissia
Tel. 210 8169700,
Fax: 210 8196709
Email: main@ldk.gr
Web: www.ldk.gr

Table of Contents

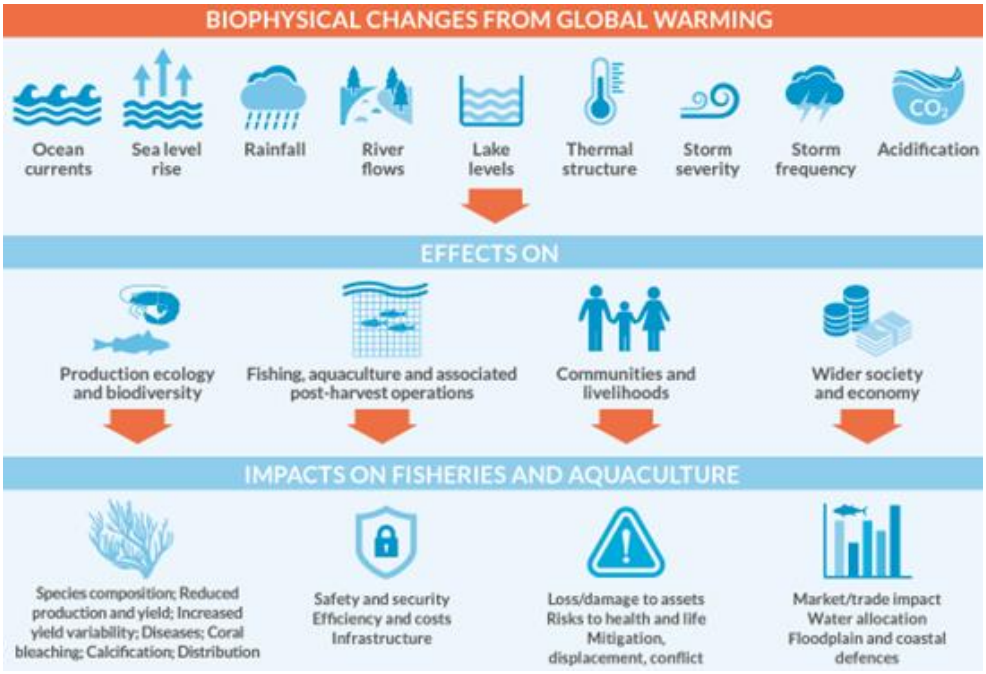
1 INTRODUCTION

The world is currently experiencing a rapid warming of the earth's climate due to human activities. EU climate policy steers both regional and national efforts to mitigate and adapt to climate change, based on the UN Convention on Climate Change, the supplementary Kyoto Protocol, and the Paris Agreement.



The global temperature change from 1850 to 2021, compared to an estimated 1850-1900 baseline average temperature. (Source: UK Met Office)

The widely recognised need for effective and progressive responses to the threat of climate change is particularly important for the fisheries and aquaculture sectors, which are especially vulnerable to climate change and associated risks. The significant effect of climate change on the productivity of the fisheries sector including the trade of fish products, on biodiversity and habitats is well-documented, as are the potentially important geopolitical and economic consequences, especially for those regions most dependent on this sector. Climate change drivers cause potentially significant changes in ocean currents, sea level rise, acidification, rainfall, river flows, lake levels and thermal structure, as well as changes in the severity and frequency of storms.



Climate variability and change impact pathways in fisheries and aquaculture
(*Source: FAO 2021, FAO's work on climate change – Fisheries and aquaculture 2020. Rome. https://doi.org/10.4060/cb3414en*)

This thematic paper has been commissioned by the EUSAIR Facility Point, which supports the innovation community in the Adriatic Ionian region. Its overall objectives are to strengthen innovation capacity in the Region, boosting development, cross sectoral cooperation and collaboration, and working towards the creation of value chains for the benefit of the Adriatic-Ionian Sea basin.

2 INNOVATION

2.1 What is Innovation

According to the EC, "*innovation is the use of **new ideas, products or methods** where they have not been used before*"[1]. Innovations are based on the results of new technological developments, new technology combinations, or the use of other knowledge, acquired by an enterprise or organisation. The innovations may be developed by the innovating enterprise/organisation or by another organisation. Innovation can also be relative to development (*new/endogenous*) or to transfer in other environments and places. Thus, innovations should be **new to the organisation concerned**: for product innovations, they do not necessarily have to be new to the market and, for process innovations, the organisation does not necessarily have to be the first one to have introduced the process.

Key components of the concept of innovation according to the Oslo Manual[2] include the role of knowledge as a basis for innovation, novelty and utility, and value creation or preservation as the presumed goal of innovation. The requirement for implementation differentiates innovation from other concepts such as invention, since an innovation must be put into use - or made available for others to use.

"*An innovation is a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process).*"[3]

The minimum requirement for an innovation is that the product, process, marketing method or organisational method must be new (or significantly improved) to the firm or entity. This includes products, processes and methods that entities are the first to develop as well as those that have been adopted from other firms or organisations.

It is acknowledged that the concept of innovation is difficult to define in such a way, as to enable the identification, measurement, comparison and assessment of 'innovative' initiatives. When international co-ordination is required in collecting and comparing innovation in a range of fields in different environments, this becomes particularly challenging. It is important, that there is a common interpretation of 'innovation' within the EUSAIR initiative, used by all the national Innovation Experts.

2.2 Development of Innovation

An innovation process is a sequence of events necessary for introducing an innovation, which can be generated by (a) a strategic approach in its identification and in the way that it constitutes the design and implementation framework, and (b) the adoption of the quadruple(quintuple)-helix contribution to its development and validation (establishment and contribution of the innovation ecosystem).

[1] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Innovation
[2] The Oslo Manual (4th Edition 2018, guidelines on how to conceptualise and measure business innovation), provides a common framework for identifying and measuring innovation in a more inclusive manner across the economy, in government, in non-profit organisations and in households.
[3] The Oslo Manual (4th Edition 2018, guidelines on how to conceptualise and measure business innovation). The generic term "unit" describes the actor responsible for innovations.

2.2.1 Strategic approach

A strategic approach is a key component of every strategy, supporting the achievement of its vision and strategic objectives and containing a linked set of specific objectives and interventions, that relate to all of the balanced scorecard perspectives:

a. Financial (or Stewardship): views financial performance and the use of financial resources
b. Customer/Stakeholder: views organizational performance from the perspective of the client or key stakeholders
c. Internal Process: views the quality and efficiency of performance related to the product, services, or other key processes
d. Organizational Capacity (or Learning & Growth): views human capital, infrastructure, technology, culture, and other capacities that are key to breakthrough performance.

Innovation becomes strategic when it is fully integrated into the design of the strategy as well as of the planning and management process. The linked objectives reveal how innovation contributes to the achievement of a strategy's vision and strategic objectives, forming the basis for communicating this cause-effect relation in a consistent manner.

The scope of the current project is related to the above approach, seeking to explore the way innovation can be embedded in the EUSAIR Strategy Pillars linked to the blue economy.

2.2.2 Quadruple (*Quintuple*)-Helix Contribution

The quadruple and quintuple innovation helix framework describes the interaction between **university-industry-government-public-environment** within a knowledge economy. In innovation helix framework theory[45] used in innovation economics and theories of knowledge, such as the knowledge society and the knowledge economy, each sector is represented by a circle (helix), with overlapping showing interactions. The quadruple and quintuple innovation helix framework was co-developed by Elias G. Carayannis and David F.J. Campbell, with the quadruple helix being described in 2009[67] and the quintuple helix in 2010[7].

The quadruple and quintuple helix framework can be described in terms of the models of knowledge that it extends and the five subsystems (helices) that it incorporates.In a quintuple helix-driven model, knowledge and know-how are created and transformed, and flow as inputs and outputs in a way that affects the natural environment.

Socio-ecological interactions via the quadruple and quintuple helices can be used in defiing opportunities for the knowledge society and knowledge economy, such as innovation to address sustainable development - including climate change. The quadruple helix has been applied to European Union-sponsored projects and policies, including the EU-MACS (EUropean MArket for Climate Services) project[8], a follow-up project of the European Research and Innovation Roadmap for Climate Services, and the European Commission's Open Innovation 2.0 (OI2) policy for a digital single market that supports open innovation[9].

---

[4] Leydesdorff, Loet (2012). "The Triple Helix of University-Industry-Government Relations (February 2012)". SSRN Working Paper Series. doi:10.2139/ssrn.1996760. ISSN 1556-5068.
[5] Carayannis, Elias G.; Barth, Thorsten D.; Campbell, David F. J. (2012-08-08). "The Quintuple Helix innovation model: global warming as a challenge and driver for innovation". Journal of Innovation and Entrepreneurship. 1 (1): 2. doi:10.1186/2192-5372-1-2. ISSN 2192-5372.
[6] Carayannis, Elias G.; Campbell, David F.J. (2009). "'Mode 3' and 'Quadruple Helix': toward a 21st century fractal innovation ecosystem". International Journal of Technology Management. 46 (3/4): 201. doi:10.1504/IJTM.2009.023374. ISSN 0267-5730
[7] Peris-Ortiz, Marta; Ferreira, João; Farinha, Luís; Fernandes, Nuno (2016-05-27). "Introduction to Multiple Helix Ecosystems for Sustainable Competitiveness". Multiple helix ecosystems for sustainable competitiveness. Cham: Springer. pp. 1–14. doi:10.1007/978-3-319-29677-7. ISBN 978-3-319-29677-7. OCLC 950971633
[8] GUIDELINES FOR LIVING LABS IN CLIMATE SERVICES – EU MACS". eu-macs.eu. Retrieved 2019-03-09.
[9] hubavem (2013-12-04). "Open Innovation 2.0". Digital Single Market - European Commission. Retrieved 2019-03-09.

The process of co-design process adopted by the EUSAIR Strategy and many of its initiatives reflect the above participation, primarily through the establishment and operation of networks (formal and informal), learning platforms and partnerships.

2.3 Types of Innovation

There are numerous ways of classifying innovation. For instance, different forms of innovation can be classified according to their basic innovative characteristics or type. A brief list of eight fields of innovation follows below[10]:

1. Product & Product Performance Innovation	A new product or service is developed or the performance of an existing product/service is significantly improved. This includes significant improvements in technical specifications, components and materials, software in the product, user friendliness or other functional characteristics. This kind of innovation is very common in the business world.
2. Technology Innovation	New technologies can be also the basis for many other innovations. The best example was the Internet, which was itself an innovation but also lead to other innovations in various fields.
3. Business Model Innovation	Using different channels, technologies and new markets can lead to new possible business models which can create, deliver and capture customer value. Digital ecosystems are a well-known example of innovation using several technologies and creating a whole new type of business.
4. Organizational Innovation	A new organisational method in business practices, workplace organisation or external relations. Managing and sharing resources in a new way can also be an innovation. This way it is possible to use resources and assets in a completely new way.
5. Process Innovation	Innovation in processes can improve the efficiency or effectiveness of existing methods. Possible process innovations involve production, delivery, or customer interaction. This includes significant changes in techniques, equipment and/or software.
6. Marketing / Sales – New Channel Innovation	New methods to capture and hold the attention of customers. Either through the use of innovative marketing/sales concepts or the use of new channels for customer acquisition/sales. A new marketing method involves significant changes in product design or packaging, product placement, product promotion or pricing.
7. Network Innovation	By connecting A new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing different groups and stakeholders it might be possible to create extra value. This type of innovation is very common.
8. Customer Engagement / Retention	Innovative concepts that try to increase the engagement of customers/clients and keep the retention levels up. The goal is to have innovative models to keep the customers/clients "locked-in" or engaged.

It is also possible to differentiate between four levels of innovation, depending if they open up new markets or when the technology is changing. The 4 different types of innovation are:[11]

[10] https://morethandigital.info/en/
[11] https://www.freshconsulting.com/

Incremental Innovation	Incremental innovation constitutes a gradual, continuous improvement of existing products and services. The goal is to improve an existing offering by adding new features, changes in the design, etc. One of the most common forms of innovation, it offers the most evident value to an established bottom line. By continuously improving products, services, and business operations, organizations can reduce stagnation and consistently grow market share.
Sustaining Innovation	Sustaining innovation is a significant improvement on a product that aims to sustain the position in an existsing market. This category is focused on creating new features or services that differentiate a product from all of its competitors.
Disruptive Innovation	Disruptive innovation is often the most well-known type of innovation. It is mostly associated with applying new technologies, processes, or disruptive business models to existing industries, with high-impact results. Sometimes new technologies and business models seem, especially in the beginning, inferior to the existing solutions but after some iterations, they surpass the existing models and take over the market due to efficiency and/or efficacy advantages.
Radical Innovation	Radical innovation involves the creation of technologies, services, and business models that open up entirely new markets. Radical innovations are new products, services or processes and involve significant change and innovation, and accordingly, have a greater immediate impact. It typically utilizes a technological breakthrough that transforms industries and creates new markets. This type of innovation completely changes how an organization interacts with the marketplace. The success of the underlying technological shift to drive this type of innovation is often related to the firm's organizational behaviors and capabilities that create the right conditions for new ideas to be successfully commercialized in the first place. In this context, examples would include innovative fishing gear, unmanned ships, offshore ports.

2.4 Innovation in Fisheries & Aquaculture

2.4.1 Fisheries

Innovation in fisheries is mainly focused on fishing gear and equipment. With sustainability being a primary policy goal, innovation is yielding multiple solutions in terms of stock preservation, protection of marine species, and energy consumption.

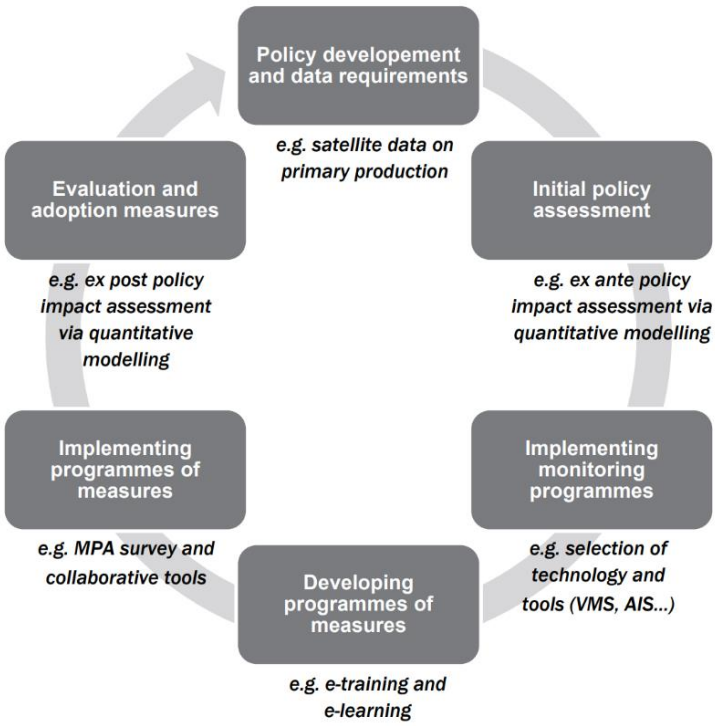
Technological innovation is prominent in the field. It primarily involves gear selectivity to target specific species, avoid unwanted catches and eliminate discards, in compliance with limitations imposed. Other technologies, are also been applied, such as in the FIS032 'Real-time reporting app to avoid unwanted catches' project[12] where live data and information is shared between fishers to notify of areas that should be avoided due to the presence of certain species. Technological innovation is also important in the development of methods and equipment to prevent vessel strikes and avert marine animals form the fishing gear (eg cetacean monitoring apps, acoustic

[12] https://fiscot.org/fis-projects/real-time-reporting-app-fis032/

devices, escape devices on nets), so as to both protect endangered species and avoid gear damages which bear a significant gear replacement cost.

Innovation featuring existing technologies from different fields and adaptation to fisheries mainly involves engine technologies in order to reduce energy consumption and cost, and related CO2 emissions. Solar power and energy storage technologies are being tried in the fisheries sector in the attempt to achieve better energy efficiency levels and minimize the environmental impact of the fleets.

Technological innovation has also played a crucial role in improving monitoring, control and surveillance. Both collaborative (VMS, AIS) and non-collaborative tools (optical or radar satellites), as well as data processing technologies (big data, block chain, smart weighing at sea, Radio-Frequency Identification (RFID), smartphones for monitoring, artificial intelligence, drones, and on-board cameras) are significantly assisting the authorities in proper stock management, Marine Protected Areas (MPA) implementation and fighting Illegal, Unreported and Unregulated fishing. Innovative monitoring technologies used at the different policy stages, enhance the design, implementation and evaluation of fisheries policy instruments[13].



Use of monitoring technologies at various policy stages (Source: GGSD FORUM 2017, Issue Paper: An inventory of new technologies in fisheries, Pierre Girard, Thomas Du Payrat)

Following on from the typology of innovation mentioned above, other types of innovation also exist to a lower degree:

[13] GGSD FORUM 2017, Issue Paper: An inventory of new technologies in fisheries, Pierre Girard, Thomas Du Payrat

- Process innovations, referring to the development of new low impact fishing techniques promoting environmental sustainability
- Network innovations, associated to local fishing communities,
- Marketing innovations in promotion of the products of local fisheries
- Management innovations in the case of MPAs, involving relevant stakeholders (national and local authorities, fishers etc)

2.4.2 Aquaculture

The increasing demand for fish over the past decades as a result of the human population increase[14], combined with the reduction of available wild fish catch worldwide, has resulted in an increasing demand for, and production of aquaculture fish.

Moving towards a more intensified aquaculture, that at the same time needs to be both green and profitable, innovation across different phases of production proves to be of significant importance in building a more resilient and sustainable sector.

Innovation in the aquaculture sector is highly technological, due to the nature of the businesses, and includes different technologies across different stages of the production process.

The importance of animal health and hygiene in the production process constantly drives innovation in the field, in order to improve product quality and reduce costs, including stock losses from disease. Ranging from veterinary medicines, such as oral vaccines, to feeds and nutrients, such as insect-meal based fishfeeds[15], and even genetic engineering, bio-technology is a prominent area for innovation in aquaculture.

Water circulation and waste management are also aspects of great interest for innovation, due to their importance in production, from both the environmental and financial perspective. Water circulation systems contribute to a better delivery of nutrients and more efficient waste management, which in turn is crucial for good animal hygiene and health, as well as for minimizing the environmental impact of aquaculture[16]. Different types of sensors are being used to provide valuable data (water temperature, salinity, pH) in order to assist in both better environmental management, as well as better living conditions and better growth rates for the fish. AI technologies have recently started being tested for quality control purposes such as prediction of algae blooms, monitoring of biomass size in pens, etc[17].

Innovations that reduce energy consumption in the production process or combine renewable energy production in the aquaculture facility (solar, wind, wave) are currently of the highest interest, and are also being researched in the framework of multi-level use of marine space, in off-shore platforms that combine energy production with aquaculture installations[18].

[14] FAO, The state of world fisheries and aquaculture-contributing to food security and nutrition for all. Fisheries and aquaculture department, Rome 2016
[15] Insects as a feed ingredient for fish culture: Status and trends, Aquaculture and Fisheries Volume 7, Issue 2, March 2022, Pages 166-178
[16] D. Miller, K. Semmens, Waste management in aquaculture, Aquaculture Information Series (2002), pp. 1-10, #AQ02-1(January)
[17] Global Seafood Alliance: https://www.globalseafood.org/advocate/make-seafood-production-and-processing-more-responsive-and-responsible-sounds-like-a-job-for-ai/
[18] https://www.ocean-energy-systems.org/publications/oes-documents/market-policy-/document/offshore-aquaculture-a-market-for-ocean-renewable-energy./

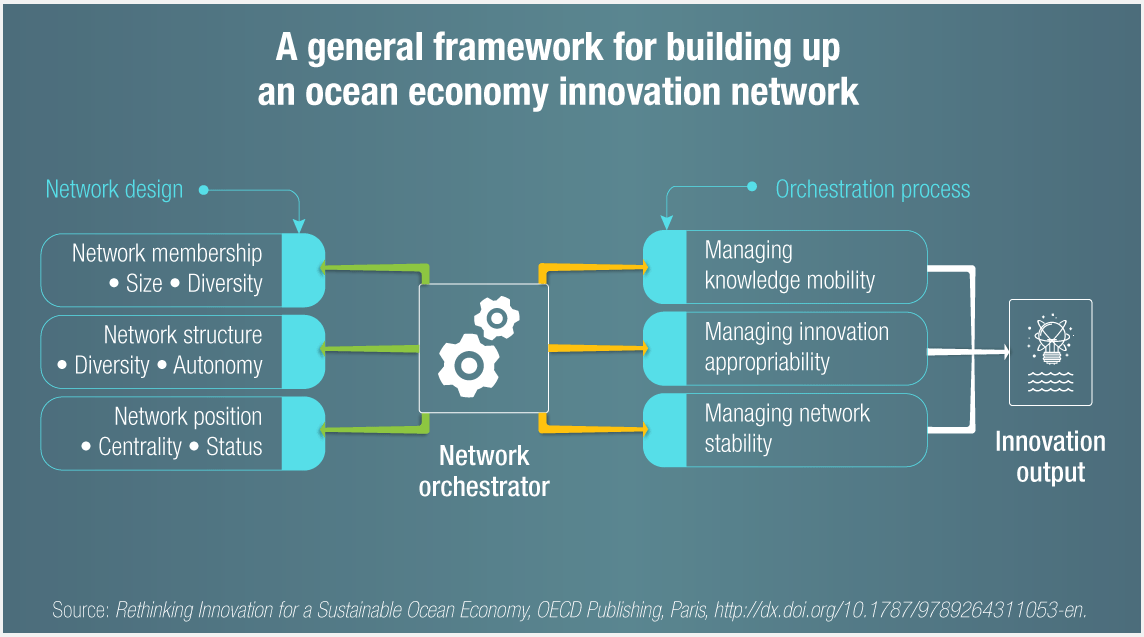
Apart from technological, other areas of innovation in the aquaculture sector include product and process innovation, related to cultivation of new marine species, and new cultivation methods for new and old ones. Also of interest is marketing innovation for the end product, as well as food technology innovation for aquaculture product processing businesses.

OECD-Rethinking Innovation for a Sustainable Ocean Economy

The OECD further emphasises the importance of science and technologies in improving the sustainable economic development of seas and oceans. Marine ecosystems are central to many of the world's global challenges: food, medicines, new sources of clean energy, climate regulation, job creation and inclusive growth. It is critical that the health of marine ecosystems is protected and improved, in order to support the ever-growing use of marine resources.

Innovation in science and technology can play a key role in both these objectives, and three priority areas are cited:

1. approaches that produce win-win outcomes for ocean business and the ocean environment across a range of marine and maritime applications;
2. the creation of ocean-economy innovation networks; and
3. new pioneering initiatives to improve measurement of the ocean economy.



2.5 European Commission Policies to Blue Economy

The EC Communication on Blue Growth[19] demonstrated that Europe's seas and coasts could generate jobs and economic growth, contributing the the Europe 2020 strategy, whilst improving the way we utilize these natural resources.

The Communication on 'Innovation in the Blue Economy: realizing the potential of our seas and oceans for jobs and growth'[20] published three years later, continued with this approach, describing

[19] Blue Growth opportunities for marine and maritime sustainable growth COM(2012)494

[20] Innovation in the Blue Economy: realizing the potential of our seas and oceans for jobs and growth COM(2014)254 final/2

the approach to realizing the potential of Europe's seas to create jobs and economic growth. According to this document, **innovation across all sectors of the blue economy** is crucial for realising its growth and jobs potential. Innovation can bring about significant environmental benefits through "eco-innovations". The document also described how innovation can contribute to the development tof cost-effective marine protection measures within the implementation of the Marine Strategy Framework Directive (MSFD).

Although a number of initiatives support the development of innovation[21], a number of barriers to innovation in the blue growth area are also identified:

- gaps in knowledge and data about the state of oceans, seabed resources, marine life and risks to habitats and ecosystems;
- diffuse research efforts in marine and maritime science hindering inter-disciplinary learning and slowing the progress of technological breakthroughs in key technologies and innovative business sectors;
- lack of scientists, engineers and skilled workers able to apply new technologies in the marine environment.

In 2021, the EC Communication 'on a new approach for a sustainable blue economy in the EU Transforming the EU's Blue Economy for a Sustainable Future'[22] explicitly described the transition from 'Blue Growth' to a 'Sustainable Blue Economy' (Art. 1), taking a systemic view that integrates ocean policy into Europe's new economic policy. The communication proposes a paradigm shift from 'blue growth' to a 'sustainable blue economy', on the basis that the division between environmental protection and economy is no longer meaningful. Economic activities at sea and in coastal areas should reduce their impacts on the marine environment and value chains should transform themselves, and contribute to climate neutrality, zero pollution, circular economy and waste prevention, marine biodiversity, coastal resilience and responsible food systems.

"*The current European Green Deal calls for a transformation of the economy into a modern, resource-efficient and competitive one where net emissions of greenhouse gases are phased out and the EU's natural capital is protected. The Recovery Plan for Europe aims to boost the green and digital transitions and make Europe's economy fairer, more resilient and more sustainable for future generations. The EU's Blue Economy can help achieve this dual challenge: if put on a more sustainable path, it will become* ***a font of action and ideas creating innovation****, spurring fast and lasting recovery and protecting our planet.*"

The important **role of innovation** envisaged in the Blue Economy is clear throughout the communication. The role of marine and maritime research and innovation, and innovative technologies as such, is crucial, with the Commission intending to set up a pan-European innovation ecosystem for a sustainable Blue Economy.

[21] Examples of programmes supporting innovation include the Innovation Union Flagship Initiative, the Competitiveness and Innovation Framework Programme for SMEs, and the Horizon 2020 programme, while a significant proportion of the EU's Structural and Investment Funds are earmarked for innovation. These programmes aim to address, in part, the perceived handicaps which innovation faces in Europe, such as lower level of investment in research and development, and difficulties in accessing finance/capital for innovative start-up initiatives. The programmes also try to mitigate the obstacles to growth in innovation caused by Europe's fragmentation into different national economies and regulatory frameworks, leading towards more European-wide coordinated policies in the area of innovation.

[22] On a new approach for a sustainable blue economy in the EU- Transforming the EU's Blue Economy for a Sustainable Future COM(2021)240 final

Thus a sustainable blue economy is expected to create tangible opportunities for new jobs and businesses to be created by work to mitigate the impacts on oceans and coasts to build a resilient economic model based on innovation, a circular economy and a respectful attitude to the ocean. It is expected that the blue economy will play a major role in achieving the European Green Deal's objectives, due to its dynamism and innovation potential, being well placed to drive the green transition, replacing unchecked expansion with clean, climate-proof and sustainable activities that tread lightly on the marine environment.

The new EU strategy on adaptation to climate change[23] sets out a response framework through smarter, faster and more systemic adaptation in the EU and stronger international action for climate resilience. Applying the guidelines of that strategy, the Commission will work to close the knowledge gaps and stimulate innovation for increased climate resilience for coastal areas; including through a new comparative analysis of traditional and nature-based solutions.
Marine and maritime research and innovation are essential for achieving the EU's ambition to become climate-neutral by 2050, for protecting and restoring marine ecosystems and for making the blue economy a font of ideas and action to generate sustainable innovation (Art 3.2 of the Communication 'on a new approach for a sustainable blue economy in the EU Transforming the EU's Blue Economy for a Sustainable Future').

Innovative technologies such as big data, artificial intelligence, advanced modelling, sophisticated sensors and autonomous systems are likely to transform the blue economy in the immediate future. New technologies can enable traditional sectors such as shipping, fisheries and tourism to improve their sustainability and circularity; emerging sectors such as blue biotechnologies, offshore renewable energies and maritime security rest on innovation for their very existence. Through innovation, coastal communities can rebuild or reshape their economies and become local drivers of sustainability. Community-led local development, funded through the European Maritime, Aquaculture and Fisheries Fund, is a powerful tool to drive this process. The role of research and innovation in driving the transformation needed to achieve the Green Deal cannot be overstressed.

2.6 Smart Specialisation Strategies and Sustainable Blue Economy

According to the EC's Smart Specialisation Platform[24], "*Smart Specialisation is a place-based approach characterised by the identification of strategic areas for intervention based both on the analysis of the strengths and potential of the economy and on an Entrepreneurial Discovery Process (EDP) with wide stakeholder involvement. It is outward-looking and embraces a broad view of innovation including but certainly not limited to technology-driven approaches, supported by effective monitoring mechanisms*."

Smart Specialisation activities support policymakers, regional and national authorities and other stakeholders involved in research and innovation, to bridge blue growth investment platforms and regional innovation initiatives. The Blue Economy represents a niche of innovation possibilities for many regions across the EU, and in fact, one out of five EU regions are specialising in at least one domain related to the blue economy, such as green shipping and water transport including highways of the seas; blue renewable energy; marine biotechnology.

In close alignment with Horizon Europe, smart specialisation strategies are helping to boost innovation in the context of the European Regional Development Fund. The new Interregional

[23] SEC(2021) 89 final.
[24] The S3 Platform assists EU countries and regions to develop, implement and review their Research and Innovation Strategies for Smart Specialisation (RIS3) https://s3platform.jrc.ec.europa.eu/what-we-do

Innovation Investment initiative will support interregional projects that develop European value chains, while the EU Climate Action Innovation Fund will support demonstration projects of low-carbon technologies in the marine environment.

DG MARE has identified Smart Specialisation Strategies (S3) as a key tool for the implementation of the EC Communication on Sustainable Blue Economy (adopted in May 2021)[25]. In coordination with DG REGIO, DG MARE launched the **smart specialisation platform for sustainable blue economy** and a number of brokerage events were held in 2022, to promote smart specialisation interregional partnerships and blue economy value chains. The events focused on the:

- facilitation of blue economy stakeholders' networking and exchange
- promotion of the definition of stakeholders' complementarities and synergies in terms of interregional value chains/partnerships
- support of the exchange of potential partnership ideas and expression of interest
- sharing of best practices and lessons learned on S3 interregional partnerships set up and implementation.

2.7 Innovation in EUSAIR Strategy

Innovation is a key for EUSAIR and is encompassed in one of EUSAIR's Pillar 1 flagships (see below, and Annex 6.1). The theme has been explored, with the support of EUSAIR platforms and networks, and focuses on the following topics:

1. Key role of Smart Specialisation in the future EU programming period;
2. The importance of innovation ecosystems for socio-economic development;
3. How to reinforce innovation capacities and innovation ecosystems in the "widening areas";
4. The role of the networks as system integrators;
5. Funding synergies and governance of the EUSAIR Macro-region;
6. Concrete interregional cooperation initiatives and pilot projects;
7. Possible strategic priorities to focus macro-regional R&I investments;
8. How to involve the industry and SMEs in the implementation of Macro-regional Strategies;
9. How to stimulate interregional innovation investments; and
10. The role of the EU financial instruments to enhance R&I in the EUSAIR Macro-region.

2.7.1 EUSAIR Innovators-Innovation Integrators

According to the European Innovation Scoreboard[26], the EUSAIR MS countries are primarily Moderate Innovators (Slovenia, Italy, Greece), while Croatia is an Emerging Innovator. The EUSAIR Western Balkan countries are also Emerging Innovators, as can be seen in the tables below.

[25] https://interreg-med.eu/no-cache/news-events/news/detail/actualites/sustainable-blue-economy-dg-mare-events/

[26] The European Innovation Scoreboard provides a comparative assessment of the research and innovation performance of EU Member States and selected third countries, and the relative strengths and weaknesses of their research and innovation system.

Figure 3: Performance of EU Member States' innovation systems

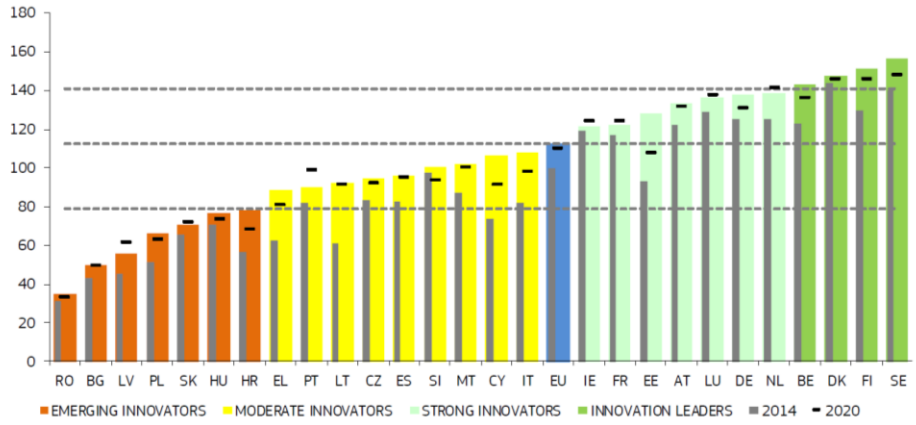
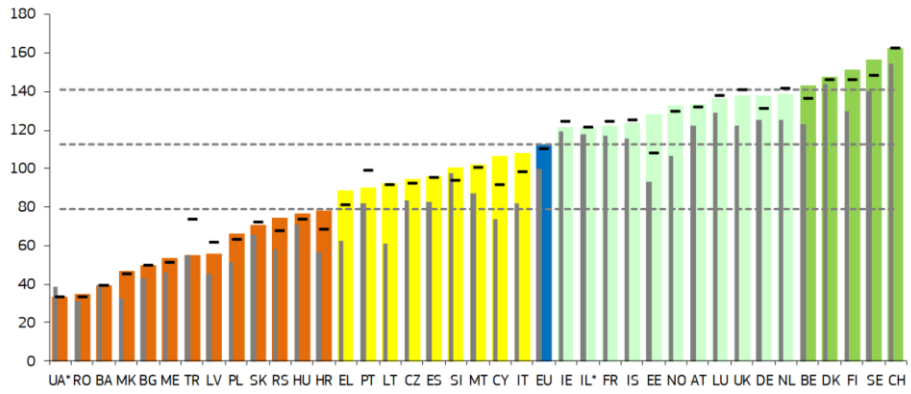


Figure 12: Performance of European and neighbouring countries' systems of innovation



Source: European Innovation Scoreboard 2021

2.7.2 Correlation to RIS Strategies- MRS3 AIR

Macro-Regional Smart Specialisation Strategy of Adriatic-Ionian Region (MRS3 AIR) was a pilot document that envisioned to set a framework for supporting and strengthening innovation system of the Adriatic-Ionian region and to design a project of a broader scope for the establishment of the Open Innovation System of the Adriatic-Ionian region (OIS-AIR).

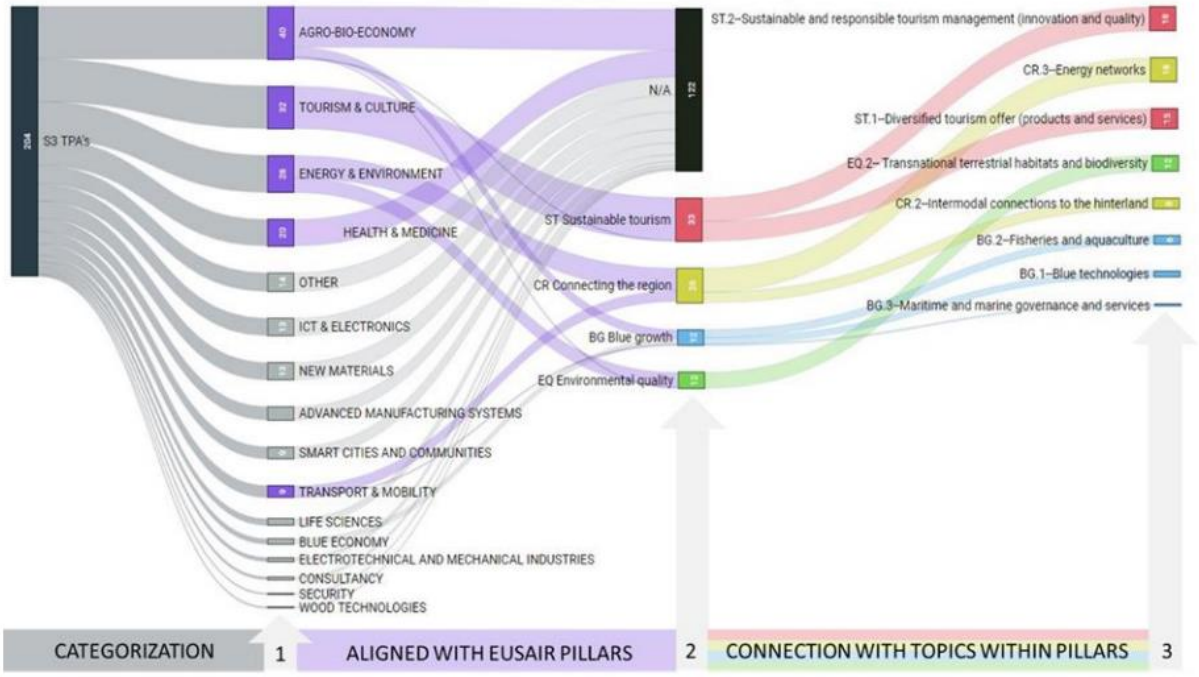
The framework of MRS3 AIR was defined by resources of partner countries and regions, outlined in their Smart Specialisation Strategies (S3) and by challenges that were recognised in EU Strategy for the Adriatic and Ionian Region (EUSAIR). By focusing on several thematic priority areas, mapping potential partners within given fields and exploring opportunities for complementarities and common R&D specialisations, this document endeavoured to set R&D directions for the Adriatic-Ionian macro-region (AIR).

The strategy framework was focused to five thematic priority areas that have emerged as strategic areas based on S3 documents' analysis and on the analysis of data available to the OIS-AIR project team. These thematic priority areas were identified as most common and most present in S3 documents and were, furthermore, interrelated with EUSAIR's pillars and identified challenges. These five proposed Macro-Regional Thematic Priority Areas (MRTPA), along with associated Macro-Regional Sub-Thematic Priority Areas (MRSTPA) were:

1. Agro-Bioeconomy – Healthy and functional food (Blue) – emphasis on seafood (including freshwater food)

2. Energy and Environment – Integration of distributed energy resources (DER)
3. Transport and Mobility – Green coastal & maritime mobility
4. Tourism and Culture – Smart and creative upgrade of cultural tourism
5. Health and Medicine – Sustainable new healthcare models.

In order to support reaching the triple objectives of smart, inclusive and sustainable growth in the Adriatic-Ionian region, the above-mentioned strategy aimed to explore the possibility of applying a mission-oriented approach to the identified MRSTPAs. Missions might come in a different shapes and sizes, and in some cases represent simply a trigger for action, still they could provide a massive opportunity to increase the impact of European research and innovation activities, to capture the public imagination and to make a real push in addressing complex challenges. Proposed MRTPAs for MRS3 AIR were based on several factors and it is the frequency of those factors as a R&D resource as well as the ability of those factors to tackle regional challenges of EUSAIR that were considered. These identified "interrelationships" between S3 and EUSAIR, MRTPAs are shown in the Sankey diagramme below.



Source: https://www.oisair.net/uploads/pages/05-21-2019-04-33-37-3239058649.pdf

2.7.3 Innovation and EUSAIR Pillar I Flagships 2021-2027

The EUSAIR Strategy encompasses four thematic areas/pillars representing key challenges as well as key opportunities in the region. For each pillar, specific topics and actions have been identified, taking into account the needs, urgency of the issue and the added value of joint actions taken in order to solve the existing challenges or build upon the future opportunities.

Thus, Pillar I Flagships comprise:

- Fostering **quadruple helix** ties in the fields of marine technologies and blue bio-technologies for **advancing innovation**, business development and business adaptation in blue bio-economy.

- Promoting **Sustainability**, Diversification and Competitiveness in the fisheries and aquaculture sectors through education, research & development, administrative, technological and marketing actions, including the promotion of initiatives on marketing standards and healthy nutritional habits.
- Bolstering **capacity building and efficient coordination of planning** and local development activities **for improving marine and maritime governance** and **Blue Growth services**

Innovation stands for a cross-cutting issue in EUSAIR. EUSAIR Action Plan identifies the relevance of Pillar I with regard to cross-cutting issues as follows.

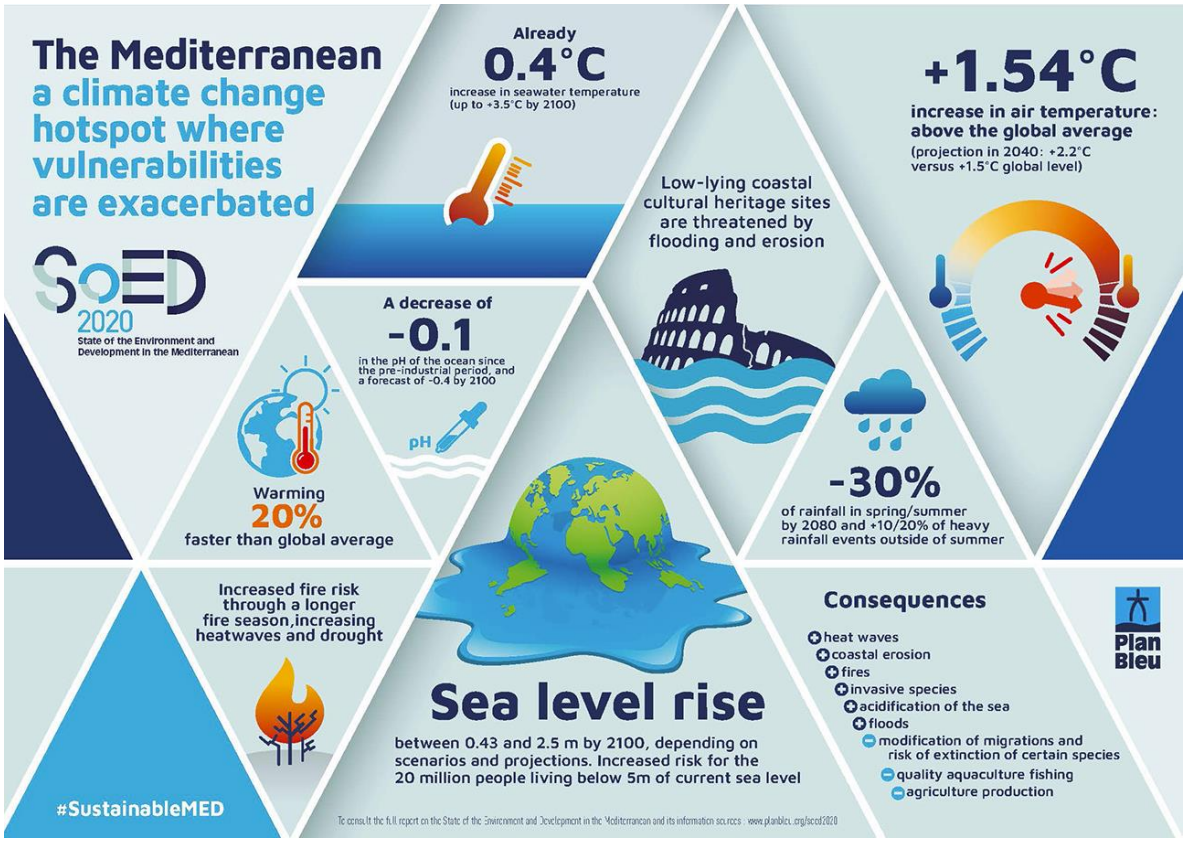
- Research, **innovation** and SMEs: both topics have a strong focus on research and innovation. Actions under these topics may therefore contribute to the development of SMEs in these sectors by transferring the latest R&D results to seafood processing and new products. *Moreover, the first pillar has a strong focus on the mobility of researchers and the establishment of joint R&I platforms.*
- Capacity building, including communication: actions under the second topic require strengthening capacity in relation to management, surveillance, monitoring, and skills. Actions under the third topic will strengthen the administrative and institutional capacities of the public sector and contribute to EU integration. Sharing of best practices and cooperation between countries will be fostered, with a focus on planning the coordinated actions necessary for better maritime and marine governance and services. Actions under Pillar 1 have therefore the potential to contribute to the strategic decision-making related to Blue Growth. On the other hand, communication is central for involving stakeholders and initiating awareness-raising processes.

Fisheries and aquaculture are sectors with special weight in EUSAIR Pillar 1. As seafood consumption grows, sustainable production is of crucial importance for the transition to a sustainable Blue Economy, and is a primary objective for related EU policies. Innovation in these fields plays a key role in enhancing sustainability, and reducing the environmental impact of both activities.

3 CLIMATE CHANGE

3.1 Introduction

The Mediterranean region is viewed as an important climate change hotspot, due to pronounced warming and drying projected under future greenhouse gas emission scenarios.



Climate change in the Mediterranean
(Source: UNEP https://www.unep.org/unepmap/resources/factsheets/climate-change)

The UNEP provides interesting information specifically about the Mediterranean basin[27]:

- There is robust evidence that the Mediterranean region has significantly warmed. Basin-wide, annual mean temperatures are now 1.54°C above the 1860-1890 level for land and sea areas, i.e. 0.4°C more than the global average change – and widespread warming is set to continue.
- Models project a consistent decrease in precipitation during the 21st century, for the entire Mediterranean Basin during the warm season (April - September, with the highest magnitude in summer) and in winter for most of Mediterranean, except for the northernmost regions (e.g., the Alps).
- Surface solar radiation in the Mediterranean Basin decreased from the 1950s to the 1980s and recovered thereafter, consistent with global trends. In future climate projections, anthropogenic aerosol loads over the Mediterranean are expected to continue to decrease, leading to an increase in surface solar radiation.

[27] *MedECC 2020 Summary for Policymakers*. In: Climate and Environmental Change in the Mediterranean Basin – Current Situation and Risks for the Future. First Mediterranean Assessment Report [Cramer W, Guiot J, Marini K (eds.)] Union for the Mediterranean, Plan Bleu, UNEP/MAP, Marseille, France, pp 11-40.

- Observations and most model projections indicate a trend towards drier conditions over the Mediterranean Basin, especially in the warm season and over the southern areas. Net water loss from the sea is expected to increase in the future due to a decrease in precipitation and river runoff and an increase in evaporation.
- Mediterranean Sea surface waters are warming, a trend which will continue into the 21st century, and deep waters are becoming saltier.
- Mediterranean Sea waters have acidified and will continue to acidify along with the global ocean. The Mediterranean Sea is able to absorb relatively more anthropogenic CO2 per unit area than the global ocean because it is more alkaline and because deep waters are ventilated over shorter timescales
- The Mediterranean Sea level is rising, similar to global trends, with strong spatial and temporal variation and expected acceleration.

Europe is the fourth largest producer of fish in the world, according to Eurostat, with approximately 80% of European aquatic food production coming from wild fisheries, and around 20% from aquaculture, or fish farms. Aquaculture, and particularly marine aquaculture, is particularly vulnerable to extreme weather/climate conditions, as it is located in open seas. Short-term effects on fisheries and aquaculture include the loss of fish and shellfish population stocks, as well as of equipment and infrastructure due to extreme natural disasters, diseases, floods, etc. Other medium- and longer-term effects include changes in the rate of increase of farmed organisms, changes in the incidence of pathogenic bacteria and parasites, changes in the infectivity of pathogens or the sensitivity of farmed species, and so on.

According to the FAO, amongst the main effects of climate warming on the Mediterranean Sea, are[28]:

- Surface warming, increasing heatwaves and a decrease in precipitation are very likely, with changes in circulation, sea level rise and winter weather being regionally likely.
- *Meridionalization* (occurrence of warm water species in northern regions) and *tropicalization* (expansion of non-native tropical species), are strengthened by warming. The resulting imbalance of fish stocks threatens biodiversity and creates numerous problems for the fishing industry, as well as having some positive impacts.
- Longitudinal gradients in the rate of warming and changes in primary production are likely and result in an expected increase in fish diversity in the Eastern Mediterranean (and decrease in the Western Mediterranean).
- Changes in primary production and runoff will likely have a negative impact on the optimum habitats for small pelagic fish in the Mediterranean.
- Demersal species will suffer regional impacts associated with the expected changes in primary production, thermohaline circulation, and the strength of winter weather. Warming and the expected increase of Atlantic water entering into the Mediterranean will likely affect migrations and spawning behaviour of large pelagic fish.
- Fisheries vulnerability to climate change is likely to be higher in south and southeast developing countries of the Mediterranean, given the higher exposure to warming and arrival of non-indigenous species, and their overall lower adaptive capacity.

[28] "*Impacts of climate change on fisheries and aquaculture; Synthesis of current knowledge, adaptation and mitigation options*", FAO Fisheries and Aquaculture Technical Paper 627, Rome 2018

- New opportunities will emerge in the small-scale fisheries and related communities, where new potentially commercial species could increase yields and economic profitability. The arrival of non-indigenous species will also trigger problems in fisheries based on native species.

3.2 Involved stakeholders

There are many stakeholders involved in addressing the issue of climate change. A brief list of the actors involved in cross-border monitoring and recording of climate change impacts, who would be engaged in transnational network(s) contributing to the early detection of climate changes in the maritime and coastal regions, would include the following (along the lines of the quadruple/quintuple helix mentioned elsewhere in this paper):

- **Government authorities**: public authorities at regional and local government levels, but also at national level as regards the development and implementation of trans-national and inter-national initiatives dealing with marine-related activity management.
- **International bodies**: the European Union Directorate-Generals (DG MARE, DG REGIO); the Food and Agriculture Organisation of the UN (FAO); the UN Environment Programme (UNEP); the Organisation for Economic Cooperation and Development (OECD); EuroGOOS, the European component of the Global Ocean Observing System of the Intergovernmental Oceanographic Commission of UNESCO (IOC GOOS), and so on.
- **Academic institutes and research bodies** (eg Centro Euro-Mediterraneo sui Cambiamenti Climatici CMCC Foundation[29] and others) contributing to the body of theoretical knowledge and policy development in the littoral countries, supporting the adaptation and/or development of innovative instruments to be used in the monitoring/recording climate change effects.
- **Private enterprises**, including industry but also SMEs (eg large- and small scale fisheries, individual fishers, as well as private sector enterprises active in non-directly related sectors, such as tourism), whose experiences on the 'front line' of the fisheries and aquaculture industries provide invaluable information for policy makers.
- **NGOs and grass-roots organisations** representing the littoral populations, protecting marine space, and so on.
- **Other regional initiatives/international projects and transnational working groups** that contribute to the adaptation of policies to specific circumstances, leading to improved coordination of action across all governance levels (eg the Interreg ADRION Programme[30]; the Interreg AdriAdapt platform[31]; the Interreg MED Programme[32]; the Union for the Mediterranean[33]; the CIRCE project "Climate change and impact research: the Mediterranean environment"[34]; Plan Bleu, one the Regional Activity Centres of the Mediterranean Action Plan

[29] https://www.cmcc.it/
[30] https://www.adrioninterreg.eu/
[31] https://adriadapt.eu/
[32] https://interreg-med.eu/
[33] https://ufmsecretariat.org/
[34] https://cordis.europa.eu/project/id/36961

(MAP) of United Nations Environment Programme (UNEP)[35]; the Center for Mediterranean Integration (CMI)[36], and many more).

3.3 Key challenges and identified needs

There is a need to build strong relationships between scientists studying climate and Europe's aquaculture and fishing industries, **leading to actionable science and innovation(s)** which can be used by policymakers. While numerous high-level strategies have been developed which provide guidance for managing aquaculture, fisheries, and other marine-related industries in coastal areas in the face of climate change, there is a lack of specific examples of implementation and actionable decision-making in real world situations.

- According to the FAO, numerous regional initiatives aim at embracing short-term measures to reverse the current fisheries and ecosystem challenges, with medium- and long-term actions to adapt to climate change impacts. **Transboundary research and management strategies** remain paramount, hence the importance of continued cross-border cooperation in the region.

> **Cross-border climate change impacts**
>
> Cross-border climate change impacts can be described as the consequences of climate change that occur remotely from the location of their initial impact, where both impacts, and potentially also responses to those impacts (such as adaptation), are transmitted across one or more borders1. Downstream consequences of climate change impacts propagate through an impact transmission system while adaptation responses to deal with the impacts propagate through a response transmission system.
>
> Impacts can cause adverse effects on a wide range of sectors, eg trade, investments, business and supply chains, transboundary water stress, the food production/supply chain system, and so on.
>
> Current research into cross-border impacts is dispersed and fragmented, often being addressed within different contexts or classified under contrasting headings. Yet an understanding of climate change impacts and responses requires recognition of different types of climate triggers, categories of cross-border impacts, the scales and dynamics of impact transmission, the targets and dynamics of responses and the socio-economic and environmental context that also encompasses factors and processes unrelated to climate change.
>
> *Source: Timothy R. Carter, Magnus Benzie, Emanuele Campiglio, Henrik Carlsen, Stefan Fronzek, Mikael Hilden, Christopher P.O. Reyer, Chris West, A conceptual framework for cross-border impacts of climate change, Global Environmental Change 69 (2021) 102307, www.elsevier.com/locate/gloenvcha*

- Furthermore, **additional proactive approaches**, including scenario planning and MSE (Management Strategy Evaluation), are needed to utilize the collective knowledge of fishermen, aquaculture managers, and scientists in the design and implementation of short- and long-term climate adaptation strategies. **Designing and implementing adaptive management systems** that identify and integrate best-fit approaches and tactics for specific fisheries/aquaculture initiatives will also contribute to sustaining productive and economically viable fisheries in the face of climate change[37]. An innovative approach to capacity building where needed among the stakeholders is highly desirable.

[35] https://planbleu.org/en/
[36] https://www.cmimarseille.org/
[37] *Actions to Promote and Achieve Climate-Ready Fisheries: Summary of Current Practice*, Bell et al, Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science 12:166–190, 2020

- While examining the effects of climate change on the distribution, abundance, seasonality of fisheries production, the **combined effects with non-climate stressors** (eg pollution) are equally important and should be included in relevant policies, strategies and implementation plans. For example, practices and techniques for the reduction of wastewater emissions, energy consumption and carbon emissions during the production, transport and processing of aquaculture products, in order to reduce the 'footprint' and increase the positive contribution of this sector to the environment, are closely linked to the issue of climate change.

3.4 SWOT Analysis (Strengths, Weaknesses, Opportunities, Threats)

The complexity of the effects which climate change has on aquaculture and fisheries is significant. For instance, the temperature of Europe's seas is increasing faster than in global oceans due to climate change, and temperature affects the physiology of both fish and pathogens, potentially leading to significant increases in disease outbreaks within aquaculture systems, resulting in severe financial impacts. At the same time, simulations suggest that at the individual level, fish may benefit from warmer temperatures in the future in terms of growth, thus reaching commercial sizes faster, while husbandry parameters may have as large an effect on growth as the projected shifts in climatic cues. However, this benefit will be largely offset by the adverse effects of extreme weather events at the population level. Such events are projected to be more frequent in the future and, depending on the intensity one assigns to them, could cause losses in biomass and farm profits that range from mild to detrimental for the industry.[38]

An analysis of the Strengths, Weaknesses, Opportunities and Threats related to climate change would include the following[39]:

Strengths:

- Fisheries management agencies and academic experts globally have produced a **significant body of work** characterizing and forecasting ecosystem changes and fishing community vulnerability. In some cases, this work now drives the development of policies, strategies, and plans, moving from general theory and principles toward explicitly addressing and mitigating short- and long-term climate change impacts on natural resources and fishing communities.
- Many fishing community members have demonstrated their **capacity for adaptation**, and many of the responses needed for achieving climate ready fisheries will require the adaptive approaches that are already employed by fishers.
- Development and adoption of **electronic reporting / monitoring technologies** are well underway and beginning to improve accountability in many fisheries. Continued progress in the pace and scale of **fisheries data system modernization** is critical—not just for improving catch accounting but also for shortening signal-to-response lags and filling diverse data and information gaps to enable cost-effective adaptive management strategies.

Weaknesses:

[38] Stavrakidis-Zachou, O., Lika, K., Anastasiadis, P. et al. *Projecting climate change impacts on Mediterranean finfish production: a case study in Greece*. Climatic Change 165, 67 (2021). https://doi.org/10.1007/s10584-021-03096-y

[39] *Actions to Promote and Achieve Climate-Ready Fisheries: Summary of Current Practice*, Bell et al, Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science 12:166–190, 2020

- There are relatively **few intentional, well-documented examples** of tactical responses to climate change impacts on fisheries, aquaculture, and other marine and coastal-based industries.
- Currently fishery management systems are typically handicapped **by excessive lags between signal and response**; but the speed and magnitude of climate impacts on coastal and marine benthic and pelagic habitats are novel and require rapid and decisive management and industry responses. Any conflict between fishing sectors and management will prevent the collaborative approaches that are needed to design and implement durable solutions.

Opportunities:

- Fishing communities have adaptive capacity, so it follows that **community based management approaches** that directly engage and enlist fishing groups in management system redesign and operations can be generated in many cases, especially where public funding for natural resource management is inadequate.

Threats:

- **Management systems based on historical** or static harvest species distribution patterns and vital rates, will likely fail to meet sustainable fisheries goals.
- Maintaining sustainable fisheries in the face of climate change will require increased attention to **reducing all of the stressors** to the social–ecological systems in which fisheries exist and persist—from portside infrastructure decline to eutrophication and coastal habitat loss.

4 RECOMMENDATIONS

4.1 Recommendations

A number or recommendations may be made in relation to further developing transnational monitoring and recording for the early detection of climate changes in the maritime and coastal areas. Many approaches and tools are applicable, which are currently applied in other fields, addressing other topics, and can be transferred to the sector which is the subject of this Paper.

✓ Optimising the collection and processing of data

In all countries of the Region, there is ongoing monitoring and recording of a wide range of data, resulting in national databases. The information thus gathered is used in the analysis: of the impact of climate change on aquaculture/fisheries; of the parameters needed for the future development of aquaculture (water temperature, pH, currents, etc.); of the relations with the physiology and pathology of farmed organisms, etc. National databases are shared at EU level and available to the countries of the region.

CASE STUDY: The Balearic Islands Coastal Ocean Observing and Forecasting System (SOCIB) is a multi-platform distributed and integrated system that provides streams of oceanographic data and modelling services to support operational oceanography in a European and international framework, contributing to the needs of marine and coastal research in a global change context. SOCIB is developing a comprehensive set of ocean indicators in the Mediterranean Sea and around the Balearic Islands, key environments that are strongly affected by climate change and human pressure. This new SOCIB value-added product addresses the sub-regional ocean variability from daily (events) to interannual/decadal (climate) scales. A user-friendly interface has been implemented to monitor, visualize and communicate ocean information that is relevant for a wide range of sectors, applications and regional end-users. These sub-regional indicators allow the detection of specific events in real time. Remarkable events and features identified include marine heat waves, atmospheric storm, extreme river discharge, mesoscale eddy, deep convection among others, all of them being oceanic phenomena that directly impact the ocean circulation and marine ecosystems. The long-term variations, in response to climate change, are also addressed highlighting and quantifying trends in physical and biogeochemical components of the ocean as well as sub-regional differences. At both (sub-) regional, national and international levels, a society-aligned science will have stronger impact on policy decision-makings and will support society to implement specific actions to address worldwide environmental challenges.

Sources: Juza M and Tintoré J (2021) Multivariate Sub-Regional Ocean Indicators in the Mediterranean Sea: From Event Detection to Climate Change Estimations. Front. Mar. Sci. 8:610589. doi: 10.3389/fmars.2021.610589
https://eurogoos.eu/

To further enhance the collection and processing of data at transnationvel, innovative approaches to the following are required:

- **Regional agreements (consensus) on the type of data sets which need to be gathered, should be regularly reviewed, updated and ratified**: the kind of data to be collected, the size of the databases in order for any conclusions to be valid, the comparability of the data collected, how/what data is to be compared/correlated for the effects of climate change, the interoperability of the data sets, and so on. Thus, the current regional marine indicators could be extended, adapted or refined according to the user needs over time; additional sub-regions could be defined and added, extending the area being monitored, or focusing on smaller sub-regions; similarly, the scope of the indicators could be extended.

Example: In order to advance "pelagic seascape ecology" and "operational fisheries oceanography", further analytical developments would be welcome, such as: (i) improving the accessibility to long time-series and near real-time predictions of key environmental variables in common data formats, (ii) accessing well-validated environmental data products from remote sensing and hydrodynamic models (long-term simulations and forecasts), (iii) sharing of appropriate knowledge of the oceanographic processes driving species ecology, (iv) designing of appropriated pelagic seascape metrics capturing the dynamic processes affecting the species ecology, and (v) collaborating on the identification of the specific needs in terms assessment and management.

To achieve the above, data from remote sensing and hydrodynamic models should be available at global, regional, and local levels from multiple operational oceanographic data providers. There should also be standardization in data formats, as well as software libraries for operational oceanographic data handling. Dedicated efforts at regional and local level are required, to develop data-assimilative high-resolution hydrodynamic models, which can combine data from multiple sampling platforms[1].

It is evident that a regional, cross-border approach to such issues is an absolute necessity.

- **The sharing and exchange of data gathered by a wide range of actors should be pro-actively facilitated** (eg through inter-national agreements taking into account national legislation): academic institutions, research foundations, public research centres, private sector organisations, private businesses in the fisheries/aquaculture sector gathering and monitoring data or operating in the coastal regions in other sectors, etc , should be actively encouraged to collect the type of data needed, in the format needed. The sharing of the data thus collected, at both national and regional levels, should be facilitated - if not rewarded. This can be achieved through facilitating agreements between institutions (especially academic/research institutions which lead the way in data identification and collection related to the impacts of climate change) and/or public authorities, through providing grants and other financial incentives for collaboration, through providing space(s) where exchange and collaboration can take place, etc.

  For example, bilateral agreements (eg Memoranda of Understanding) could specifically address the systematic exchange of data gathered by academic and research institutions, with government. A formalized arrangement would greatly improve the transfer of data, since it would clearly lay out what data is to be shared, by whom, when and how: increasing transparency and efficiency. Academic institutions have been studying climate change for many years and have sophisticated data collection systems in place. This wealth of information should feed into policy development which states are now called upon to deliver[40].

- **The development and dissemination of relevant IT systems and tools able to process Big Data should be a priority** for national authorities – and eventually, for regional-level bodies charged with monitoring and recording climate change effects on aquaculture and fisheries, including the coastal areas. The tools of Big Data and systems sciences have an important role in the recognition of climate challenges and mitigation opportunities due to the integration of

[40] Indicatively, the Horizon programme, the EC's research and innovation initiative, has attracted great interest. For instance, according to the Horizon 2020 Data Hub, the European Maritime and Fisheries Fund has allocated funds totaling 133 mio Eur, to 153 projects involving 39 countries, and a total of 481 partnering organisations. Specifically on the topics: Blue Economy, Blue Careers, Common Information Sharing Environment (CISE), Environmental Monitoring and Restoration, Sea Basin Cooperation, it has funded 60 projects; involving 224 partners, 54 coordinators, 31 countries, and a total of 38 mio Eur in funds. Under the topic 'Climate Action' funded by the Horizon 2020 programme, a total of 80 projects were allocated a total of 487 mio Eur, distributed between 831 partners in 81 countries.

heterogeneous data and models, and the exploration of the relationship between environmental and social factors, acting as the foundation for future climate computing[41]

A recent study highlights the **heterogeneity of the European operational modelling capacity of marine and coastal systems**, in terms of atmospheric and land boundary conditions, its limited deployment for biogeochemical phenomena, and a restricted use of data assimilation methods[1].

A wide variety of operational models are currently used in European Seas, based on different computer codes and sets of parameterizations, resolving a disparate range of spatial and temporal scales, using diverse data sources as forcing and as initial and boundary conditions and relying, or not, on data assimilation methods. This diversity in model technical characteristics stems from geographical constraints and from the specific requirements of different modelling objectives.

The described issues call for institutional integration efforts and promotion of good practices to homogenize operational marine model implementations, and to ensure that external forcing datasets, observation networks and process formulations and parameterizations are adequately developed to enable the deployment of high-level operational marine and coastal modelling services across Europe.

✓ Improving communication and collaboration with stakeholders across borders

When approaching a 'wicked problem' such as climate change[42], it is imperative that cooperation between all stakeholders in identifying and eventually working towards implementing solution(s) is achieved. The cornerstone to achieving cooperation is through effective communication with all actors involved (directly and indirectly) in the fisheries/aquaculture sectors, including those operating in the coastal areas in related sectors.

Without the **collaborative cooperation of all stakeholders**, it will be impossible to achieve meaningful monitoring and recording of climate change, given the complex inter-relationships and the sheer volume of relevant stakeholders in the maritime and coastal areas.

- Carrying out a coordinated stakeholder identification, mapping and analysis exercise at national and transnational level, and keeping this updated, is a prerequisite for stakeholder engagement. This will identify the most appropriate channels of communication as well as the tailored messages to be used in a communication campaign reaching out across the region.

[41] Mitigating the impacts of climate change, and successful adaptation to climate change, requires effective strategic planning by countries at a transnational level, and decision-making based on complex models and sources of information. There is a need for more research and development objectives, to realize and manage the complex issues of climate change through Big Data tools. The Big Data toolkit enables the systematization, processing, and evaluation of heterogeneous data and information sources (which cannot be achieved with traditional disciplinary analysis tools) while at the same time taking socio-economic factors into account. The System of Systems (SoS) thinking or climate computing can offer improved knowledge integration – data and models which focus on particular areas of sustainability contribute to the study of the complex problems of climate change. See Sebestyén V, Czvetkó T and Abonyi J (2021) The Applicability of Big Data in Climate Change Research: The Importance of System of Systems Thinking. Front. Environ. Sci. 9:619092. doi: 10.3389/fenvs.2021.619092

[42] In fact, climate change has been classified as a "super wicked problem", as it has the following characteristics: (i) there is a significant time deadline on finding the solution, (ii) there is no central authority dedicated to finding a solution, (iii) those seeking to solve the problem are also causing it, and (iv) certain policies irrationally impede future progress. (Levin, Kelly; Cashore, Benjamin; Bernstein, Steven; Auld, Graeme (23 May 2012). "Overcoming the tragedy of super wicked problems: constraining our future selves to ameliorate global climate change". Policy Sciences. 45 (2): 123–152.)

- Appropriate **channels of two-way communication** should be established, where open and transparent discussions can take place. For example, online discussion fora, in-person meetings and debates, local- and regional-level workshops, the use of sectoral newsletters and publications, etc, under the auspices of the relevant national authorities. It is important that the participating parties understand and see that their inputs are taken into account, whether in policy-formulation or decision-making.
- To this end, **capacity building for stakeholders** would further enhance their constructive involvement, particularly as regards the identification and adaptation/use of innovative approaches, techniques, tools and instruments. Knowledgeable stakeholders will vastly improve the region's ability to adapt to the changes expected due to climate change.
- For instance, **upgrading the role of Small Scale Fisheries (SSF)** so that their knowledge and experience is taken into account when gathering data in the detection of climate changes, and when developing strategies to address climate change in fisheries, particularly adaptation and mitigation plans.
- It is equally important to achieve broad **consensus amongst stakeholders**, about dealing with the impacts of climate change in the maritime and coastal area.

✓ Strengthening the governance of fisheries/aquaculture

Strengthening the governance of the maritime and coastal areas has a direct impact on the fisheries and aquaculture industries. Recommendations in this area include

- Better scientific and socio-economic data should be integrated into fisheries governance systems by **embedding the use of data into policy-making processes** (where possible) and investing in data collection.
- **Transparent mechanisms for stakeholder participation** in the governance process (e.g. advisory groups) should be more widely used.
- The decision-making processes should be reviewed to **find more efficient pathways** than consensus-based decisions.
- To improve fisheries governance, further **analysis of institutional arrangement** of fisheries governance is needed to better understand how different structures impact policymaking. The emergence of Transnational Municipal Networks is an interesting development in this respect; they act as a tool for cooperation that supports marine governance in the context of climate change adaptation and mitigation. Municipalities/cities work together implementing primarily soft mitigation actions, and also adaptation measures.

✓ Dissemination of innovative technologies and solutions promoting sustainability in fisheries/aquaculture

Sustainability in fisheries/aquaculture is a wide-ranging issue, to be tackled in-depth on a regional basis. Specific aspects to be addressed include the dissemination of innovative technologies and solutions across the region which will mitigate the effects of climate change: facilitating cooperation in the development, adaptation and use of such solutions (eg through financial incentives

programmes, facilitation of cross-border cooperation of relevant institutions and organisations, inclusion of technological issues in policy making at national and transnational levels). For instance:

- Funding and facilitating cross border cooperation on transnational studies, blueprints, pilot operations for **improving the technical characteristics for aquaculture infrastructure** (eg cages, moorings) and for coastal infrastructure, resistant to extreme weather conditions.
- Development of regular **monitoring and regulation of abiotic parameters** at transnational level (eg temperature, water circulation speeds) in marine aquaculture units in floating cages.
- Promotion of medium-term **planning for the gradual 'reassignment' of aquaculture units** from vulnerable to less vulnerable positions: exchange of relevant information, realisation of collaborative studies, pro-active stakeholder consultations, all feeding into transnational planning.
- Preparatory studies and agreement on the **implementation of prevention and biosecurity measures** to maintain the health of farmed organisms in the marine and coastal areas.
- Promotion of innovative solutions for the **monitoring of non-native species**.

4.2 Innovation Secretariat

The setting up an international 'Innovation Secretariat' in the EUSAIR Region is proposed, in order to pro-actively support the planning and implementation of transborder cooperation, representing all the participating countries and coordinating a joint, innovative approach to monitoring and recording climate change.

- It will have an important role in **coordinating**
  - the alignment of legislation/regulations impacting transborder cooperation in all relevant fields;
  - the collection and sharing of data;
  - the exchange of best practices and experiences within the fisheries and aquaculture industries;
  - the effective operation of international experts' working groups
- It will facilitate the **communication** between all stakeholders, who will need to work together in addressing the impacts of climate change, assisting in the collection and dissemination of accurate and reliable information in an effective way, facilitating the creation of a common understanding of the problems and proposed solutions.
- It may be authorized to **represent** the Region as it participates in international platforms, fora, programmes, initiatives, etc., addressing relevant issues on an international level.
- **Other activities** it may undertake include capacity building workshops for stakeholders, and training seminars, hosting events bringing together experts in a particular field, publishing findings/recommendations on an ad hoc or regular basis, linking academia, public bodies, private institutions, NGOs, grassroots organisations, through facilitating stakeholder meetings.

The approach to establishing an Innovation Secretariat would involve:

1) Establishing a common vision for its role and reaching agreement on its creation and the scope of its activities/responsibilities. Formal political recognition would be necessary, to ensure that it is not marginalized or even ignored.

2) Discussion and agreement upon its structure, settling management arrangements (eg proposing a rotation between the participating countries) and operational issues, as well as joint sources of funding. It is necessary to put such arrangements in place, to ensure that the body will not be merely a discussion group without direction or agenda. External funding is crucial (it should not rely on financing from a single country/organization): it will ensure that the Secretariat can function independently, and will encourage partners to join.
3) Agreement upon an initial strategy (a 24-month and 48-month plan of action, including a timetable of activities, deliverables, monitoring / evaluation procedures, available budget).
4) The establishment of the Innovation Secretariat to be accompanied by a region-wide communication campaign signaling the commitment of the participating countries to the aims of the Secretariat and the need to engage with all stakeholders.

An Innovation Secretariat would bring together the relevant expertise, experience and resources of the participating countries, and its added value would be the improved coordination and creation of momentum to generate and support innovation in the region.

While innovation requires flexibility, adaptability, and change, at the same time, an effective Innovation Secretariat requires some institutionalization and primarily, a tangible, steady, and certain commitment of resources. Thus, one critical success factor would be securing commitment of resources. A second success factor is the careful selection of appropriate leadership, coupled with investment in the leadership, and the provision of appropriate support for the leadership to carry out its mandate. Another success factor is the creation of a specific mission, tied to specific impacts. Specific and meaningful goals need to be identified and maintained, for the Secretariat to act with integrity and longevity. Other important factors include securing partners' support of the Secretariat work, ideally through their direct engagement and hence commitment from the participating countries; maintaining effective two-way communication with all internal and external partners (taking into account what they want from the Secretariat, and disseminating information about what the Secretariat achieves); conducting a communication campaign; seizing opportunities to share lessons and information emerging from the Innovation Secretariat through both formal and informal networks.

A breakdown of the initial steps needed for setting up a Secretariat would be as follows:

Nr	Description	Result
1	Reach consensus agreement on the need for a Secretariat, define its strategic goals and agree on the organizational model it will follow	Agreement to have the Secretariat
2	Discussion and agreement on the ToR for the Secretariat, including scope of activities, overall and specific objectives, the main services it will offer, but also staff establishment, equipment, etc. The input(s) and degree of involvement of partners must be very clear and understood by all.	Agreement on the ToR and practical details
3	Selection of a small committee to lead and guide the set-up of the Secretariat	Functioning Committee on the Secretariat
4	Explore options for funding for the Secretariat (national contributions, EC financing, donations, etc.)	Funding for the Secretariat ensured
5	Discussion of job description of the Secretariat leadership (Executive Secretary)	Job description for the Executive Secretary
6	Discussion and agreement on the selection of Executive the Secretary. S/he must have the trust of all partners, good	Executive Secretary is appointed

Nr	Description	Result
	communication and diplomatic skills, and there should be recognition of his/her capabilities in the sector. (Before the Secretariat achieves legal recognition as an independent entity it cannot hire/fire staff, so the initial staff, including the Executive Secretary, may be employed by the host organisation or deployed by one of the Secretariat partners.)	
7	Discussion and agreement on host country/organization for the Secretariat, negotiations with the host on the terms for hosting the Secretariat. It is important that the host organization understands the function of the Secretariat, and does not attempt to 'own' it, while at the same time, recognizing that the Secretariat can add value to its own work, and therefore, be prepared to support it.	MoU with host country/organization is concluded, including the terms of hosting the Secretariat
8	Registration of the Secretariat and its function, as part of the host establishment It is suggested that initially, at least, the Secretariat is organised as a component or a project within the host organization (or other registered institution). This avoids the need for potentially complex and time-consuming legal procedures needed to establish a separate legal entity. Once it starts to operate successfully, its legal status can be decided upon at a later date.	Secretariat position and function within the host organization is assured
9	Discuss draft work plan and budget for the operation of the Secretariat, as a minimum for the first 1-2 years of operation (including risk management plan, monitoring, impact assessment, etc.)	Secretariat work plan and budget agreed
10	Review and select additional staff for the Secretariat	Secretariat is staffed
11	Arrange formal inauguration of the Secretariat, linked to a communication campaign informing all stakeholders of its operation	Formal opening of the Secretariat, awareness raising campaign about the Secretariat

The establishment of the Secretariat will necessarily take into account both (i) the 'demand-driven' nature of the Secretariat (i.e., it will respond to the actual needs of the region in developing innovation in this sector, as identified in its mission statement and during the early stages of its operation), and (ii) the resources it will have at its disposal (human and financial) forming the parameters within which it can operate.

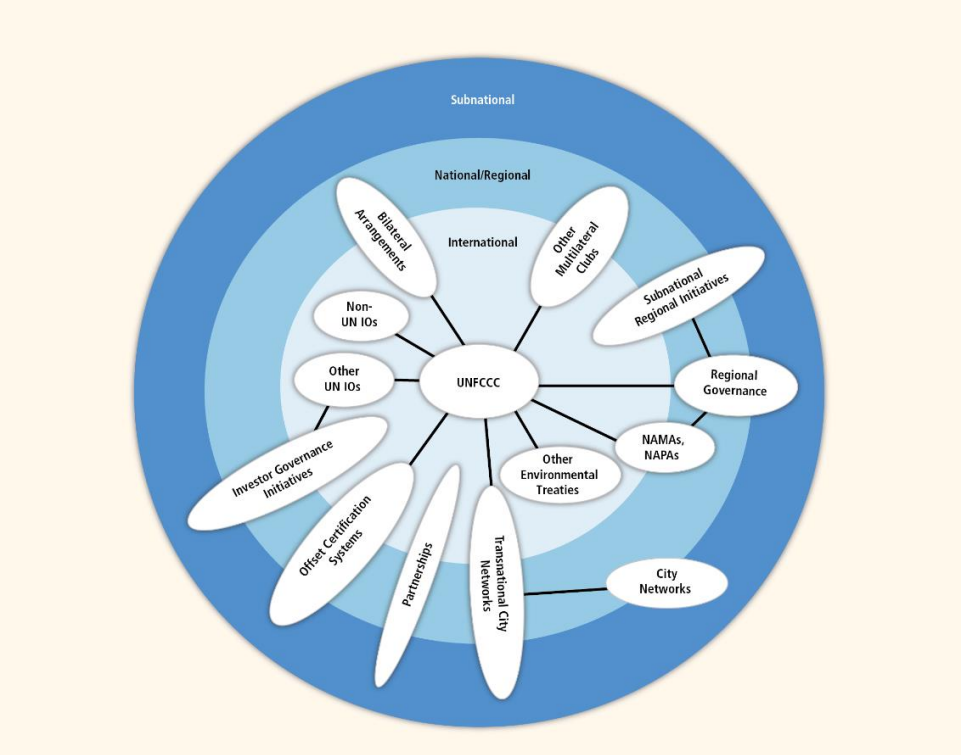
4.3 Memoranda of Understanding, transnational agreements

The importance of collaboration between governmental authorities in the field of climate change as it affects fisheries and aquaculture, and by extension marine and coastal areas, is clear. Although public authorities can be aware of the need for such cooperation, the process is often slow and complex, as meetings and discussions take place at various levels and between the numerous involved stakeholders; there are varying agendas, and often lack of clarity as to a specific goal or

objective to be attained; there are delays in following through with specific actions. The necessity for long-term planning as regards climate change, is also a constraining factor for decision-makers who are often more focused on short- and medium-term results.

However, it is imperative that transnational collaboration is achieved. It is suggested that **Memoranda of Understanding** can provide a useful tool. Memoranda of Understanding (MoUs) describe the broad outlines of an agreement between two or more parties, communicating the mutually accepted expectations of the parties and signalling the intention to move forward to a more binding type of contract – or, in this case, partnership.

Depending on the character of each MoU, it can clearly outline the specific points of understanding, naming the parties involved, describing the issue(s) on which they are agreeing, defining the scope of cooperation, each party's roles and responsibilities.



International Cooperation: Agreements and Instruments
Source: UN Intergovernmental Panel on Climate Change (IPCC) https://www.ipcc.ch/

An MoU indicates intention to proceed to a more formalized, **legally binding agreement** aligned with the agreement outlined in the Memorandum. There is a growing body of international agreements addressing climate change, and it is expected that transnational cooperation in the Adriatic Ionian region will also be expressed through international treaties.

Within this framework, there is **a range of instruments** available to central authorities, regional authorities and other institutions, which promote cooperation on a bilateral basis between cooperating bodies, or within and between networks of organisations including academic institutions.

Examples of instruments typically used by collaborating institutions

Cooperation	*Collaboration*	*Education & Outreach*
Exchanging of good practices	Collaboration with the private sector	Educational materials (education and outreach)
Thematic conferences/workshops	Cooperation with other urban networks	Publications
Competitions and awards	Lobbying	Communication tools (website, newsletter, social media, …)
Positions/declarations	Scientific and academic cooperation	Technical assistance
Working groups/subnetworks		Training programmes/webinars
Study visits		Databases

The existence and operation of transnational cooperation instruments and tools depends primarily on the availability of human resources which the authorities allocate, and their commitment. Financial resources are also an important factor, although most of the above instruments can be applied with varying degrees of financial resources.

The object(s) of the MoUs and the various types of instruments listed above, depends on the policy priorities of each authority and the degree to which these coincide with the policy priorities of other authorities. How technical the various meetings, trainings, conferences, etc., are, depends on the organizing authorities and their long-term agenda, what they hope to achieve through the specific event or action.

4.4 Sources of funding

Sources of financing for the adoption of processes and methods (innovation transfer), as well as technological tools, can be found at international level as well as national level for initiatives undertaken (fully or in part) by each individual littoral country.

A list of potential sources of finance follows below:

International level	
EU financial instruments	Programmes such as - European Maritime, Fisheries, and Aquaculture Fund EMFAF (ESIF), now delegated to the European Climate, Infrastructure and Environment Executive Agency CINEA - Interreg (for cooperation across borders) - Horizon Europe (for research and innovation) - InvestEU (for investment, innovation and job creation) - COSME (for SME competitiveness) - LIFE programme - EaSI (for employment & social innovation) - etc.
European Investment Bank EIB	

National level	
Government grants	Incl. via the Structural Funds
Private funds	- Academic grants, bursaries, research scholarships, etc - Funding by private enterprises (eg prizes, research funds, financing via CSR initiatives, etc) - Business Angels, Venture Capital
Banking system, financial institutions	Debt, Equity, Business Angels, Venture Capital
Fund raising, donations, crowdfunding	

5 NEXT STEPS

The need to develop transnational monitoring and recording of climate change impacts on fisheries and aquaculture is quickly becoming widely understood and accepted. So is the urgency of this issue, and the need to strengthen, as much as possible, stakeholder capacity to identify and implement innovative solutions. The EUSAIR partners are committed to addressing the issue through the pursuit of synergies and the establishment of suitable coordination mechanisms, as for all the challenges which the region faces.

The recommendations described above are fully aligned with this approach: the impacts of climate change in maritime and coastal areas can only be addressed through multi-stakeholder collaboration at regional, trans-national level. The following next steps may be envisaged, briefly:

(1) Setting up institutional arrangements at international level (formal agreements) to define what data is to be collected and how this data is to be shared within the Adriatic-Ionian Region. Attention must be paid to issues such as: who will retain ownership of the data; which national authority(ies) will have access to the data; how the data will contribute to governmental policy-making, and so on.

(2) Transnational arrangements (MoUs) to set up collaboration between national Ministries or other authorities, and with academic/research institutions. It is important to harness the knowledge generated by academia in this field, given their lengthy, in-depth and highly relevant occupation with all aspects of climate change in the region.

(3) Institutional agreements at national level, to ensure that all stakeholders are actively engaged, including research organisations, non-governmental organisations, private enterprises collecting data and taking action for their specific sector, and any other entity not bound by international MoUs or similar regulations.

(4) Stakeholder mapping in the participating countries is a key action, since an analysis of the relevant actors is the foundation for planning subsequent initiatives to be taken in the region.

(5) In terms of soft actions, targeted communication initiatives throughout the region will generate interest and secure the engagement of all stakeholders, which is an important pre-requisite for the successful adaptation of the fisheries/aquaculture industries to climate change.

(6) Innovation Secretariat: taking into account the level of inter-national cooperation, the establishment of an Innovation Secretariat in the EUSAIR region may be considered.

6 ANNEX

6.1 EUSAIR STRATEGY

The EU Strategy for the Adriatic and Ionian Region is one of the four EU macro-regional strategies, besides the EU Strategy for the Baltic Sea Region (2009), the EU Strategy for the Danube Region (2011) and the EU Strategy for the Alpine Region (2016).

The EUSAIR covers ten countries: four EU Member States (Croatia, Greece, Italy, Slovenia) and six non-EU countries (Albania, Bosnia and Herzegovina, Montenegro, North Macedonia, San Marino, Serbia).

The general objective of the EUSAIR is to promote economic and social prosperity and growth in the region by improving its attractiveness, competitiveness and connectivity. With four EU members and four non-EU countries the strategy will contribute to the further integration of the Western Balkans.

The participating countries of the EUSAIR agreed on areas of mutual interest with high relevance for the Adriatic-Ionian countries, being it common challenges or opportunities. The countries aim to create synergies and foster coordination among all territories in the Adriatic-Ionian Region in **four thematic areas/ pillars** representing key challenges as well as key opportunities in the region. For each pillar, specific topics and actions have been identified, taking into account the needs, urgency of the issue and the added value of joint actions taken in order to solve the existing challenges or build upon the future opportunities.

6.1.1 Pillars

PILLAR 1: BLUE GROWTH

The specific objectives for this pillar are:

- To promote research, innovation and business opportunities in blue economy sectors, by facilitating the brain circulation between research and business communities and increasing their networking and clustering capacity.
- To adapt to sustainable seafood production and consumption, by developing common standards and approaches for strengthening these two sectors and providing a level playing field in the macro-region.
- To improve sea basin governance, by enhancing administrative and institutional capacities in the area of maritime governance and services.

To achieve the abovementioned objectives, Pillar 1 will focus on three topics:

Topic 1 – Blue technologies

Topic 2 – Fisheries and aquaculture

Topic 3 – Maritime and marine governance and services

PILLAR 2: CONNECTING THE REGION

The specific objectives for this pillar are:

- To strengthen maritime safety and security and develop a competitive regional intermodal port system.
- To develop reliable transport networks and intermodal connections with the hinterland, both for freight and passengers.
- To achieve a well-interconnected and well-functioning internal energy market supporting the three energy policy objectives of the EU – competitiveness, security of supply and sustainability.

To achieve the abovementioned objectives, Pillar 2 will focus on three topics:

Topic 1 – Maritime transport

Topic 2 – Intermodal connections to the hinterland

Topic 3 – Energy networks

PILLAR 3: ENVIRONMENTAL QUALITY

The specific objectives for this pillar are:

- To ensure a good environmental and ecological status of the marine and coastal environment by 2020 in line with the relevant EU acquis and the ecosystem approach of the Barcelona Convention.
- To contribute to the goal of the EU Biodiversity Strategy to halt the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restore them in so far as feasible, by addressing threats to marine and terrestrial biodiversity.
- To improve waste management by reducing waste flows to the sea and, to reduce nutrient flows and other pollutants to the rivers and the sea.

Two topics are identified as pivotal in relation to environmental quality in the Adriatic-Ionian Region:

Topic 1 – The marine environment

Topic 2 – Transnational terrestrial habitats and biodiversity

PILLAR 4: SUSTAINABLE TOURISM

The specific objectives for this pillar are

- Diversification of the macro-region's tourism products and services along with tackling seasonality of inland, coastal and maritime tourism demand.
- Improving the quality and innovation of tourism offer and enhancing the sustainable and responsible tourism capacities of the tourism actors across the macro-region.

To achieve the abovementioned objectives, Pillar 4 will focus on two topics:

Topic 1 – Diversified tourism offer (products and services)

Topic 2 – Sustainable and responsible tourism management (innovation and quality)

6.2 List of related projects

IT IS NOT POSSIBLE TO LIST ALL RELATED PROJECTS, as the number of initiatives in the fields of climate change impacts on fisheries and aquaculture, the monitoring and recording of climate changes is very large – especially when projects in fields related to the impact of climate change on maritime and coastal regions are also taken into account (eg tourism, urban/rural development, etc). However, the selection below is indicative of the great investment of the EC in issues relevant to climate change, fisheries and aquaculture, transboundary cooperation for marine and coastal areas.

PROJECT TITLE	LINK
HORIZON	
HORIZON 2020: 3.791 projects listed under the topics 'climatic change', 'coastal ecosystems' and 'fisheries'	https://cordis.europa.eu/search?q=contenttype%3D%27project%27%20AND%20(%2Fproject%2Frelations%2Fcategories%2FeuroSciVoc%2Fcode%3D%27%2F23%2F45%2F30018%2F30032%2F30055%27%20OR%20%2Fproject%2Frelations%2Fcategories%2FeuroSciVoc%2Fcode%3D%27%2F23%2F49%2F335%2F1009%2F54034042%27%20OR%20%2Fproject%2Frelations%2Fcategories%2FeuroSciVoc%2Fcode%3D%27%2F27%2F81%2F489%27)&p=1&num=10&srt=Relevance:decreasing
Mission Climate adaptation and Mission Ocean and waters - Joint demonstration for coastal resilience in the Arctic and Atlantic Sea basin **TOPIC ID: HORIZON-MISS-2022-OCEANCLIMA-01-01**	https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-search;callCode=null;freeTextSearchKeyword=;matchWholeText=true;typeCodes=0,1,2,8;statusCodes=31094501,31094502,31094503;programmePeriod=2021%20-%202027;programCcm2Id=43108390;programDivisionCode=null;focusAreaCode=null;destination=null;mission=45320869;geographicalZonesCode=null;programmeDivisionProspect=null;startDateLte=null;startDateGte=null;crossCuttingPriorityCode=null;cpvCode=null;performanceOfDelivery=null;sortQuery=sortStatus;orderBy=asc;onlyTenders=false;topicListKey=topicSearchTablePageState
DOGMATiCC Digestion, Osmoregulation and Metabolism in fish relevant to Aquaculture and in a Changing Climate **TOPIC ID: MSCA-IF-2018 - Individual Fellowships**	https://cordis.europa.eu/project/id/839168
MARINA Marine Knowledge Sharing Platform for Federating Responsible Research and Innovation Communities **TOPIC ID: ISSI-3-2015 - Knowledge Sharing Platform**	https://www.marinaproject.eu/
MARmaEd Marine Management and Ecosystem Dynamics under climate change	https://www.marmaed.uio.no/

TOPIC ID: MSCA-ITN-2015-ETN - Marie Skłodowska-Curie Innovative Training Networks (ITN-ETN)	
MaCoBioS Marine Coastal Ecosystems Biodiversity and Services in a Changing World **TOPIC ID: LC-CLA-06-2019 - Inter-relations between climate change, biodiversity and ecosystem services**	https://macobios.eu/
MultiSeaSpace Developing a unified spatial modelling strategy that accounts for interactions between species at different marine trophic levels, and different types of survey data **TOPIC ID: MSCA-IF-2018 - Individual Fellowships**	https://cordis.europa.eu/project/id/847014
CLOCK Climate Adaptation to Shifting Stocks **TOPIC ID: ERC-StG-2015 - ERC Starting Grant**	https://futureoceanslab.org/projects/clock/
INTERREG	
Interreg Mediterranean: 140 projects in the countries Croatia, Greece, Italy, Malta, Slovenia	https://interreg-med.eu/projects-results/our-projects/
FishMPABlue 2, **FishMPA Blue 2 plus** **Improving Sustainability of the Small Scale Fisheries in Marine Protected Areas of Mediterranean**	https://fishmpablue-2.interreg-med.eu/
AMAre, AMArePLUS **Actions for Marine Protected Areas**	https://amare.interreg-med.eu/
SHAREMED **Sharing and Enhancing Capabilities to Address Environmental Threats in the Mediterranean Sea**	https://www.fundacion.valenciaport.com/en/project/sharemed-sharing-and-enhancing-capabilities-to-address-environmental-threats-in-the-mediterranean-sea/
MPA Adapt – Guiding Mediterranean MPAs through the Climate Change Era building Resilience and Adaptation	https://mpa-adapt.interreg-med.eu/
MPA Engage - Monitoring Climate change-related responses in the Mediterranean	https://mpa-engage.interreg-med.eu/our-story/the-mpa-engage-project/
FAME Fisheries and Aquaculture Monitoring and Evaluation	
TEKNOFISK Real-time camera observation in the Danish trawl fishery—technology based intelligent fishery	https://oceans-and-fisheries.ec.europa.eu/news/teknofisk-trawling-new-tune-2021-12-22_en
FARNET Fisheries Areas Network	
A coastal management plan by local fishers and fish farmers (Italy, Emilia Romagna Coast FLAG)	https://webgate.ec.europa.eu/fpfis/cms/farnet2/on-the-ground/good-practice/projects/coastal-

	management-plan-local-fishers-and-fish-farmers_en.html
Promoting aquaculture products (Slovenia, Soča Valley FLAG)	https://webgate.ec.europa.eu/fpfis/cms/farnet2/on-the-ground/good-practice/projects/promoting-aquaculture-products_en.html
Cooperating to preserve protected species and fishing businesses (Italy, Venetian - VeGAL FLAG)	https://webgate.ec.europa.eu/fpfis/cms/farnet2/on-the-ground/good-practice/short-stories/cooperating-preserve-protected-species-and-fishing_en.html