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TOWARDS SUSTAINABLE BLUE ECONOMY IN TERRITORIAL WATERS OF CYCLADIC ISLAND COMPLEX

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Abstract

Human population and its demand for land, energy and natural resources is growing, creating pressure on marine ecosystems. The uses and users on seas are increasing. Very careful weighing of different user interests against one another and in particular against environmental concerns is required. It is of vital importance to achieve a sustainable development and to ensure that equilibrium is maintained. The role of Marine Spatial Planning (MSP) aims to contribute through effective management of marine resources and sustainable use of them. MSP is taking into account the socio-economic and environmental aspects, ensuring the involvement of all stakeholders and their cooperation too, organizing the available accurate data, and sharing knowledge. There are many human activities in the territorial waters of the Cycladic island complex in Greece without appropriate allocation plan. Some of them are already developed in the study area, while other human activities are going to be deployed soon. In both cases, there is a need for each marine activity to be operated and implemented in a sustainable way by balancing its economic growth with the marine environmental conservation and protection. The involvement of the pillars of sustainability into the marine space aims to reduce the pressure from each marine activity on the marine space of the Cyclades. The pillars are considered as key components for the achievement of the Blue Growth Strategy and thus the Blue Economy Concept; but their development is still in early stages in the case study area. The sustainability analysis leaded to the conclusion that there are more opportunities and strengths, than threats and weaknesses towards a Blue Economy in the Cycladic island complex marine space.

Keywords: marine activities, marine spatial planning, sustainable development, economic growth, environmental conservation, blue growth, blue economy, Cycladic island complex

Chapter 1

Introduction

1.1. The importance of oceans

The planet Earth is covered 71 % by oceans which contain 97 % of the Earth's water and 99 % of the living space on the planet (ECORYS, 2012). Worldwide, millions of people are dependent on oceans. They live within 100 km from the coast. Particularly in Europe, 41 % of the population lives in coastal areas (Economou et al., 2020; Tonazzini et al., 2019). The ocean is a source of life, an ultimate provider of economic and social services; but its meaning and usage are different to everyone. Healthy oceans are vital for humankind and the future of the planet.

Oceans are characterized as the seventh-largest economy on the planet. They are valued at more than USD 24 trillion; however, their actual value is considered higher because some services to humankind are difficult to be calculated. The global value of the marine activities is enormous; estimated at least USD 2.5 trillion (Hoegh-Guldberg et al., 2017; Dalton et al., 2018a).

The marine space is much larger than land. The processes, the ecosystems, the activities that are involved are regulated by different regimes, legislations. The legal boundaries are not combined with the physical one and the management of the resources is difficult. Monitoring procedures and marine science activities are costly, wherefore there is a lack of overall knowledge about the oceans (OECD, 2016).

Figure 1.1. Devastating effects of climate change
Source:https://www.rocketspace.com/corporate-innovation/24-innovative-startups-making-climate-change-impact-in-2019

Oceans have been affected by anthropogenic activities as overfishing, land-based activities, the urban development of coasts, and acidification by carbon dioxide emissions from fossil fuels, marine litter, marine pollution, loss of habitats (EC 2017; Virapat, 2011). Thus, the activities caused sea level rise, degradation of marine habitats, loss of ecological balance, depletion of resources, loss of biodiversity, destroy of coral reefs and consequently their diverse ecosystems including fish species and organisms leading to loss of food source and income (Visbeck et al., 2014; Virapat, 2011). Climate change is a major problem as well as natural disasters that affect various aspects and can cause land loss and loss of maritime zones (Visbeck et al., 2014; Tsaltas et al., 2010).

1.2. Blue Growth and Blue Economy

In recent years, the marine industry contributes to achieving a smart, sustainable and inclusive growth (EC, 2020c; Soma et al., 2017; ECORYS, 2012). In 2012, the European Commission adopted the Blue Growth Strategy. This strategy aims to sustainable development in European seas and to assure protection of its resources (EC, 2017). According to the European Commission, the EU's blue economy represents 5.4 million jobs and a Gross Value Added (GVA) of just less than 500 billion euro per year (Ehlers, 2015; EC, 2012; EC, 2017). Ocean development along with new industries affect and may harm the marine environment, and consequently human wellbeing. Nowadays, neither policy frameworks nor adequate environmental assessment processes exist to manage properly those risks (Bennett et al., 2019).

Blue Growth emerging economic activities that support the strategy's visions namely are ocean energy, aquaculture, biotechnology, and marine mineral resources; present an opportunity to provide economic growth and jobs, enhance the security of energy supply and support local communities (Dalton et al., 2018a; Rodríguez-Rodríguez et al, 2016). The established Blue Economy include the following sectors: marine living resources, marine non-living resources, marine renewable energy i.e. offshore wind farms, port activities, shipping and maritime transport, and marine coastal tourism (EC, 2020a). Blue Growth and Economy are related. The first one is considered as the general strategy for the expansion of marine activities in a planned way. It demands healthy ocean ecosystems in order to be more productive and support the economic activities. The other one refers to the concept through which oceans and coasts can be used for economic activities. It is based on natural resource efficiency, zero waste and circular economy, and social equity (EC and WWF, 2018; WB/UN, 2017).

The Blue economy encompasses all economic activities with a direct or indirect link on marine resources and classifies in two categories; the marine-based and the marine-related. Marine-based refers to those activities that take place into the sea such as fisheries, aquaculture, and ocean energy, shipping and transport, etc. The marine-related correspond to those that use products and services from the sea such as marine biotechnology, seafood, chemicals, and materials in order to be utilized by marine-based activities and produce products and services respectively (UNDP, 2018). Their efficient operation depends on each depth. The Fig. 1.2 presents the suitable activities that can operate efficiently according to each depth (Van den Burg et al., 2018).

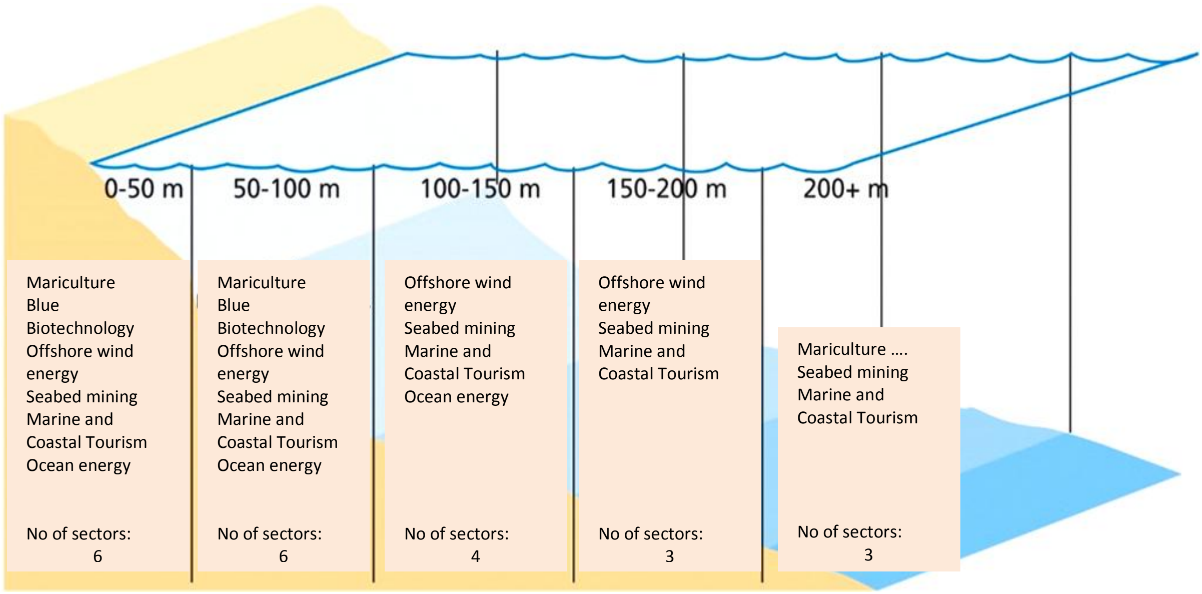

Figure 1.2. Blue Growth sectors operate depending on depth.
Source: Van den Burg et al., 2018

1.3. Marine Spatial Planning (MSP)

Marine space is an area where natural and human activities co-exist (Coccosis and Beriatos, 2016). A highly increasing range of interactions and claims is recognized for different purposes between traditional and emerging activities. The more users, actors, stakeholders, and activities are take place into marine space, the more competitions and conflicts among them and the marine environment will arise. It is required a very careful balance between different interests against one another and against environmental concerns in order to ensure equilibrium (Ehlers, 2015).

MSP, as defined by UNESCO, ‘is a public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that usually have been specified through a political process’ (Ehler and Douvere, 2009; Lillebø et al., 2017). MSP is a process that guides when, where and how human activities take place. It considers a region as a whole and integrates policies and objectives across different sectors, addressing the multiple and potentially conflicting uses of the sea (Blæsbjerg et al., 2009).

Maritime Spatial Planning is an element to ensure efficient and sustainable management of human activities at sea (EC, 2020c). It is characterized as a key tool for achieving sustainable Blue Growth and tackling its challenges (EC, 2018b) and the role of MSP has been recognized in many different aspects of decision-making. Its success demands the consideration of socio-economic, ecological, institutional and political aspects, as well as the engagement of a wide variety of stakeholders (EC, 2018b).

MSP encourages smart and sustainable solutions and tools to address and reduce conflicts into the marine spaces (García et al., 2019b). One of those is the Multi-Use (MU) concept. The MU approach is an umbrella term that covers a multitude of combinations of uses and can favor positive coordination and win-win options under specific geographical conditions. MU refers to the development of marine activities in the same space or infrastructure with a goal to decrease the conflicts between users and uses, and thus increasing the available space for other claims (Economou et al., 2020; Sefrioui, 2017). The Multi-Use of Space refers to the synergy of two or more different marine sectors in an adjacent geographic area (Dalton et al., 2018b; Abhinav et al., 2018). The Multi-Use Platform refers to an integrated built infrastructure that benefits the synergy and sharing of resources of two or more different marine sectors (Dalton et al., 2018b; Abhinav et al., 2018; Depellegrin et al., 2018). It requires technological and innovative solutions or use of infrastructure for co-location. The benefits from co-location of activities are numerous. It empowers the efficient use of marine space, allows synergies, reduces the footprint of carbon dioxide, minimize the impacts on traditional activities (shipping, fisheries), cost savings during installation and maintenance procedures, and increase energy and water demands, etc. (Kyvelou and Ierapetritis, 2019; Calado et al., 2018; Dalton et al., 2018a; MUSES, 2017).

The marine space is ideal for the development of human activities, offering employment, products to the population. In the meantime, nature may be damaged from those activities. For this reason it is important to maintain the equilibrium. Where do priorities lie when a marine area is a home to wildlife fishing and shipping at the same time? The responsible planner faces many challenges in dealing with all these demands. How can the planner satisfy all stakeholders and their interests? How can the planner balance usage and protection of the same ocean space? An integrated planning and management approach with a long term focus is required (EC, 2016; ECORYS, 2012).

1.4. Purpose of the Study

Blue Economy concept and the tool of MSP are recently emerged and still are not developed across Europe. There are only existing pilot projects or particular legislation frameworks about the deployment of specific marine activities into the marine space. Most of them are taking place especially in Northern European countries. There is a requirement of marine cohesion depending on the characteristics of each area.

The goal for an integrated use of marine spaces with sustainable and smart solutions provided a motivation to study and analyze how Greek marine space can achieve sustainable Blue Economy. An integrated system is the key step to understand both the sea and its use, and the interactions between nature and society. The geographical scope of the present dissertation covers the territorial waters of the Cyclades complex. It presents and discuss the role of Marine Spatial Planning (MSP) to achieve sustainable Blue Economy in Cyclades, the actions that are required as well as the challenges and tools that could support it.

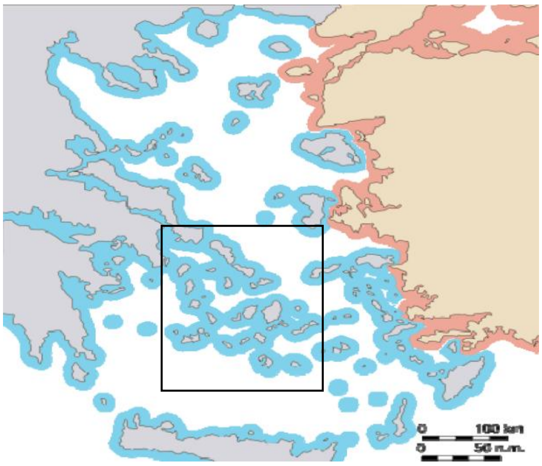

Figure 1.3. Greek territorial sea of 6 nm
Source: Siousouras and Chrysochou, 2013 , pp 38

The planning scenario of integrated and sustainable development lies in the socioeconomic development of local and regional population, enhancing the social and territorial cohesion, while fully respecting the fragility of natural environment and its components. Marine and coastal activities can be implementing within certain limits and restrictions in order to achieve the protection of marine environment and the socio-economic equity. The role of local stakeholders into this is fundamental (SUPREME, 2018b).

Data on marine space of Cyclades complex, economic sectors and environmental concerns founded at different spatial scale: EU publications, EUROSTAT, Greece's official statistical compilations, and private sector associations, marine NGOs etc. (Lazoglou et al., 2015; Rickels et al., 2018). There is not a commonly agreed set of indicators that can be used to measure sustainability. The indicators need to promote the principles of sustainable development, to be adaptable to future development, to be accessible, to be reliable and provide trustworthy information (Lazoglou et al., 2015; Rickels et al., 2018). Moreover, they need to provide access for all stakeholders to marine resources and markets, increase scientific knowledge and marine technology applications, and provide social and economic benefits. Additionally, they need to eliminate the implementation of instruments aiming to combat illegal, unreported and unregulated techniques, especially on fishing activities, reduce human pressures, and restore, protect and maintain the biodiversity, productivity and resilience of marine area where is necessary (WWF, 2015a; Vasileiou et., 2017). The indicators goal to achieve sustainability and need to inform policy makers for the appropriate legislation, administrations for their planning process, and specific competent authorities for their measures implementations in meeting expected outcomes (Cormier and Elliott, 2017).

They used socio-economic and environmental indicators to point issues or conditions in order to present if a system is working well or what needs to be done for addressing a problem. Indicators relied on the marine activities themselves: Fisheries, aquaculture, marine and coastal tourism, shipping, renewable energy, marine minerals, marine protected areas, maritime transportation. For the marine renewable energy sector need to consider the energy capacity installed, energy production, the GVA rate, the number of employees. For the fisheries need to indicate the amount of fish caught (tons), the percentage of fish stock over-exploited, the total value of fisheries production (landing value), the amount of fish caught by artisanal fisheries (tons), the number of fishers employed, the number of small scale fisheries vessels. For the marine and coastal tourism need to point out their economic value (GVA), the number of jobs, the number of arrivals, the coastal and marine areas conserved. For the maritime transportation require the economic value (GVA), the number of employment, the volume of passenger traffic, the number of ports and marinas volume (Plan Bleu, 2017a). The environmental parameters that affect the development of Blue Economy and need to be considered are: the climate change effects (changes on water temperatures, sea level rise and area lost), natural processes and disasters (coastal erosion, earthquakes and tsunamis phenomena), and technical disasters (number of oil spills) (Papageorgiou, 2018; EC, 2018b). In addition need to be considered the number of accidents, wastes, and alien species in ballast water, emissions causing air pollution, the biodiversity lost, and the potential diseases from the escape of farmed species, bird mitigation cause of the turbines that affect marine mammals, fishes and sea birds (Ehlers, 2015).

The methodology used is the SWOT analysis which determines the factors that have either a positive or a negative effect along with its significance level. The assessment of indicators for Cyclades complex marine space tries to answer the following:

- Is the Blue Economy performing in a sustainable way?
- Which are the necessary actions that need to take towards a vision to manage and govern Blue Economy

1.5. Organization of the Study

In chapter 1, the scope of the thesis and general information about oceans, Blue Growth, Blue Economy and MSP are defined. Chapter 2, introduces the theoretical framework about the oceans; Blue Growth; and MSP, and describes the role of sustainability in the oceans. Chapter 3 presents the general socio-economic and environmental characteristics of the study area, the indicators that used to assess the current situation in the marine space of the study area and provides the methodological analysis through which are identified the advantages and disadvantages. Chapter 4, presents the results which are discussed in detail in chapter 5. There, the findings are compared with previous studies and also are made suggestions for further research in order to help towards a sustainable Blue Economy in the area. Last, chapter 6 presents the main conclusions of the dissertation.

Chapter 2

Literature Review

2.1. Sustainable Development

2.1.1. Meaning of Sustainability

Sustainability is the ability for current generations to satisfy their current needs using natural resources in a way that does not endanger future generations to meet their owns (EC, 2019a). Sustainable Development composes of three pillars: social, economic, and environmental (EC, 2019a). It is feasible if only humans understand the great value of nature and oceans as well (WOR, 2015a).

Humanity faces major challenges of social justice, environmental protection, poverty, climate change, global economic crisis (Global Ocean Commission, 2016; Virapat C., 2011); and nowadays the COVID-19 crisis. The role of the ocean is prominent to tackle them. It provides jobs and reduces poverty, increases wealth, improves health and education; and supports on economic growth.

The sustainable use of the ocean requires the mitigation and adaptation of climate change by reducing emission of greenhouse gases on marine activities and accordingly by taking appropriate action to prevent or minimize the damage caused via marine activities (Visbeck et al., 2014; WB/UN, 2017; UN, 2020). Furthermore, sustainable development requires the understanding the role of authorities, marine scientists, policymakers, institutions, and stakeholders' behaviors into the oceans. Consequently, it is a requirement to understand their preferences for each marine activity (Gkargkavouzi et al., 2019; OECD, 2016). Oceans and seas are very large and particular sensitive ecosystems that need to be preserved from the economic exploitation and exploration activities that take place on them (Ehlers, 2015). So, a sustainable ocean and sea encompasses both environmental conservation and the management of resources to support the future generations to meet their needs. (EU, 2011; Howard, 2017).

2.1.2. Sustainable Development into the Oceans

Historical Brief

The first reference of sustainability appeared at the first UN Conference in Stockholm in 1972, where defined its environmental pillar. The second one appeared at the second UN Conference in Rio de Janeiro in 1992 where clearly marked the economic pillar, recognized the importance of sustainable development of oceans, and produced an action plan called Agenda 21 about general actions needed to achieve a sustainable development plan. Twenty years later at the third UN Conference in Johannesburg in 2002 marked the social pillar and defined the final definition of sustainability (Eikeset et al., 2018; Visbeck et al., 2014; WB/UN, 2017). After the fourth United Nations Conference about Sustainability, 'Rio+20' which took place in Rio de Janeiro in 2012, Blue Growth is seen as an ambitious framework for ocean management (Eikeset et al., 2018). Then was produced the Agenda 2030: 'The Future We Want' which was finally adopted in 2015. It reasserted the Agenda's 21 actions and proposed a set of 17 Sustainable Development Goals (SDGs). These UN SDGs are political expression; covered all areas occurred mankind activities; are strongly interdependent on each other to ensure a safe, equitable, and sustainable planet to all (Österblom, 2019; Ntona and Morgera, 2018; Singh et al., 2017). For instance, sustainable fisheries require a complement by sustainable consumption patterns (Ntona and Morgera, 2018).

The SDG14, refers to oceans and seas, and is called 'Life Below Water. It aims 'to conserve the oceans, seas and its resources and ensure their sustainability use for sustainable development'. It encompasses 10 targets which aim to (14.1) reduce marine pollution; (14.2) restore marine and coastal ecosystems; (14.3) minimize and address the impacts of ocean acidification; (14.4) end overfishing, illegal, unreported, and unregulated fishing activities; (14.5) conserve of marine and coastal areas; (14.6) prohibit or eliminate fisheries subsidies; (14.7) expand economic benefits to Small Island Developing States, i.e. SIDS, and least developed countries; (14.a) increase scientific knowledge, technical innovation and research capacity to ensure and improve oceans and seas health; (14.b) permit to small scale fishers

Figure 2.1. SDG 14, Life Below Water
Source: http://ocean2018.wmu.se/sdg14

to marine resources; and (14.c) implement international legislation to improve and contribute the environmental conservation and sustainable use of the oceans (Eurostat, 2019a; OECD, 2016; Singh et al., 2017; Frazão Santos et al., 2014b). The regional ocean governance has been proposed as an important instrument to achieve SDG14 targets (Mahon and Fanning, 2019). These SDGs are flexible for each national government to set their own target and incorporate them into their national processes, policies and strategies (Cormier and Elliot, 2017).

The importance of oceans

Oceans contribute to sustainable development as well as to human wellbeing by providing Ecosystem Services. Such services are classified into four general categories: (i) Provisioning services; (ii) Regulating services; (iii) Cultural services; and (iv) Supporting services (EC, 2019a; WOR, 2015a). Provisioning services include the direct benefits from the ecosystem to human nutrition (e.g. food, water, pharmaceutical ingredients, materials, gas, and oil, etc.). Regulating services contain the benefits of climate regulation through the transportation of heat by ocean currents and heat exchange between water and atmosphere. Oceans absorb carbon dioxide, dilute it and maintain the good air and water quality, respectively. Cultural services comprise the non-material benefits from the ecosystem (e.g. aesthetic value – beautiful landscapes, cultural heritage, spiritual value, recreation, etc.). Supporting services regard the maintenance of the ecosystem itself (e.g. water cycle, food chain, resilience of marine habitats, nutrient cycles, etc.) (EC, 2019a; WOR, 2015b).

Marine provisioning services support Blue Growth areas of aquaculture (plants and animals from in situ aquaculture for human nutrition), blue biotechnology (fibbers and other materials from all biota for bioprospecting of active compounds for nutraceutics, pharmaceutics and cosmetics), and blue energy (production of biofuel from macroalgae and microalgae). Marine abiotic provisioning supports the extraction of marine mineral resources (e.g., poly-metallic nodules, cobalt-rich crusts, poly-metallic massive sulphides) to provide for rare earth elements (REEs) and other commonly used industrial metals (e.g., Cr, Ni, Zn, Mo, Pb, W), and for concrete aggregates for construction (e.g., sand and gravel) (Lillebø et al., 2017).

2.2.3. Sustainability and Blue Economy

The linkages between the blue economy, sustainable development and economic growth are recognized in SDGs of 2030 Agenda (UNDP, 2018). The Blue Economy concept adopted on Rio+20 Conference to increase the economic growth of the marine environment while maintaining healthy ocean ecosystems and ensure the continuous providing of marine resources and consequently been efficient and productive (WB/UN, 2017). Billions of people rely on the sea for food, transportation, jobs, resources and recreation, thus, their relationship between oceans is crucial for their well-being (WWF, 2015b).

The European Commission turns towards emerging and established marine sectors to facilitate sustainable economic growth and employment (Wenhai et al., 2019; Global Ocean Commission, 2016; BEP, 2016; FAO, 1995). In 2016, EU developed a Strategy named 'Mediterranean Strategy for Sustainable Development 2016-2025' that aims to provide a strategic policy framework to secure a sustainable future for the Mediterranean region. The Strategy is presenting a collective process that provides indicators for monitoring and promoting an environmentally sustainable economy in the Mediterranean both on territorial and marine space (Plan Bleu, 2017).

Marine industries are operating deepening on each other. For example, unsustainable fishing activities or fishing in prohibited areas may degrade coral reefs, threaten its role to conservation habitats, and to coastal protection. It reduces the food security by overexploiting fish stocks and could affect the tourism too (EC and WWF, 2018; BEP, 2016). Social pillar contribute to changing behaviour across stakeholders and provide possibilities for innovation by exchanging of knowledge and ideas (Soma et al., 2017). Another example refers to the sustainable extraction of biological components. The bio-prospecting procedure has high potential positive effects for healthy ecosystems and food supplies (BEP, 2016).

Characteristics of a Sustainable Blue Economy

Figure 2.2. Sustainable Blue Economy
Source: https://www.euractiv.com/section/circular-economy/opinion/the-sustainable-blue-economy-eus-actions-must-match-its-words/

A Sustainable Blue Economy is a holistic and innovative approach based on environmental-friendly technologies and techniques e.g. renewable and clean energy production with low-carbon emission and less use of energy, land, and water resources. It is a precautionary, transparent, and adaptive approach (WB/UN, 2017; WWF, 2015a). In order to be truly sustainable it needs to be circular too. Wenhai et al., characterize the Blue Economy as 'strategic framework', 'a kind of policy', 'a part of green economy', 'a sustainable marine economy', and 'a marine-based new technology economy' (Wenhai et al., 2019). This concept is based on low footprint and zero waste processes. Every waste output from one activity becomes input to another one and transformed into new resources, thus reducing pollution (WWF, 2015b; BEP, 2016). In addition, it includes policy tools to transform the marine activities into environmental friendly one, e.g. eco-ports, ecotourism, eco-fleet, and ensure the long-standing sustainable management of them. The application of those tools is greatly depend on the political will of relevant authorities, access to finance, engagement of all stakeholders, as well as the availability and quality of data; e.g. Green taxes, carrying capacity, ecological footprint-consumption, and life cycle assessment of each component (UNDP, 2018 ; EC, 2020e).

The main challenges for a truly sustainable Blue Economy are summarized below (Elliott et al., 2020; Tonazzini et al., 2019; BEP, 2016; Ehlers, 2015; WWF, 2015a):

- Clear and measurable goals and targets.
- Proper management and government of marine space and its resources. The conservation and use of oceans should be considered as a global public and common good. It requires a stewardship of sustainable management.
- Develop and implement the appropriate guidelines for each marine activity.

- Accurate data information, sharing knowledge and lessons learned. Technological tools in combination with available accurate scientific knowledge could prevent potential damages.
- Sustainable use of biodiversity, in terms of food and livelihood provision.
- Provide food security through sustainable exploitation of fish stocks and aquaculture.
- Transit into low carbon and zero wastes economic activities to address the climate's change effects on oceans.
- Provide protection tools such as Marine Protected Areas (MPAs) to ensure the preservation of sensitive ecosystems or Emission Control Areas to reduce toxic emissions.
- Address marine and coastal tourism effects on loss and degradation of habitats, and ecosystems services.
- Decrease the greenhouse gas emissions, tackle the water and energy demand, and manage the wastes.
- Tackle marine pollution and marine debris from both land-based and marine-based sources.
- Monitoring and evaluation of marine activities.

2.1.3. Smart technology in sustainable development

In this section is quite important to mention the trend of smart technological applications into a sustainable marine industry. There are a lot of smart solutions in the marine industry. Some of them are already operating into the marine environment, while others are still in the research and development phase. Smart solutions require surveys to understand the needs for each marine activity and how their innovation would improve their performance and their delivery of products and services to citizens and other activities, too.

The Europe 2020 strategy defines smart growth as 'the economic development which is based on knowledge and innovation. It requires the improvement of education quality and research performance. The goal is to ensure that innovative ideas can be turned into new products and services that can create growth of quality jobs and help to address social challenges' (EC, 2010). Additionally, providing of technological innovations is the key for sustainable discovery and exploitation of oceans and seas. Information and communications technology (ICT) has potential to reduce the energy and material flows, thus mitigate the climate change pressure (Hilty et al., 2014).

In shipping there exist smart applications for finding alternative transport routes to avoid accidents and reduce energy consumption. Also, there are applications for controlling and decreasing the maritime traffic inside the ports, for monitoring noise and air quality. Electric vehicles for transportation, charging stations and smart lighting are used on ports as an eco-friendly solution that can reduce energy consumption. Hence, they can reduce the fuel consumption and carbon dioxide footprint for the surrounded area. In aquaculture and fisheries sector there are applications for monitoring the quantity and quality of their production and their automation capacity. Smart fishing gears can support control the exploitation of resources and thus conserve the biodiversity, as demonstrates the Fig. 2.3. The water temperature, dissolved oxygen, pH, salinity etc. are some of the monitored and advanced data. Tourism is a sector with high quality smart applications that used for selecting and finding activities in an area such as blue flag marinas and beaches, yachting cruises, recreational activities (Pavlić et al., 2019; Hannemann, 2019; Lillebø et al., 2017).

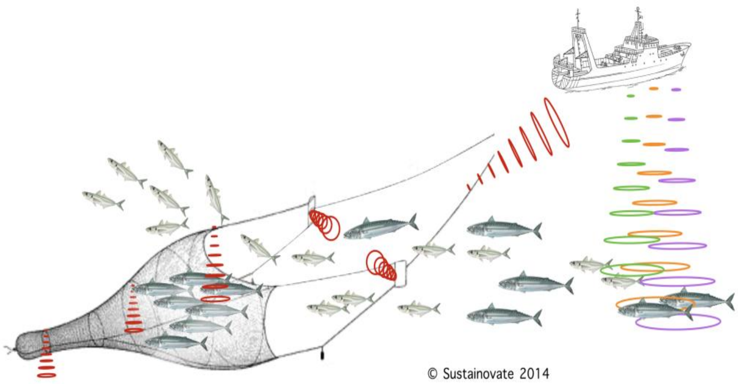

Figure 2.3. Smart fishing gears
Source: https://sustainovate.com/fisheries/smart-gear/

Smart technologies have practical and economic benefits as presented below (Pavlić et al., 2019; Stratigea and Panagiotopoulou, 2014):

- Reduction of carbon dioxide footprint. Improvement of energy efficiency and storage, waste and water management, traffic conditions both on marine and terrestrial side are among the greatest advantages.
- Real time monitoring of resources can increase their availability and quality as well as the security of their implementation.

- Address new development perspectives. Track solutions can tackle pressing challenges, quantifying economic benefits of nature, creating better battery storage for renewable energy sector, and improving water quality and quantity.
- Enable applications to improve their quality and range of services that are going to deliver to citizens.
- Support owners and operators of sectors to efficient use of their resources. Increase their revenues and profitability.
- Create new jobs and increase the quality of life of local communities on islands and the mainland.

2.2. Theoretical Frameworks

2.2.1. Historical Brief

The United Nations Convention on the Law of the Sea (UNCLOS) is an international treaty provided in 1982 the legal framework. It sets the rules to the marine environment for managing all marine activities that take place at national, regional and global level (WB/UN, 2017; Wright, 2015; Blæsbjerg et al., 2009). It is the primary law and acts as an umbrella convention. A substantial number of supplemented agreements exist, addressing different marine uses, and executing protection measures (Stefanakou and Nikitakos, 2015; Ehlers, 2015). UNCLOS defines the different maritime zones at sea and their legal status; confirms rights, obligations and responsibilities of States depending on the zone; promotes peaceful uses of the seas and oceans, and the efficient utilization and conservation of their resources; and protect, and preserve the marine environment (Coccosis and Beriatos, 2016; Ehlers, 2015; Burnett et al., 2013).

Maritime zones under UNCLOS as presents the Fig. 2.4 are (i) Territorial Waters, 12 nm; (ii) Contiguous Zone, 24 nm; (iii) Exclusive Economic Zone, 200nm (iv) Continental Shelf, 200mn with an upper limit of 350 nm; and (v) High Seas, beyond the upper limit of Continental Shelf. The nautical miles (nm) are counted from the baseline of each State’s coastline. States’ claims are not possible to the (v) high seas (Burnett et al., 2013; Sefrioui, 2017).

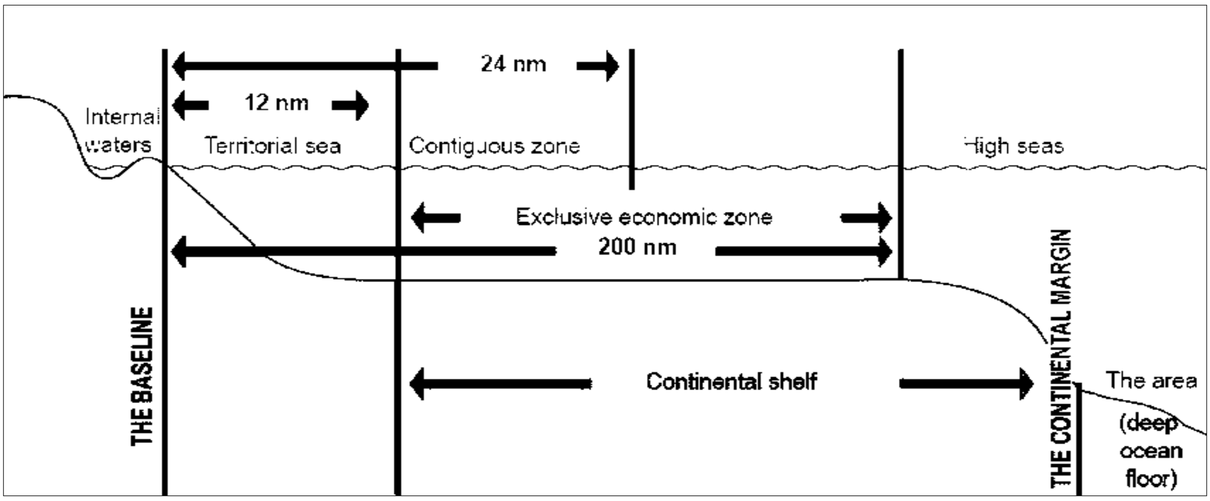

Figure 2.4. Maritime Zones according to UNCLOS.

Source: https://www.researchgate.net/figure/Maritime-Zones-The-right-to-regulate-navigation-of-ships-varies-between-the-maritime_fig9_273756694

2.2.2. European Conventions and Regulations

The EU has adopted a range of policy documents to address and eliminate human pressures on marine and coastal ecosystem, and to reduce conflicts between the utilization and conservation of marine space e.g. Marine Strategy Framework Directive (MSFD), Habitats Directive Natura 2000 Network, EU Recommendation on Integrated Coastal Zone Management, Common Fisheries Policy (CFP) (Gkargkavouzi et al., 2019). The Directive 2011/92/EU defines the requirements to carry out an Environmental Impact Assessment (EIA) for projects and activities both on land and sea. MSFD 2008/56/EC does not directly regulate maritime activities. It provides a legal framework for the marine environmental pillar and is important for maintaining Good Environmental Status (GES) (EC, 2007). GES is based on the ecosystem management approach (EPRS, 2020; Lillebø et al., 2017; Meiner, 2010). The Ecosystem-Based Management (EBM) considers the management of natural resources sustainably and protectively and aims to ensure that the cumulative pressures of different human activities do not affect the ability to remain healthy, clean and productive (EC, 2020; De Grunt et al., 2018; Frazão Santos et al., 2014a). The Directive requires Member States through national plans to assess their marine waters, protect and preserve the marine environment, determine their GES, and set the appropriate objectives and targets to achieve it by 2020 (EPRS, 2020; De Grunt et al., 2018; EC, 2012b; Blæsbjerg et al., 2009). MSFD is characterized as one of the main EU policies to meet Rio+20 marine obligations (EC, 2012b). In Decision 2010/477/EU defined that MSP and MSFD were interlinked. In fact, the MSFD aims to protect the marine resources depending on which economic and social activity taking place. The MSP focuses on sustainable development and achievement of GES by combining the economic growth with the need for environmental protection (Frazão Santos et al., 2014a; Blæsbjerg et al., 2009). MSP is essential to identify and regulate cooperation with establishing and emerging marine activities (Dalton et al., 2019). It is considered as the marine economic pillar of the EU policy (EPRS, 2020; Mulazzani and Malorgio, 2017). Maritime Spatial Planning Directive (MSPD) is a framework Directive 2014/89/EU that was adopted in 2014 by the European Union to encourage Blue growth. This directive is obliging the MSFD and the Integrated Maritime Policy (IMP) (Soma et al., 2017) and acts as a framework for the management of marine space (García et al., 2019). It aims to reduce conflicts, encourage investment, increase coordination, and protect the marine environment (Jones et al., 2016). Member States of EU are obliged to implement their MSP plans under this Directive and to enforce them before 2021 (Manea et al., 2020; García et al., 2019; EC, 2014a; EC, 2014B). Their MSPs plans are required to comply with requirements, such as stakeholders' participation; trans-boundary coordination; EBM application; data and knowledge sharing; awareness of land-based activities; promotion of multi-use concept (De Grunt et al., 2018). MSP is formally guided three Directives; the Water Framework Directive, the Marine Strategy Framework, and the Marine Spatial Planning Directive (Tolvanen et al., 2019).

In 1974, the United Nations Environmental Programme (UNEP) introduced the Regional Seas Programme (RSP). MSFD makes it necessary to cooperate at the regional level provided by multilateral regional sea conventions. These conventions are 'coordinating activities aimed at the protection of the marine environment through a regional approach'. Nowadays, there are four of these RSPs in Europe that are responsible for the protection of the European marine environment: The Barcelona Convention (UNEP-MAP), the Helsinki Convention (HELCOM), the OSPAR Convention (OSPAR), and the Bucharest Convention that conclude the Mediterranean Sea, the Baltic Sea, the North-East Atlantic Ocean (including the North Sea) and the Black Sea, respectively. They act like an interchange-information network (De Grunt et al., 2018; Meiner, 2010). Maritime Spatial Planning Directive (MSPD) promotes regional coordination and cooperation between the Member States as a fundamental tool to implement national maritime spatial plans (Mahon and Fanning, 2019). Regional partnerships bring together States, regional and global organizations and mechanisms, and a variety of stakeholders, including non-governmental organizations, marine researchers, and private sector actors (G20, 2017). In the EU level there are many different authorities for each state with different jurisdictions being responsible for the protection of the marine environment. They depend on the type of protected area and the National Network to which the area belongs, the respective competent authority responsible for monitoring these areas is also designated (Economou et al., 2020). The involvement of RSPs is stated in Marine Directives, both MSFD and MSPD (De Grunt et al., 2018).

Barcelona Convention

Barcelona Convention is the first RSP, a Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean and was firstly adopted in 1975 as the Mediterranean Action Plan (MAP). In 1995, the second phase of MAP (MAP Phase II) was adopted by replacing the one from 1975 (De Grunt et al., 2018; Dalton et al., 2018b; ECORYS, 2012; Coccosis and Henocque, 2001). UNEP/MAP's main objectives are to address marine pollution issues and ensure sustainable management of coastal and marine resources; protect the natural and cultural heritage; ensure sustainable development in Mediterranean (Coccosis and Henocque, 2001; Barcelona Convention, 1995). The Contracting Parties are 22 including Greece (UNEP/MAP 2020; Barcelona Convention, 1995) and its headquarters are in Athens (ECS, 2011).

Barcelona Convention consists of seven protocols and provides strategy policies for the conservation and management of the Mediterranean Sea by ensuring sustainable growth for future generations (MMG, 2009). These protocols are: (1) Dumping Protocol (from ships and aircraft), (2) Prevention and Emergency Protocol (pollution from ships and emergencies), (3) Land-based Sources and Activities Protocol, (4) Specially Protected Areas and Biological Diversity Protocol, (5) Offshore Protocol (pollution from exploration and exploitation), (6) Hazardous Wastes Protocol, and (7) Protocol on Integrated Coastal Zone Management (ICZM) (Barcelona Convention, 1995). The ICZM protocol entered into force in 2011 contributing to better manage and protect Mediterranean coastal zones, as well as to deal with the emerging coastal environmental challenges e.g. sea-level rise (Dalton et al., 2018b; OECD, 2016). The ICZM framework regards both the terrestrial and the marine part of a coastal zone about 5 km. It is the provider for implementing the MSP concept (ECS, 2011).

2.2.3. Blue Growth and Marine Spatial Planning

In 2006, the European Commission adopted a Green Paper discussing the future of maritime policy. It recognized the need of sustainable development of marine activities through situate spatial planning (Frazão Santos et al., 2014a). In 2007, the EU adopted a Blue Paper promoting Integrated Maritime Policy (IMP). Both Papers highlight the transboundary nature of marine activities and the importance of governance (Li and Jay, 2020; Meiner, 2010). The Blue Paper on European Maritime Policy introduced Marine Spatial Planning (MSP) as fundamental for sustainable development of marine and coastal areas. It is based on the ICZM concept which has already entered into force in the EU (Blæsbjerg et al., 2009). ICZM first introduced in Rio de Janeiro Conference in 1992 'Earth Summit' via Agenda 21 (Tonazzini et al., 2019) and is objective was to address the challenges on coastal zones. After Barcelona Convention in 2008, was estimated the fragility of ecosystems and started acting as a joined device that links the terrestrial and marine areas (Meiner, 2010; Papageorgiou, 2016b).

The European Commission set up in 2007 the Integrated Maritime Policy (IMP), which promoted the development of the marine industry in sea basin level (Dalton et al., 2019; De Grunt et al., 2018). It is an integrated approach with a framework that applies to the entire marine economy. It aims to develop coordinate, coherent, and transparent decision-making policies, and to maximize the sustainable development, economic growth and social cohesion of EU's Member States (EPRS, 2020; EC, 2019c; Frazão Santos et al., 2014a; EC, 2014a; Meiner, 2010). IMP has been recognized as the first step in realizing Europe's future policies and Strategies (ECORYS, 2012). In 2009, the EU adopted a Communication in which IMP covers cross-cutting policies such as, Blue growth, Marine data and knowledge, Maritime spatial planning, Integrated maritime surveillance, Sea basin strategies (EC, 2009). It was followed by an additional communication in 2014 and a working document in 2017.

The European Commission established in 2009 an Atlas of Seas as an educational tool by highlighting the common marine heritage. This action was fundamental for promoting a spatial information database system for European Union, hence creating an international marine open-access data network, the European Marine Observation and Data Network (EMODNET) (Meiner, 2010; EC, 2019c).

In 2011, the EC adopted a Communication on Blue Growth. It presented the potential opportunities of Europe's coasts, seas and oceans that can encourage employment and create new jobs by protecting the marine environment, too. This Communication aimed to contribute to the development of Blue Economy as a policy tool (EC COM, 2014b). The Communication focused on emerging marine activities such as marine mineral exploration and exploitation, submarine cables laying, exploration, and/or exploitation for pharmaceutical enterprises (marine biotechnology activities), ocean energy (wave, tidal), and aquaculture (EC, 2014b; Wenhai et al., 2019). According to the World Bank, the Blue Economy is the sustainable use of ocean resources for economic growth, improves livelihoods and jobs availability, while preserves the heath of ocean's ecosystems (WB/UN, 2017).

In the same year, at Agenda 21 UN was referred for the first time the sustainable development on EU islands. Until today there is not any established exclusive EU policy for EU islands. It is recognized the need to protect and develop islands in a sustainable way. Hence, it was proposed the 'Island 2020' strategy. It classifies the islands in three categories and defines a vision about each development. The first one called quality islands. Its development should be focused on products and services qualifications that utilize local resources in a sustainable way. The second category called green islands and focuses on reuse of local resources i.e. circular economy. The last and third category called island with equal opportunities. The development of this is based on provided guidelines of equal opportunities with the mainland area. These guidelines though are similar to MSP's goals (Lazoglou et al., 2015).

In 2012, the EC launched Blue Growth EU Strategy based on IMP's scope. It was divided into seven sea basins; (i) the Atlantic Ocean, (ii) the Baltic Sea, (iii) the Black Sea, (iv) the Mediterranean Sea, (v) the Adriatic and Ionian Seas, (vi) the North Sea, and (vii) the Arctic Ocean (Dalton et al., 2019; EPRS, 2020). The strategy highlighted the fact that the blue economy needs to be sustainable and protect marine environmental at a time (EPRS, 2020; Mulazzani and Malorgio, 2017). In addition, it facilitated the cooperation between marine business and public authorities across borders and stakeholders to ensure sustainability (EC, 2014c). The EC provided a strategic framework for development. It included the Marine Strategy Framework Directive (MSFD), which was entered into force in 2008, and the Maritime Spatial Planning (MSP) (Blæsbjerg et al., 2009).

In 2014, the EU launched the Blue Economy Innovation Plan to develop sectors with a high potential for sustainable jobs and growth, to provide knowledge, legal certainty and security in the blue economy and sea basin strategies to foster cooperation between countries by taking prompt measures (Wenhai et al., 2019).

The same year, the EU investigated on several MUS and MUP projects to support its Blue Growth Strategy facilitating the cooperation between established and emerged maritime sectors, authorities, and stakeholders (Depellegrin et al., 2018; Dalton et al., 2018b; EC, 2017; OoT, 2010-2013). The MSP Directive/2014/89/EU identifies the different uses and users in marine space and encourages the Multi-Use concept as a proper management tool of the uses and users and their potential arising conflicts (Depellegrin et al., 2018; EC, 2017).

2.2.4. Legislation Issues and Challenges

According to OECD in 2016, are occurring gaps in international ocean regulation such as a lack of detailed regulations to implement the emerging marine sectors, i.e. the technological improvements in the marine industry are moving faster than regulatory activities. Furthermore, there is a lack of effective instrument to monitor and specify requirements for conservation tools, i.e. Environmental Impact Assessment (EIA), Marine Protected Areas (MPAS) etc. (OECD, 2016). Last, the natural disasters combining with the climate change effects might add important challenges to international law. The implications from sea level rise may change the baselines and have an impact on the legal status of maritime zones. Hence, this shifting may contribute to loss of territory, implications on rights and changes to States' obligations. The Blue Economy and MSP procedures which are based on the delimitation of marine boundaries may be affected by force of circumstances, too (Sefrioui, 2017). MSP is a key procedure to ensure both blue growth and protection of marine space (Papageorgiou, 2018).

2.2.5. Blue Growth and Marine Spatial Planning in Hellenic Legislation

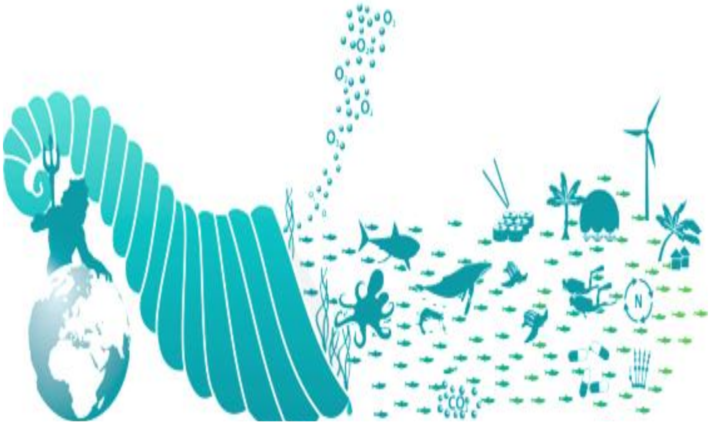

Figure 2.5. A sea of many colours
Source: Boonstra et al., 2017

In 2005, Greece started the first attempt for the development of the General National Framework of Spatial Planning which included three Special Frameworks e.g. for Renewable Energy Sources, Industry, and Tourism. These frameworks specify directions on national level and take into consideration principles and guidelines of the National Spatial Planning Strategy. The goal was through them to specify objectives and targets of ICZM and promote the incorporation into National Spatial Planning Strategy. The Tourism special framework defines the conditions for the marine and coastal tourism development, and the development of nature tourism in marine protected areas.

In 2009, a fourth Special Framework for Aquaculture added to Greece's legislation. The aquaculture sector constitutes a major marine activity in Greek seas with high economic profits due to the large levels of exportation (Papageorgiou, 2016a; ECS, 2011). The same year Greece adopted the National Renewable Energy Action Plan under the EU Directive 2009/28/EC (SUPREME, 2018a; YPEKA 2009). Seven years later, in 2016, Greece adopted the Law 4447/2016 (GG 241/A/23-December-2016) named Spatial Planning – Sustainable development and other provisions where incorporated the above mentioned Special Frameworks for Spatial Planning and Sustainable Development (EC, 2020b; García et al., 2019).

Each marine activity in Greece applies to a range of international agreements for the protection and management of the coastal and marine environment, i.e. MARPOL, The Convention on the Law of the Sea and the Conventions on the Protection of the Marine Environment; The International Convention for the Control and Management of Ships' Ballast Water and Sediments; the Barcelona Convention (Economou A. et al., 2020). Greece has ratified, by Law 3497/2006 (GG 219/A/13-October-2006), some of Barcelona's protocols, i.e. the 2002 Prevention and Emergency Covering Protocol from ships (ECS, 2011).

The EU MSP Directive is adopted in Greek legislation under the Law 4546/2018 (GG 101/A/12-June-2018) as a place-based approach. According to the provisions of the Law 4546/2018, the Hellenic National Maritime Spatial Planning Strategy (NMSPS) will apply to all territorial waters of Greece. It will be developed as a part of National Spatial Strategy with strategic priorities and guidelines for marine space development. The scope of MSP in Greece is to support and promote sustainable development and spatial cohesion between marine space and coastal environment. Its application will require the co-operation between ministries, regional authorities, and the public as well (EC, 2020b; Coccosis and Beriatos, 2016; García et al., 2019). There are identified two types of plans, at national and regional level – including subregional, local, etc. scales. The identification of the scales is challenged due to the limited territorial water which extended only up to six nautical miles and the absence of Exclusive Economic Zone determination (Beriatos et al., 2019). The planning is aiming at establishing and safeguarding equivalent living conditions under the state's jurisdictions and sovereignty (Magel and Luttmann, 2017).

The responsible governmental body for the Marine Spatial Planning is the Hellenic Ministry of Environment and Energy. The General Secretariat of Environment has jurisdictional rights and obligations for the environment and biodiversity issues, climate change and licensing, and waste and water management (EC, 2020b YPEN, 2020). Moreover, responsible for implementing tasks are the General Secretariat of Spatial Planning and Urban Environment; Directorate General of Spatial Planning; and Directorate of Spatial Planning (EC, 2020b; UN, 2017b; Coccosis and Beriatos, 2016). However, the Marine Spatial Planning is an interdisciplinary process that needs to take into account all involving economic sectors regionally or locally and enhance their participation (UN, 2017b; Damanaki, 2014). Despite that MSP concepts have been discussed from the mid-2000s, yet none specific implementation has taken place in the marine space of Greece (Papageorgiou, 2016).

2.3. Previous researches

The vision of a sustainable ocean requires restrictions to avoid negative effects on marine and coastal ecosystems and the accomplishment requires policy tools such as Marine Spatial Planning (MSP), Integrated Coastal Zone Management (ICZM), and/or Marine Governance (EC, 2014a). Worldwide several nations have developed spatial planning processes in an effort to advance sustainable ocean development.

European countries have already started to use MSP to achieve sustainable use for their marine and coastal areas, by considering the biodiversity conservation. Belgium and Germany have developed their plan on the basis of their territorial spatial planning law. The Netherlands and Norway have developed plans that act as guidance to each sector ex. for site-selection, but are not legally-binding yet. The United Kingdom and Scotland have prepared policy framework documents to implement a national MSP and drive to future marine sustainable development. These documents are still under development in Sweden. Last, France has applied MSP principles in small zones along the coast, mostly in heavily-used areas, to address the competition between its marine activities (Schäfer, 2009).

An integrated analysis of marine activities is also given by papers focused on management and MSP. Bennett et al., recommended that ‘the UN should establish or design a commission or agency within the economic and social council system to be responsible for developing best practices and establishing international guidelines for the implementation, monitoring and management of Blue Economy’s activities. Blažauskas et al., deal with the integration of economic activities, while others present the spatial planning in the framework of ecosystem based management. Similarly, there are papers indicating the incompatibility between conservation and specific marine activities. Moore et al., highlight the tension in the fisheries sector between advocacy for blue growth in maritime policy and efforts to safeguard future economic growth via the MSFD. Rodriguez-Rodriguez et al., do the same by demonstrating the incompatibility between offshore wind energy production and protected areas. Soma and Haggett discuss the social acceptance, suggesting that market benefits cannot always balance problems such as visual impacts. The ecosystem service concept is even more explicit in other papers. Jansen et al., in their study on offshore aquaculture and its multi-use potential in the North Sea, consider the importance of including the value of ecosystem services in the cost–benefit analysis. Zanuttigh et al., take a similar position by a multi-purpose offshore installation in the Northern Adriatic. Depellegrin et al., Dalton et al., Abhinav et al., and Van den Burg et al., have been focused on implementation of MU projects across Europe. The following Fig. 2.6 and Fig. 2.7 present the existing and potential site combinations in Mediterranean Sea basin. The Fig. 2.6 refers to potential combinations of tourism activities with fisheries, and aquaculture, and underwater cultural heritage, and environmental protection. The Fig. 2.7 refers to potential combinations of renewable energy systems with aquaculture and desalination plants (Depellegrin et al., 2018).

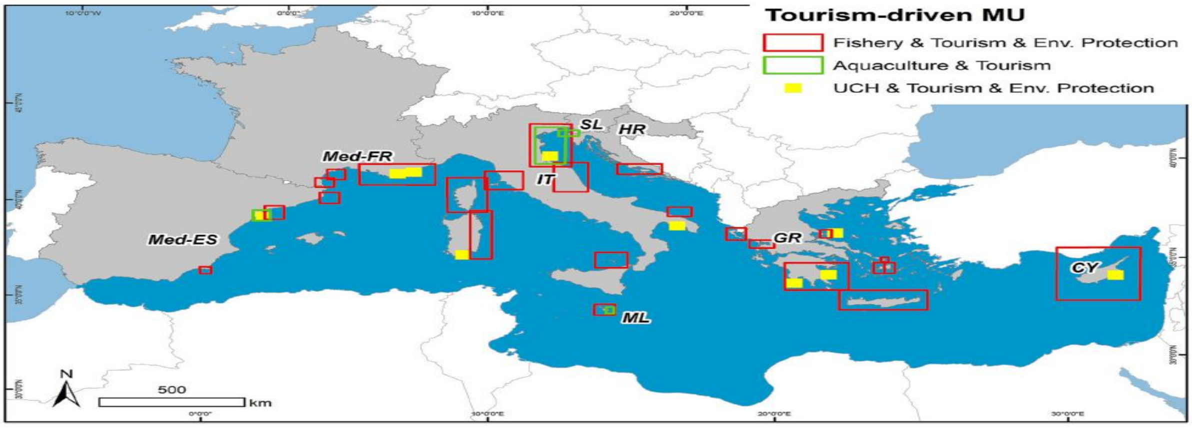

Figure 2.6. Existing and potential tourism-driven MU combinations in the Mediterranean Sea basin: Med-ES and Med-FR (refer to only Mediterranean Sea areas), IT – Italy, SL – Slovenia, HR - Croatia, GR – Greece, ML – Malta and CY –Cyprus. Note: The Figure presents a not exhaustive list of MU locations and polygons illustrate approximate location of MU.
Source: Depellegrin D. et al., 2018, p. 616

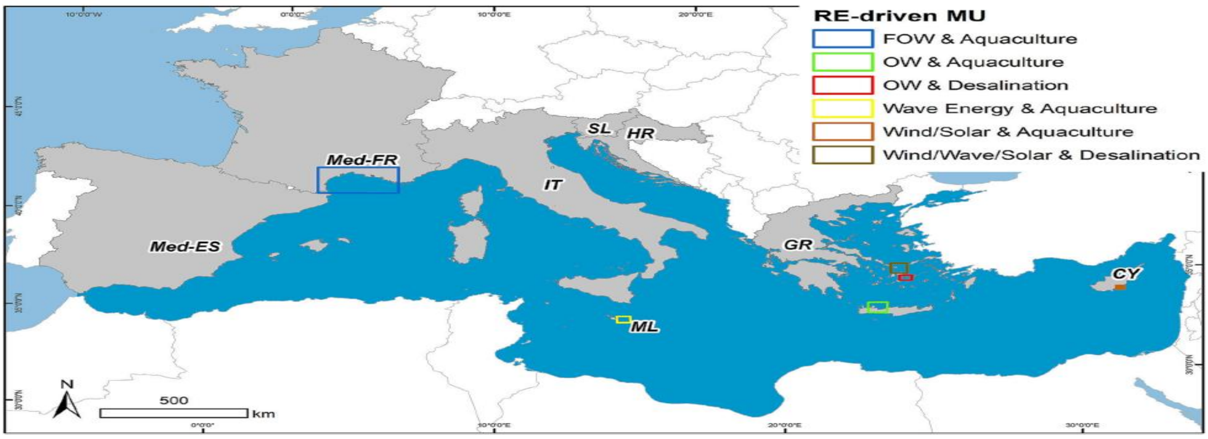

Figure 2.7. Existing and potential renewable energy-driven MU combinations. France: FOW & Aquaculture (Gulf of Lion); Malta (ML): Wave Energy & Aquaculture (South-eastern Malta); Greece (GR): OW& Aquaculture (Souda Bay, Crete); OW & Desalination (Iraklia Island) and Wind/Wave/Solar & Desalination (Mykonos Island). Note: Polygons illustrate approximate location of MU.
Source: Depellegrin D. et al., 2018, p. 617.

Jobstvogt et al., consider the valuation of ecosystem services to be essential to guarantee sustainability, especially when management decisions involve a trade-off between marine protection and the opportunity costs of the blue economy. Mulazzani et al., try to model the causal relationships between marine activities and ecosystems services. Finally, Liquete et al., deal with the assessment of ecosystems services and support the sustainable blue growth. At a more conceptual level, Ehlers questions the meaning of sustainability in the definition of blue growth. Frazão Santos et al., Jones et al., and Qiu and Jones analysis rely on strong or weak sustainability concepts, thus prioritizing the achievement of GES or blue growth, respectively. In the weak approach, since all forms of capital are considered to be substitutes, only the sum of utility counts and natural capital can decrease if replaced by enough man-made capital (Mulazzani and Malorgio, 2017). In this perspective, Qiu and Jones conclude that the MSFD and IMP prescribe two different types of MSP depending on sustainability: (i) 'Integrated use' based or 'soft' sustainability which focuses more on economic performance and growth of marine sectors; and (ii) 'Ecosystem–Based' (EB) or 'hard' sustainability which prioritize the environmental conservation due to marine activities (Frazão Santos et al., 2014a; Frazão Santos et al., 2014b; Jones et al., 2016). However, although ecosystem-based MSP is more precautionary, by putting the emphasis in achieving/maintaining ecosystems good environmental status, does not assure that it will be more effective than Integrated-use MSP in delivering sustainable management. The ultimate goal of MSP is to foster economic development through marine activities in a sustainable way (Frazão Santos et al., 2014a; Mulazzani and Malorgio, 2017). Through an integrated approach are analyzing activities and their pollution pressure on the marine and coastal areas, services provided by marine and coastal ecosystems and their vulnerability to environmental changes, the need for adaptation, and measures that need to take to address any potential implication (Rodríguez-Rodríguez et al., 2016; Guerra et al., 2015; Meiner, 2010).

Chapter 3

Materials and Methods

3.1. Study area

3.1.1. Main characteristics of Greece

Greece is located in the southeastern Europe and particular in the east of the Mediterranean Sea (Tonazzini et al., 2019). It has a lush marine environment consisting of thousands of islands and islets, and containing various depths and great biological diversity. The total length of Greek coastline is about 15000 km, where the 7300 km are regard to mainland and the 7700 km are regard to islands. Greece has territorial water approximately 92095 square km which cover only the zone of 6 nautical miles (Vasileiou et al., 2017; Lazoglou et al., 2015). It is less than 12 nautical miles which UNCLOS indicate due to the conflicts and boundaries issues with Turkey in the Aegean Sea (EC, 2020b; SUPREME, 2017; Papageorgiou et al., 2016). Recently it has agreed continental shelf delimitation with Italy and an agreement with Albania for the delimitation of their maritime zones, but has not yet entered into force. The conflicts with Turkey do not allow yet proclaiming an EEZ (Dendias, 2020; EC, 2020b; Lazoglou et al., 2015).

Its climate is Mediterranean, i.e. temperate with mild and winters and hot and dry summers. In Greek marine areas occur seabirds and zoobenthos such as marine mammals e.g. *Monachus-Monachus, Delphinidae;* marine reptiles, e.g. *Caretta-Caretta*; 476 fish species, and marine algae, e.g. *503 taxa.* There are also habitats of Posidonia meadows and Coralligenous formations (SUPREME, 2017). Greece has also natural resources such as lignite, petroleum, iron ore, bauxite, lead, zinc, nickel, magnesite, marble, salt, hydropower potential and with none significant exploitation (CIA, 2020). The country is high seismic with earthquakes to be occurred daily all over. It has volcanoes situated all of them in the Aegean Sea; in Santorini, in Methana, in Milos and in Nisyros (Kouskouna and Makropoulos, 2004).

Greece could be considered as an archipelagic state which is divided by a peninsula between the Aegean and the Ionian Sea (EC, 2020b). Most of its islands and islets are occurred in the Aegean Sea (Vasileiou et al., 2017). According to Hellenic Agency for Local Development and

Local Government, Greek islands are categorized in to four types according to their characteristics (Lazoglou et al., 2015):

- 1st type island: Significant tourist activities, increasing environmental pressures, high population and density, requirement to control their development.
- 2nd type island: Increasing tourism development, significant natural resources and productive activities, reducing reliance on tourism development.
- 3rd type island: small islands, crucial development problems, fewer residents, limited infrastructures, isolation from the mainland and other islands too.
- 4th type island: small islets, little to none population, geographical isolation, absence of infrastructures.

As about its economic characteristics Greece has a capitalist economy with a public sector accounting for about 40 % of GDP. The per capita GDP was recorded in 2019 at USD 24024. It is equivalent to two-thirds of that of the leading euro-zone economies. Marine Tourism contributes 18.5 % in GDP and provides 23.1 % of employment, Shipping 7 % of GDP by providing 92000 jobs, Oil and Gas extraction contributes 0.5 % of GDP (SUPREME, 2017). According to the economic performance across Europe for the year of 2018 as it is presenting in the following Fig 3.1, Greece's turnover range is about 3 to 5 % of the total turnover of Europe. Persons employed is 10 %, personnel costs is around 5 %, GVA is less than 5 %. The gross operating surplus is almost 3 % and the gross investment is negligible in contrast to the whole Europe, as well as the net investment (EC, 2020a).

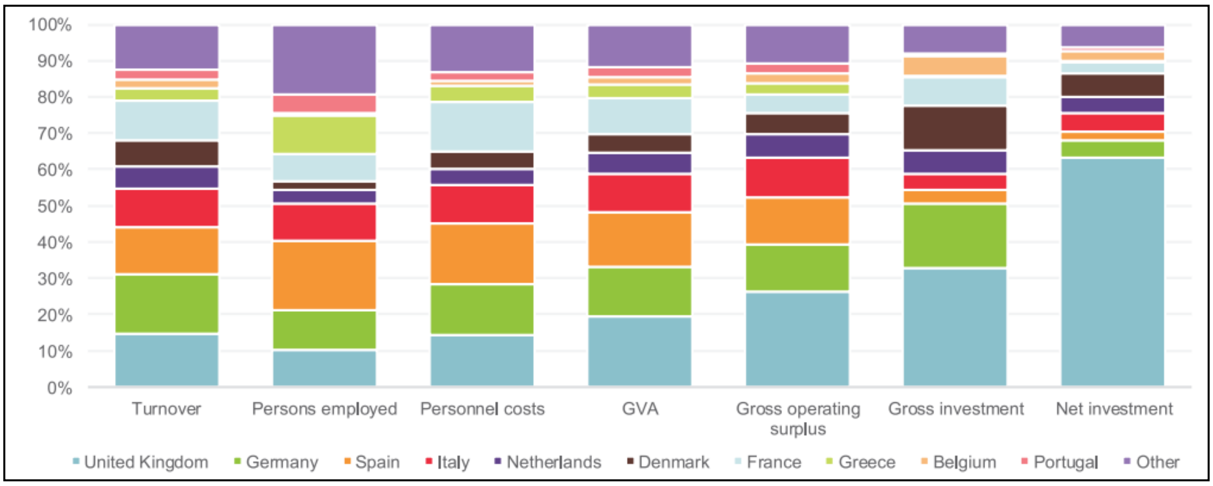

Figure 3.1. Economic performance across Member States of EU, 2018
Source: EC, 2020a.

Marine Activities in Greece

- Fisheries: In 2017, Greece had 14987 active fishing vessels registered, representing 17.3% of the fishing fleet operations in the Mediterranean and the Black Sea. The total tonnage of its fishing fleet in 2017 was 49308 tons. In 2018, catches reached up to 76506 tons with a total value of 256 million euro (Economou et al, 2020; HAS, 2019).
- Aquaculture: Greece is one of the most important world producers, according to the Food and Agriculture Organization (FAO). In 2017, Greek aquaculture production reached up to 125421 tons (FAO, 2018). In 2016, according to the sales volume, Greece produced 10 % of the total European aquaculture productions (EPRS, 2020). The country remains a world leader of Mediterranean marine finfish, producing approximately 20 % of global sea bass and 50 % of sea bream (Theodorou et al, 2015). Fig. 3.2 demonstrates the production of fisheries and aquaculture from 1950 to 2014.

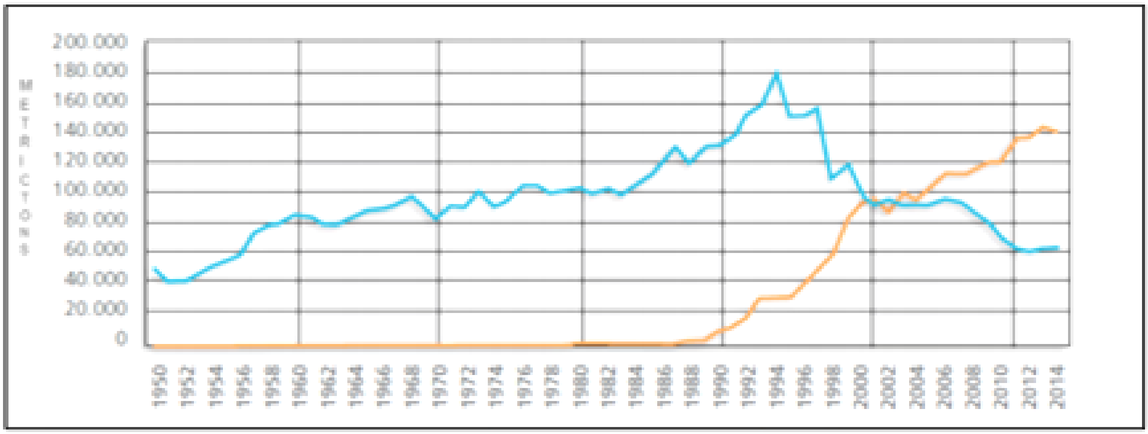

Figure 3.2. Greek fisheries and aquaculture production from 1950 to 2014, blue line represents the fisheries trends and orange line the aquaculture trends.
Source: SUPREME, 2018a.

- Coastal and Marine Tourism (Blue Tourism): Many activities related to boating are developed. There are 19 marinas with 6661 docking berths and thousands of yachting anchorages. Many cities like Piraeus, Heraklion, Corfu or Katakolo, are home ports for many cruise ships in the Aegean, the Eastern and the Western Mediterranean and the Levantine Sea. Greece, also, has almost 1600 sea bathing areas. The 96.7% of all existing coastal bathing waters met at least sufficient water quality standards. In 2019, 519 beaches and 15 marinas of Greece have been awarded with the blue flag award. Those areas were privileged sites for sea sports like surfing e.g. Paros island is a world- famous kite surfing site) (EC, 2020b). There are many ancient, byzantine and war wrecks in Greek waters. Some are under archaeological protection laws; others are under archaeological research (EC, 2020b).

- Marine Biotechnology: It is a new and recently growing sector, still under development in Greece. The Institute of Marine Biology, Biotechnology and Aquaculture (IMBBA) is one of the three research institutes of the Hellenic Centre of Marine Research. It aims to carry out scientific and technological research as well as experimental development. To date, there are not specific strategies, plans and policies. There are existing only some innovative companies such as Phee that biocomposite materials from dead leafs of Poseidonia Oceanica (EC, 2020a).
- Maritime shipping: The Greek port system consists of approximately 900 ports of different size, administrative organization, uses, and importance. There are major Mediterranean ports in Greece. Piraeus for example, which is the main port of Athens, is predominantly for major shipping activity (SUPREME, 2018a). Many ports have adopted Port Master Plans that establish policies and guidelines to direct the future development of the port and manage its operations. According to the national legislation in force, the terminal operators of the 57 most important Greek ports are obliged to develop a Master Plan for the ports under their jurisdiction. The Master Plans are approved by the Committee for Port Planning and Development (ESAL) chaired by the General Secretariat of Ports, Port Policy and Maritime Investments of the Ministry of Maritime Affairs and Insular Policy (EC, 2020b).

Figure 3.3. Port of Piraeus
Source: https://www.exporters-eoaen.gr/articles/piraeus-port-as-international-hub-for-greek-exports

- Marine Minerals: According to the EU Blue Economy Report in 2020, have already been recorded 26 deposits of hydrothermal mineralization, and 3 of marine placers in the Aegean Sea. Marine placers typically found in shallow waters and include minerals such as zircon (Zr), magnetite (Fe), monazite (Th and REE), etc. Hydrothermal mineralisation also known as seafloor massive sulphides, typically found at depths between around 400 and 3900 meters. These deposits have a high content of copper, zinc, lead, silver and gold. The Fig. 3.4 presents the occurrence records in European marine regions for different deposits.

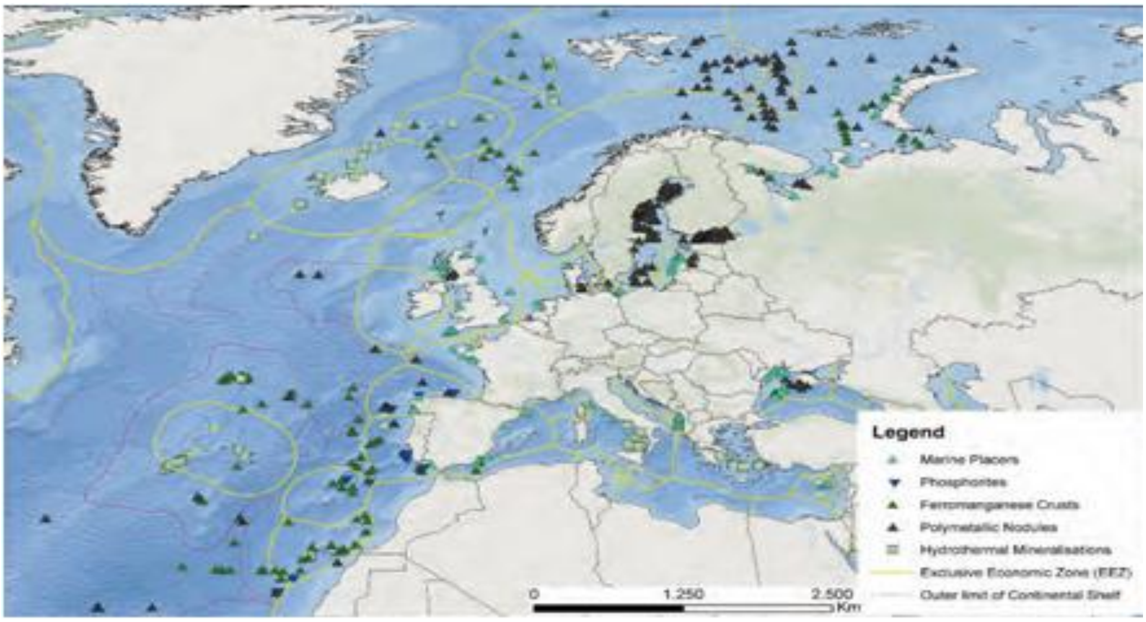

Figure 3.4. Marine mineral occurrences in EU waters
Source: EC, 2020a

- Marine Renewable Energy: There are not occurring or operating any marine renewable energy sectors in Greece’s marine space, either offshore wind or wave/tidal infrastructures. They have been done quite a lot of studies about potential installation of such infrastructures, but are still on research and development phase in the country. The target is to produce 1500 MW from wind and 28 MW from wave and tidal (SeaEnergy 2020, 2011). Through the EU’s funding pilot projects have been implemented two infrastructures but are not operating (see section 3.1.2).
- Oil and gas: The Prinos Oil Field is the main structure in the Prinos-Kavala basin, located offshore in the Gulf of Kavala. It covers an area of 4 km^2, about 8 km north-west of the island of Thassos and 18 km south of the mainland of North Greece, in a water depth of 31 m. Currently, 14 wells are producing and four are injecting sea water. The oil production averaged 3,177 bbls daily in 2016, which is a 151 % increase compared to 2015 production. Recently, the Hellenic Parliament ratified four concessions allowing the extraction of hydrocarbons in the Ionian Sea and in the west of Crete (EC, 2020b).

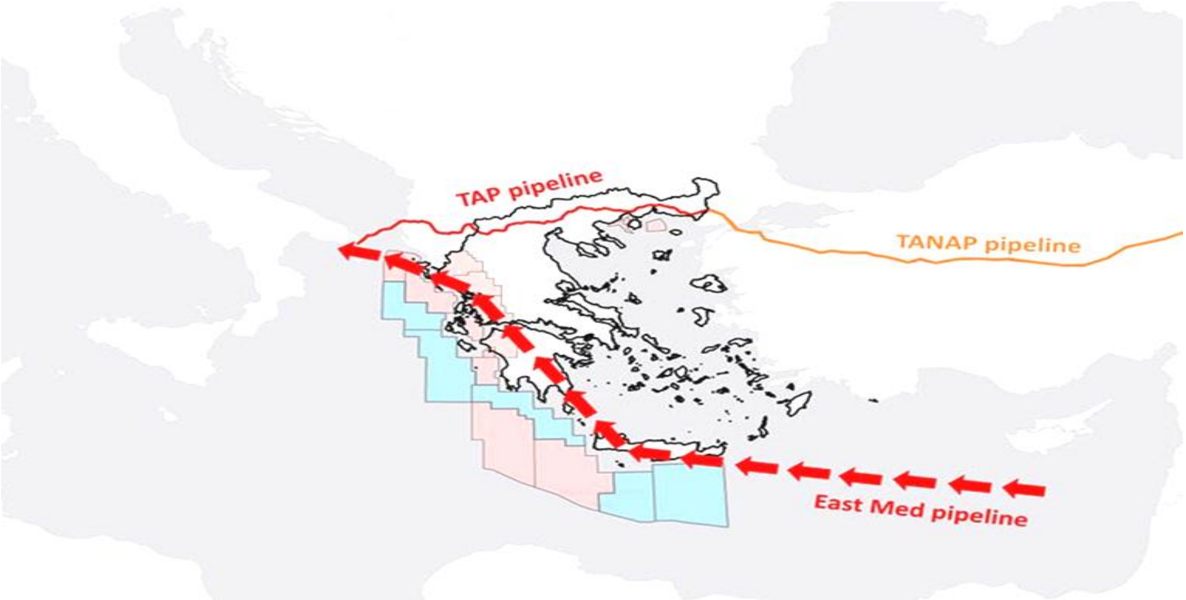

Figure 3.5. Offshore Deepwater Exploration and Drilling in Greece. Block awarded or under ratification (pink), Areas of interest (light blue)
Source: https://www.geoexpro.com/articles/2019/03/offshore-deepwater-exploration-and-drilling-in-greece

- Desalination: As the marine renewable energy sectors, are not occurring or operating any desalination procedures on the Greek marine space. The sector is still under development on the marine environment. In the territorial area there are already there are currently 157 operating desalination plants, with a total capacity of 109,115 m^3 per day. The only implementations that have been done on marine space are through EU's Multi-Use projects (see section 3.1.2).

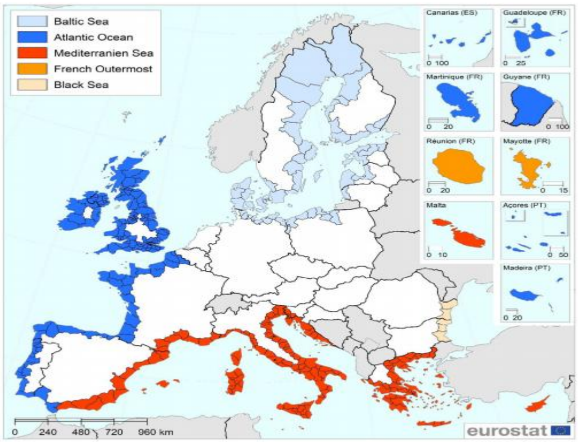

Figure 3.6. Greece belongs to Mediterranean Sea basin
Source: EC, 2019a

Greece is participated in 12 international initiatives related to ICZM and MSP in the Mediterranean Sea Basin which are presented analytically in Annex II of the final report of the European Commission Study in 2011. There are analyzed all the related legislations about marine areas, i.e. shipping pollution legislation; environment and planning; underwater cultural heritage; etc. (ECS, 2011). Actually the country participate in three sea basins strategies; the Mediterranean, the East-Mediterranean, and the Adriatic-Ionian; as are presenting in Fig.

3.6, Fig. 3.7 and Fig. 3.8. These strategies promote cooperation and collaboration between the Member States addressing the transboundary challenges (EC, 2019a).

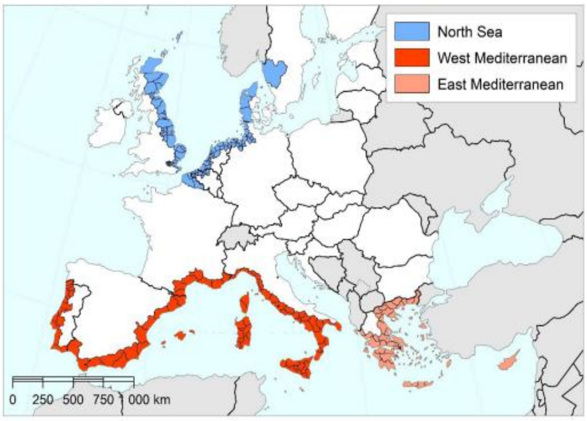

Figure 3.7. Greece belongs to East- Mediterranean Sea basin
Source: EC, 2019a

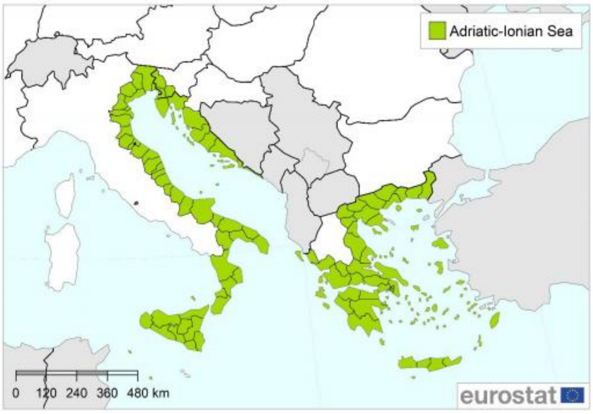

Figure 3.8. Greece belongs to Adriatic-Ionian Sea basin
Source: EC, 2019a

Last, in Greece, has not been framed in legal, policy strategic and planning documents none the MU concept either at national or at regional/local level. The two MU projects that have been done in the Cycladic island complex, in Iraklia and Mykonos were pilot (Maniopoulou et al., 2017). Major barriers are related to Greek bureaucracy and its legal gaps, the lack of financial support and the lack of initiatives (Depellegrin et al., 2018; MUSES, 2017).

3.1.2. Case study: the Cycladic island complex

The geographical scope of the study covers the territorial waters of the Cycladic island complex. It is located on the Aegean Sea, in the southeast of Greece's mainland. The Cyclades are consisting of 30 small islands and could be characterized as an archipelago. The islands belong to the 3rd islands type as it was describing in the previous section. The major ones are Amorgos, Anafi, Andros, Antiparos, Ios, Kea, Kimolos, Kythnos, Milos, Mykonos, Naxos, Paros, Folegandros, Santorini, Serifos, Sifnos, Sikinos, Syros, and Tinos. The capital and administrative center is in Ermoupolis city on Syros. The total area of islands is 2572 square km with 122613 inhabitants. The population growth rate was increased by 8 % since 2001 (PEGASO, 2018; HAS, 2011). The 16 of them have a population of less than 3000 people.

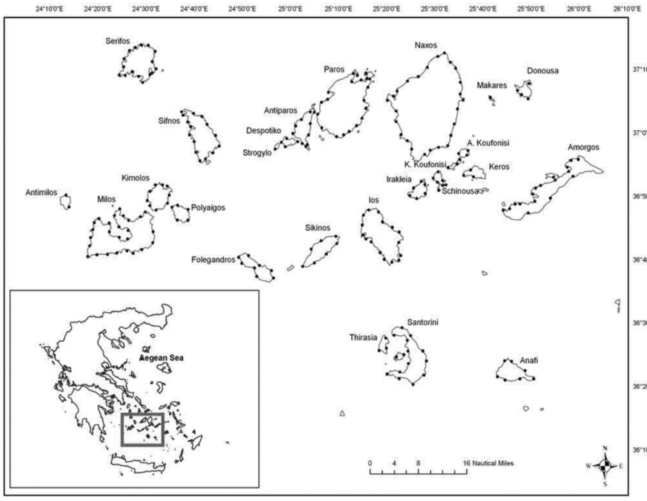

Figure 3.9. Case study, Cyclades Archipelago
Source: https://www.researchgate.net/figure/Study-area-in-the-Cyclades-Archipelago-Central-Aegean-Sea-Greece-Points-represent-the_fig1_307701103

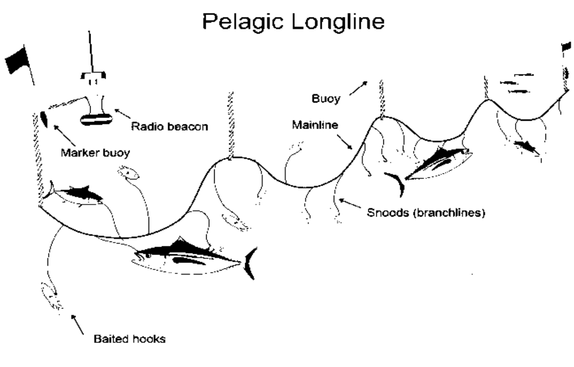

Figure 3.10. Pelagic longlines
Source:https://www.afma.gov.au/fisheries-management/methods-and-gear/longlining

Activities within Cyclades' marine space include aquaculture, capture fisheries, tourism-related activities, recreational and transport-related navigation. The main economic sector that has been deployed there is the tourism. The total number of overnights in Cyclades was increased from 2010 to 2018 about 66 %. Despite this, fisheries remain particularly important for the area. The sector supports the local residents all year around. The catch is composed of mullets, scorpion fish, bogues and picarels and calculated for about 3830 tons in 2016. The fishing equipment includes nets, longlines, trawls, traps and pelagic longlines (Economou and Mitoula, 2020; SUPREME 2018). It is divided into three sectors: trawlers, purse seiners and small-scale coastal fisheries. Fishing effort depends on the depth. When trawlers are banned small-scales are more active and vice versa. The fleet distribution depends on the shape of each locality. The larger the fleet is the larger will be the fishing effort (Issaris et al., 2012).

The seafloor morphology in central Aegean is featureless and the average depth is about 200m. Due to its extremely insular nature, the Cyclades islands are overloaded with a dense marine transportation system and sea lanes. The Cyclades complex has remarkable resources of coasts, energy and cultural. The area is characterized by wind and sea dynamics. The highest wind potential is in Andros, Mykonos, Tinos, and Naxos with an average wind speed of six to ten meters per second. The wind is called Meltemi and starts to blow from May to September with a period of two to four days or even weeks (Climates to Travel, 2020). The velocity can reach up to eight meters per second and ten meters above the sea level. The potential generation energy from the offshore wind farms is estimated at 1000 TW per hour. Milos and Santorini have geothermal fields too. The potential wave energy generation can reach from 5 to 8 meters per second only due to the presence of the insulars (Vasileiou et al., 2017). The potential wind velocity and wave energy are presenting in the Fig. 3.11.

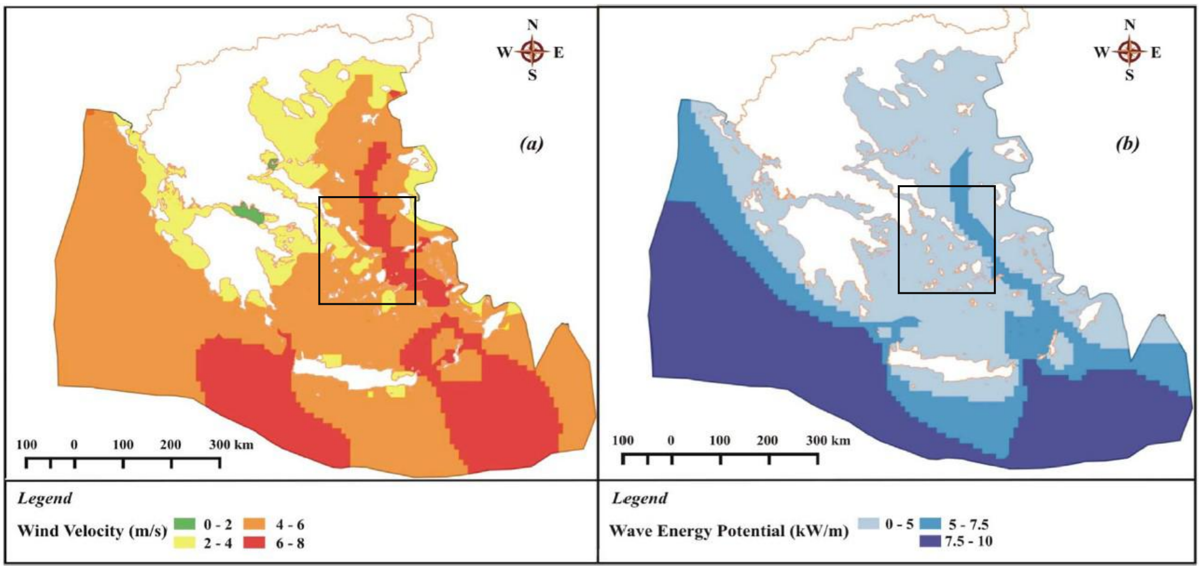

Figure 3.11. Thematic Maps of wind velocity and wave energy potential.
Source: Vasileiou M. et al., 2017, p75.

In the Cycladic island complex are including four categories of port systems. Mykonos' port belongs to K1: Port of International Interest. Santorini', Paros' and Syros' ports belong to K2: Ports of National Interest. Naxos' and Tinos' belong to K3: Ports of Major Interest. All the rest islands' ports belong to K4: Ports of local interest (SUPREME, 2018a).

Although there is a strong shipping and maritime transport activity, the area has high biodiversity; probably due to the water exchanges. This can be translating to economic terms as an area with large and small scale fishing activities which can contribute to the population richness. Its natural and cultural environment is under threat due to degradation of intense human activities and land-use implications (Economou and Mitoula, 2020; Papageorgiou 2016a).

Figure 3.12. Ydriada platform
Source: EcoWindWater

As it mentioned on the previous section, in Cyclades have been implemented two MU pilot projects. In 2015, through the MARIBE program, a Multi-Use Platform designed by EcoWindWater (EWW). EWW is a Greek clean-tech company which aimed to address the scarcity of freshwater and generate energy production satisfies consumer's needs in Iraklia Island. The project entitled Ydriada, Fig. 3.12 and is a Multi-Use Platform presented the combination of offshore wind and desalination. It is installed 1.9 km from the island's port, but is not operating nowadays (Maniopoulou et al., 2017). The initial focus of wind turbines was to power the desalination process but they can also contribute and export electricity to the island of Iraklia too (MARIBE, 2015). The domestic market focuses on various Greek islands especially in the Cyclades complex import freshwater during the high pressure in tourism season. EWW has trailed the Ydriada platform since 2010, delivered desalinated water at 70m^3/day maximum capacity, and used technology current status at TRL 6 level (e.g. TRL is Technology Readiness Level: 1-Basic concept, 2-Conceptual Design, 3-Preliminary Design, 4-Detailed Design, 5-Lab testing, 6-Prototype, 7-Field test, 8-

Preproduction, 9-Commercialized) (Dalton G. et al., 2019, Dalton G. et al., 2018b). The major positive effect of this combination was that the platform was floating and can be allocated on preference locations avoiding conflicts with other marine uses (e.g. fishing, aquaculture, tourism, and shipping/transportation), offering 100 % eco-friendly power source with a low carbon footprint, and requires only half of square kilometer space. The annual cost was estimated at 1.13 million euro per year and the annual revenue at almost 1.5 million euro per year, providing 562 jobs per square km (Dalton et al., 2019).

In 2017, through the MUSES project, Mykonos Island was selected for was selected for exploring existing and potential offshore multi-uses in Greece. Like the other Greek islands, it faces problems due to the long distance from the mainland, the increased and costly energy generation, and the lack of freshwater and waste management. Especially, during the touristic season the energy and the water demands are extended. One of the potential uses to be explored along with renewable energy in the case study of this project was initially to be aquaculture. However, that was not available as the national spatial plan for aquaculture development had already excluded Mykonos from the proposed sites. Consequently, it was considered desalination. The island of Mykonos is not connected to the central national water provision and its water supply is ensured through the application of a mixed system by wells, transportation from private drillings, and transportation indirectly by two dams on the island, and three land-based desalination plants (Maniopoulou et al., 2017). The Fig. 3.13 presents a similar installation of the potential combination of this case study.

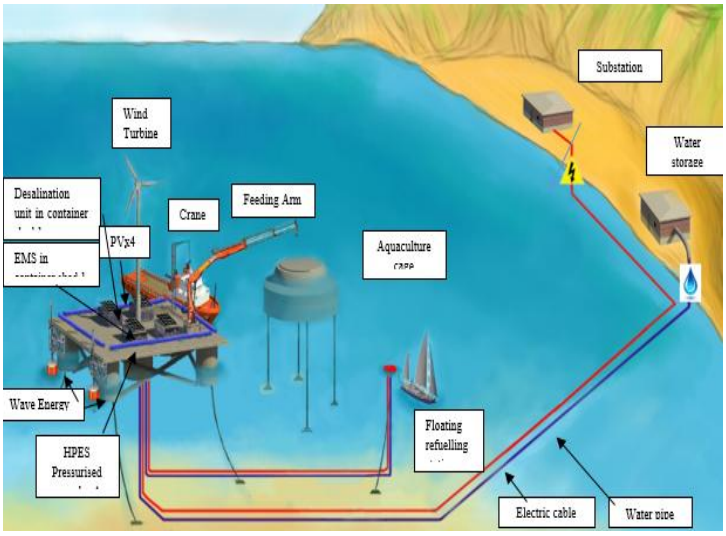

Figure 3.13. Image demonstrating MUSICA platform, RES, aquaculture, floating electricity, and water recharging station services, and connection to shore.
Source: https://www.offshore-energy.biz/marei-to-build-green-powered-offshore-platform-for-small-islands/

Although the results were promising, the stakeholders' conflict on the local scale forced stopped further installation development. A DABI, i.e. Drivers-Added Values-Barriers-Impacts; analysis was executed on socio-economic, technical, and environmental pillars through interviews and stakeholders' participation to evaluate the effects of the combination of renewable energy and desalination plant in Mykonos island (Maniopoulou et al., 2017). Drivers are factors promoting MU, Barriers are factors hindering MU, Added Values present positive effects of an MU, and Impacts the negative effects of such a project. According to this, Drivers (e.g. lack of freshwater, better wind quality at the sea, water stress during high tourism season, elimination of spatial conflicts, and floating installation) and Barriers (e.g. water corrosion, lack of funding, visual pollution, increased costs, multiple interests) had an average score of 0.12 for the potential installation. Added Values (e.g. low carbon footprint, stakeholder engagement for the site selection, possible combination with a third use, and energy and water independence) and Impacts that have not been identified had an average score of 1.15 (Depellegrin et al., 2018; Maniopoulou et al., 2017).

3.2. Materials

Classical indicators such as turnover and employment can quantify the social and economic importance towards Blue Economy development. The main indicators to access economic performance are the turnover, persons employed, personnel costs, GVA, gross operating surplus, gross investment and net investment (EC, 2020a; MUSES, 2017; Plan Blue, 2017). The GVA removes the danger of double counting and determines the share of Blue Economy in the national GDP. The focus on the accountability of Blue Economy excludes non-market benefits, e.g. protection against coastal erosion, waste treatment, and climate regulation (Mulazzini and Malorgio, 2017). According to Mulazzani and Malorgio, to develop a strategy for marine space the analysis includes two sections. The first one focuses on the socio-economic importance of each marine space. The second one focuses on the costs of degradation lost due to existence of human activities (Mulazzani and Malorgio, 2017).

The indicators used were the GVA rate and the number of employment for each marine activity that occurs in the marine space of Greece. Population indicators are relevant to the current status and future social growth in the area. Tourism arrivals are relevant to issues of overexploitation of resources, as well as to economic benefits in the area. Fish stocks show the critical status and are important to ensure the safeguard. Marine and coastal areas conserved are relevant to the implementation and compliance of Barcelona Convention. Sea level rise and area lost are relevant to mitigation and adaptation measures to climate change.

3.3. Methods

The indicators selected are grouped in categories with a view to cover the three pillars of sustainability. Each one affects to a different level and degree the goals and objectives, thus differs their importance and their role to the development (Lazoglou et al., 2015). The analysis is divided into five main forces in order to investigate social aspects, economic and funding tools, legal background, technological features, and environmental dimension. This disaggregation enables a wide overview of Blue Economy's implementations in the study area. The value of each activity is crucial for the decision process in order to recognize costs and benefits to each other (Papageorgiou, 2018). The resulting indicators consider being suited for measuring the status and trends of a Blue Economy in Cyclades complex.

3.3.1. SWOT analysis

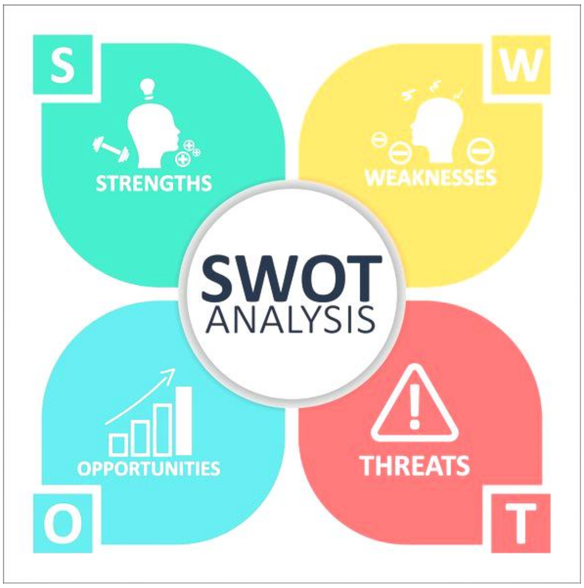

Figure 3.14. SWOT analysis
Source: https://www.rhythmsystems.com/blog/4-steps-to-swot-a-pandemic

The methodology used is the SWOT analysis. It is a holistic analysis which highlights the main strengths, weaknesses, opportunities and threats; considering social, economic, legal, technical and environmental dimensions. It is a useful method to identify the main internal and external factors that may prevent or contribute to the development of a sustainable Blue Economy in the Cyclades. Strengths and weaknesses are indicated as internal factors within a system and can be managed more easily than the external ones which are opportunities and threats. Threats and weaknesses are affecting the realization of achieving sustainable Blue Economy. On the other hand, opportunities and strengths are supporting the vision towards the Blue Economy (Goffetti et al., 2018; WWF, 2015a). Strengths are considering the provision of jobs, the GVA rate and the number of employees on each marine activity. Weaknesses are related with the non-compliance to laws and regulations. In addition, they comprise the unavailability to resources as well as to data and information. Opportunities are considering the ways of maximizing the development in the marine space, while preserving and protecting the marine environment. This could be achieved through technological innovations and improvements, national and European funding, raising awareness of stakeholders' to marine environment, and eco-friendly applications. Threats are related with space competition between marine activities, environmental hazards, political and economical issues, gaps in laws and regulations, potential illegal or unregulated activities, and lack of social acceptance.

Through the SWOT analysis can be assigned significance to each factor, apart from the determination and description of factors that have either a positive or negative effect. The assignment is based on the determination of weights (Bieda et al., 2019). Vanek et al., approach' was used to determine the weights for each indicator to this case study. Strengths and opportunities have a positive sign and weaknesses and threats a negative sign one. The weights are summarized and plotted in a coordinate system, where each point determines the resulting strategic quadrant. The larger absolute value of the pair of strengths and weaknesses, opportunities and threats determines the required coordinates of the point and the relevant strategic quadrant of the SWOT matrix (Vanek et al., 2012). The weights that have been chosen in the analysis based and present author's opinion. It used the scale of -3 to 3 where 0: no influence, 1/-1: low influence, 2/-2: average influence, 3/-3: significant influence. If the quadrilateral center locates at Opportunity – Strength quadrant then it means that these factors have the main influence in Cyclades sustainable Blue Economy (Kong et al., 2012).

Chapter 4

Results

Conflicts arise when activities are in competition for resources or for space or due to negative effects on the environment. These conflicts would need to be addressed through MSP process. In the following Table 4.1 are presenting the current and future conflicts between marine activities as resulted from SUPREME projects. The evaluation scales that used were low and high (SUPREME, 2017).

	Fisheries Commercial	Fisheries Recreational	Aquaculture	Marine Transport	Renewable Energy	Coastal and Marine Tourism
Fisheries Commercial		HCR	LC	HCSNE	HCSNE	LC
Fisheries Recreational	HCR		LC	LC	HCSNE	LC
Aquaculture	LC	LC		LC	HCSNE	HCSNE
Marine Transport	HCSNE	LC	LC		HCS	LC
Renewable Energy	HCSNE	HCSNE	HCSNE	HCS		HCSNE
Coastal and Marine Tourism	LC	LC	HCSNE	LC	HCSNE	

Table 4.1. Current and future conflicts between marine activities.
Source: Supreme 2017, p. 52

The HCR corresponds to High Conflicts due to competition for Resources. The HCS relates to High Conflicts due to competition for Space. The HCSNE relates to High Conflicts due to competition for Space and Negative Effects on the Environment. Last, the LC means Low Conflicts (SUPREME, 2017). Fisheries sector on this project is separated in two subsectors, the recreational and the commercial one. If commercial fisheries are over the limit then the recreational ones will not operate and will lead to jobless for the subsector and vice versa.

The renewable energy sector which includes the offshore wind farms and ocean energy requires lots of space for its establishment. This can lead to high conflicts for space between all the other sectors. At the same time, the construction of a renewable infrastructure can lead to environmental problems for the aquaculture, fisheries and tourism sector by causing degradation of the marine environment, biodiversity loss, noise etc.

In the Table 4.2 are presenting the possible conflicts between marine activities in Greek seas considering economic impacts. The NC refers to No Conflict. The IC corresponds to Incidental Conflict, where activities can co-exist. The CC relates to Considerable Conflict, co-existence may lead to costs. Last, the SC means Strong Conflict, co-existence is implausible (Stefanakou and Nikitakos, 2015).

	Shipping	Marine Renewable energy	Fisheries	Aquaculture	Marine Tourism
Shipping		NC	NC	NC	NC
Marine Renewable Energy	CC		NC	NC	IC
Fisheries	NC	SC		NC	NC
Aquaculture	CC	NC	SC		IC
Marine Tourism	NC	IC	IC	IC	

Table 4.2. Possible conflicts between marine activities in Greek seas considering economic impacts
Source: Stefanakou and Nikitakos, 2015, p8.

The above table differs from the corresponding of Supreme project. For example, Stefanakou and Nikitakos considered that there is no conflict between aquaculture and marine renewable energy sector as well as no conflict between aquaculture and fisheries.

According to the literature and taking into account the two above tables, is presenting the table of author's opinion for the study area. The conflicts between activities should consider all the socio-economic and environmental impacts and competitions in order to support or dismiss co-existing of them. The scale that used is positive (+) and negative (-). The positive rate refers to the occurrence of conflict and the negative rate refers to the absence of conflict.

	Shipping/ /Maritime Transport	Marine Renewable energy	Fisheries	Aquaculture	Marine and Coastal Tourism
Shipping/Maritime Transport		+	-	-	-
Marine Renewable Energy	+		+	+	-
Fisheries	-	+		-	+
Aquaculture	-	+	-		+
Marine and Coastal Tourism	-	-	+	+	

Table 4.3. Conflicts between marine activities in the study area

4.1. Indicators

4.1.1. Employment Indicators:

Table 4.4. Greece: Evolution of the Established Blue Economy sectors- People employed (thousands). Source HAS, 2020; EC, 2020i.

People employed (thousands)	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Marine living resources	42,9	43,9	43,3	42,3	40,0	36,5	37,9	38,3	35,6	37,1
Marine non-living resources	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1
Marine renewable energy	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Port activities	6,8	6,7	6,1	5,7	6,3	14,0	15,6	15,5	14,9	14,9
Shipbuilding and repair	9,5	9,0	6,5	6,6	5,7	8,1	7,8	8,4	8,1	8,1
Maritime transport	23,6	21,1	20,9	19,2	18,1	21,9	20,7	20,3	20,1	20,1
Coastal tourism	493,3	396,4	283,7	178,9	225,9	293,7	243,0	315,8	361,5	453,3
Total Blue Economy Jobs	576,2	477,3	360,6	252,8	296,1	374,3	325,1	398,4	440,3	533,5

National Employment (thousands)	4469	4306	3979	3636	3459	3480	3548	3610	3683	3751
Blue Economy (% of national jobs)	12,9	11,1	9,1	7,0	8,6	10,8	9,2	11,0	12,0	14,1

Table 4.5. Evolution of the Established Blue Economy sectors- GVA at factor cost by the Blue Economy (€million). Source HAS, 2020; EC, 2020i.

GVA at factor cost by the Blue Economy (€billion)	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Marine living resources	0,283	0,254	0,256	0,198	0,176	0,283	0,262	0,649	0,553	0,563
Marine non-living resources	0,004	0,005	0,005	0,005	0,004	0,004	0,003	0,006	0,004	0,005
Marine renewable energy	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Port activities	0,331	0,342	0,276	0,257	0,268	0,539	0,718	0,767	0,781	0,781
Shipbuilding and repair	0,441	0,265	0,235	0,200	0,175	0,196	0,218	0,186	0,175	0,175
Maritime transport	1,123	0,788	0,713	0,784	0,724	1,030	1,234	1,126	1,119	1,119
Coastal tourism	11,006	8,399	5,750	3,294	3,961	3,885	3,404	3,627	4,973	5,785
Total Blue Economy GVA	13,187	10,054	7,234	4,737	5,308	5,937	5,838	6,361	7,605	8,427

National Economy (GVA €billion)	237,5	226,0	207,0	191,2	180,7	178,7	177,3	176,5	180,2	184,7
Blue Economy (% of national GVA)	5,6	4,4	3,5	2,5	2,9	3,3	3,3	3,6	4,2	4,6

The next charts Ch. 4.1 and Ch. 4.2 are presenting the evolution of persons employed and GVA in Greece in the established Blue Economy sectors from 2009 to 2018 as a result from the above tables. The Ch. 4.3 is presenting Evolution of GVA at factor cost of each marine activity by the Blue Economy sectors in Greece.

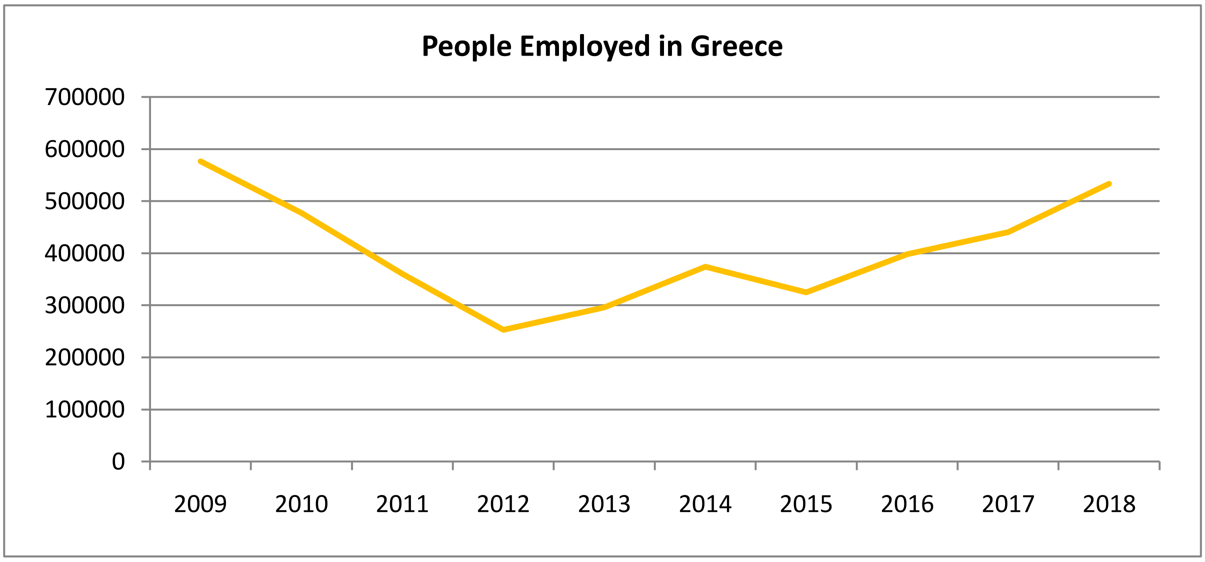

Chart 4.1. Evolution of People employed in the Blue Economy sectors in Greece

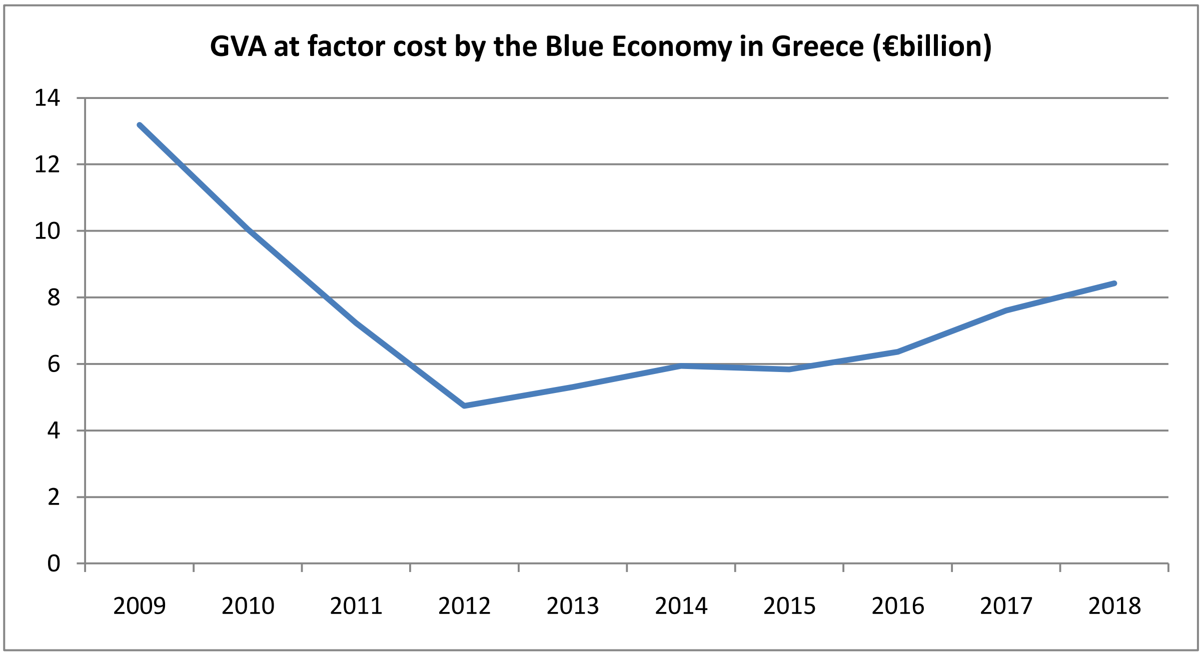

Chart 4.2. Evolution of GVA at factor cost by the Blue Economy sectors in Greece

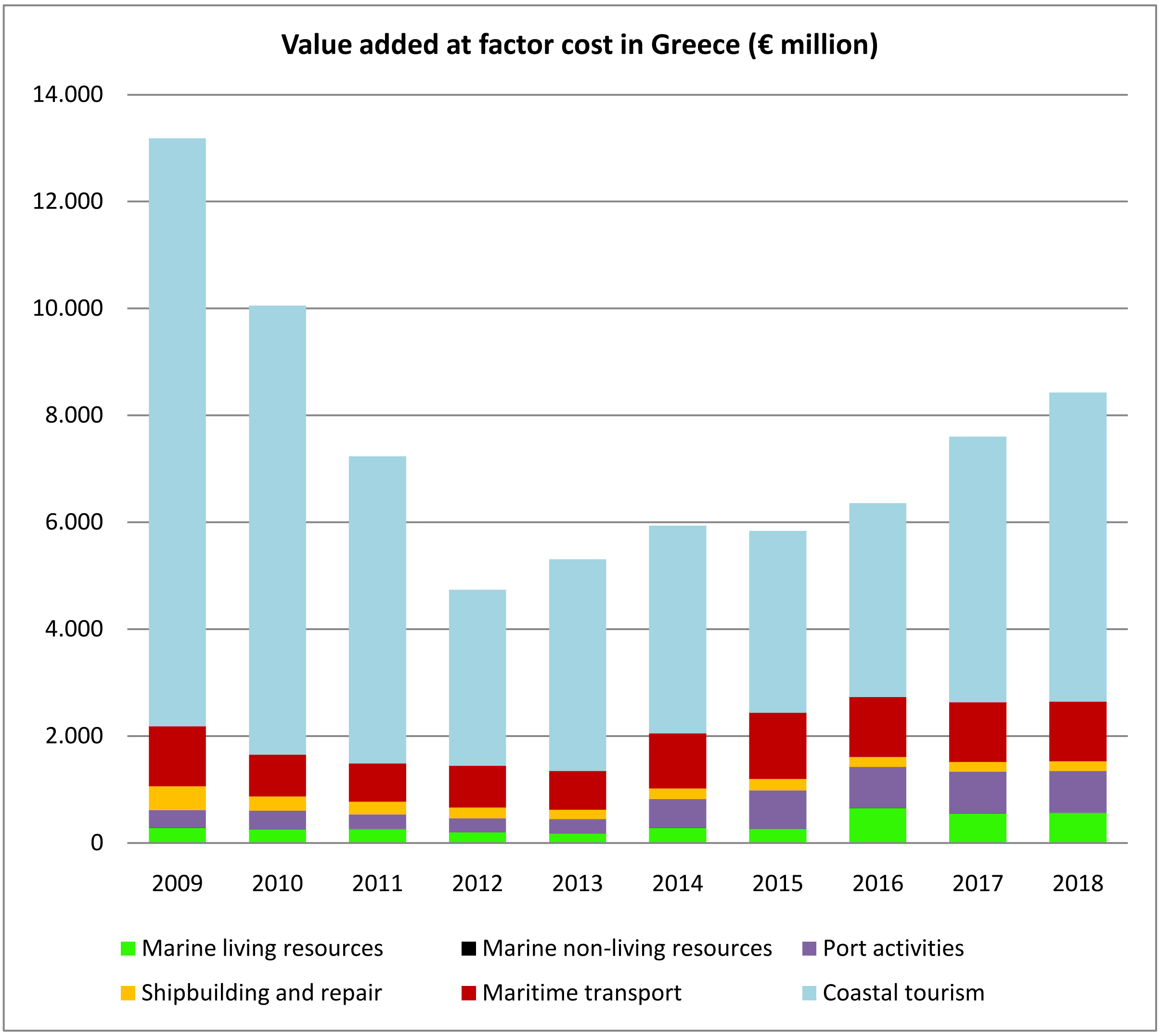

Chart 4.3. Evolution of GVA at factor cost of each marine activity by the Blue Economy sectors in Greece

4.1.2. Population indicators:

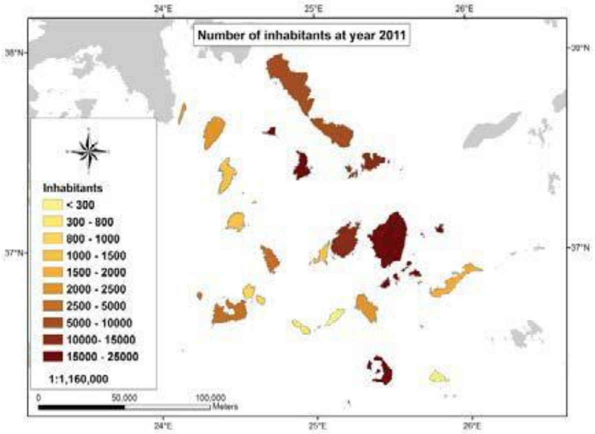

Figure 4.1. Population in 2011 in Cyclades

Source: PEGASO, 2018 p.203

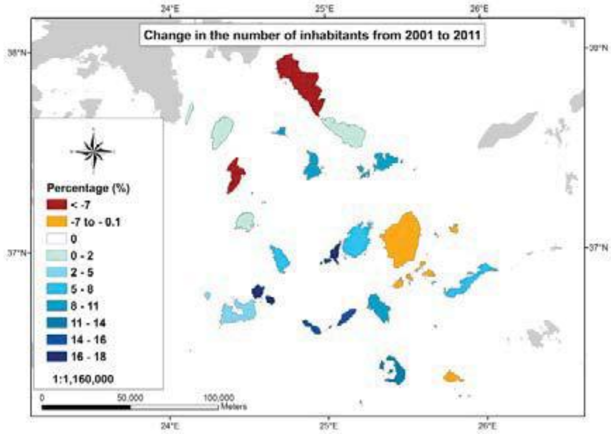

Figure 4.2. Population change from 2001 to 2011

Source: PEGASO, 2018 p.203

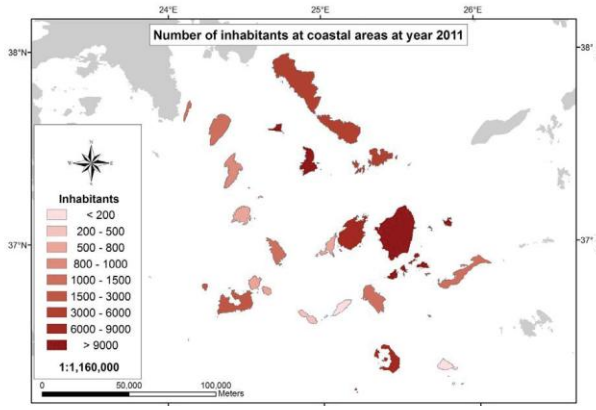

Figure 4.3. Population at coastal areas
Source: PEGASO, 2018 p.205

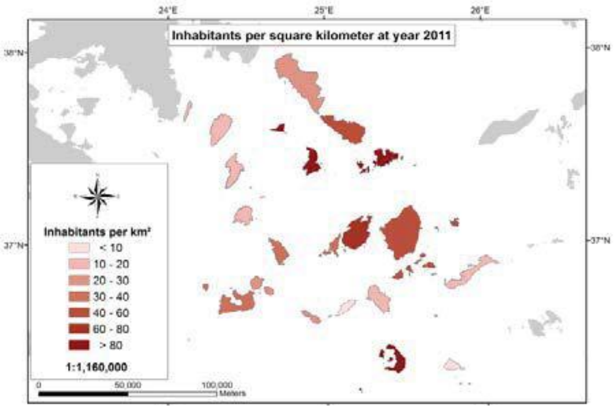

Figure 4.4. Population density in 2011
Source: PEGASO, 2018 p.204

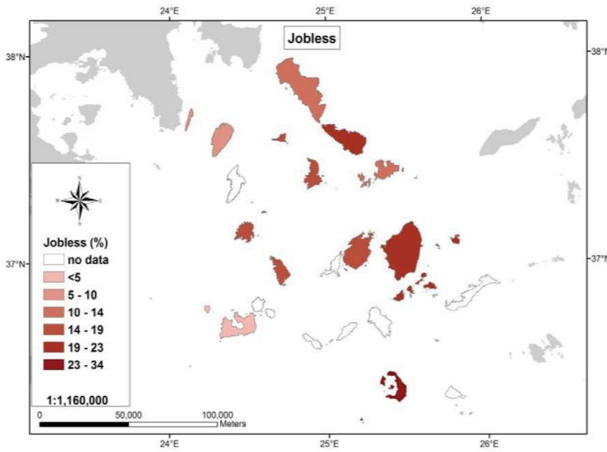

Figure 4.3. Jobless in Cyclades complex
Source: PEGASO, 2018 p.231.

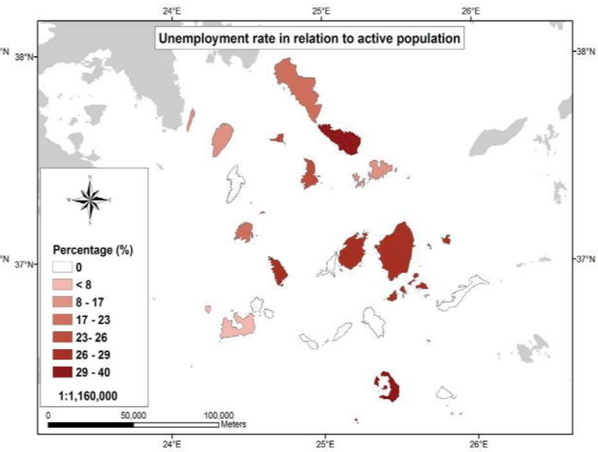

Figure 4.4. Unemployment compare to active population
Source: PEGASO, 2018 p.232.

4.1.3. Hazard indicators:

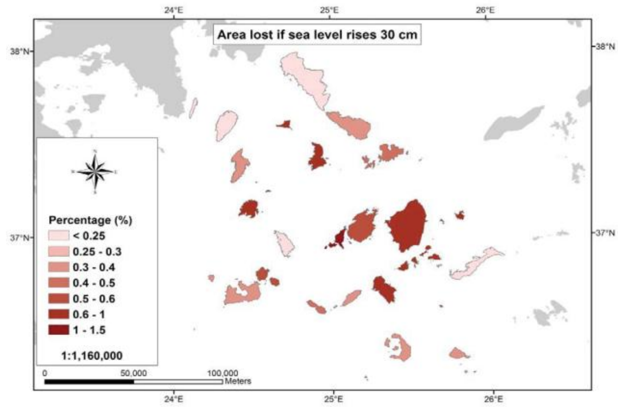

Figure 4.5. Sea Level Rise 30cm – Area lost
Source: PEGASO, 2018 p.206

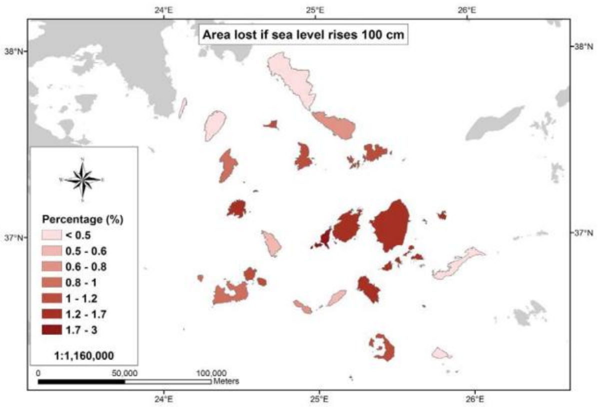

Figure 4.6. Sea Level Rise 100cm – Area lost
Source: PEGASO, 2018 p.208

4.1.4. Fisheries indicators:

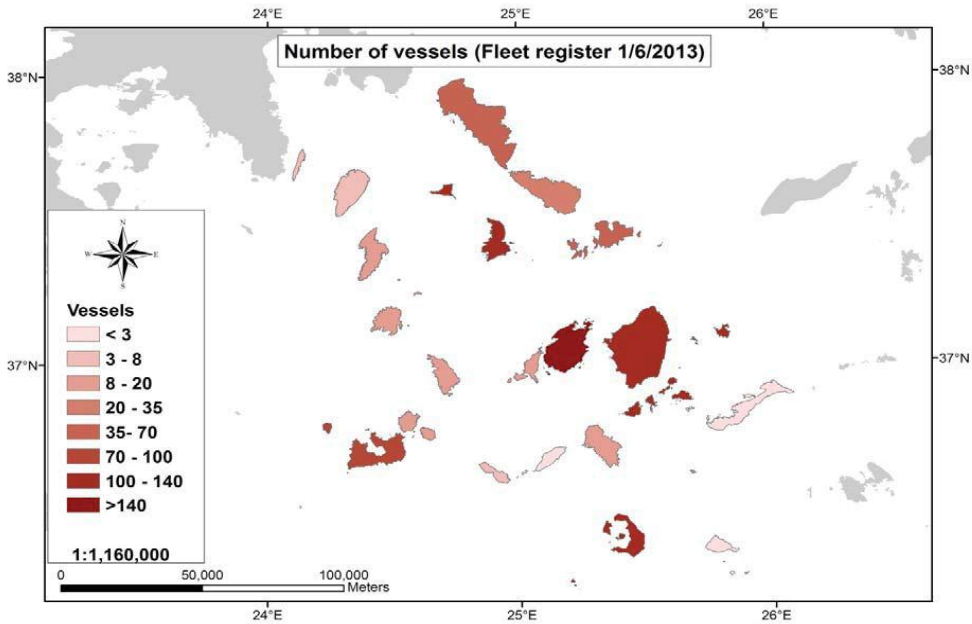

Figure 4.7. Fleet of Cyclades
Source: PEGASO, 2018 p. 222

4.1.5. Environmental Indicators:

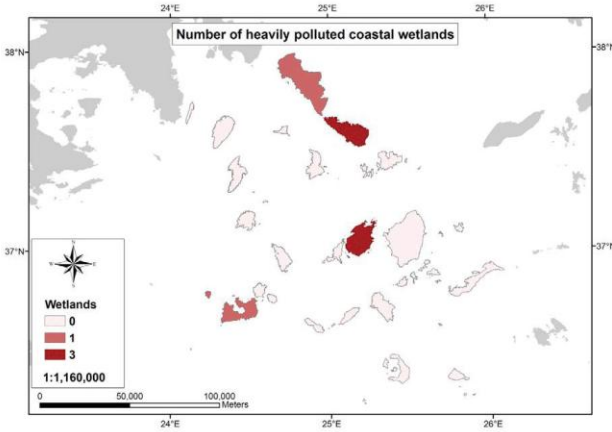

Figure 4.8. Heavily polluted coastal wetlands
Source: PEGASO, 2018 p.211.

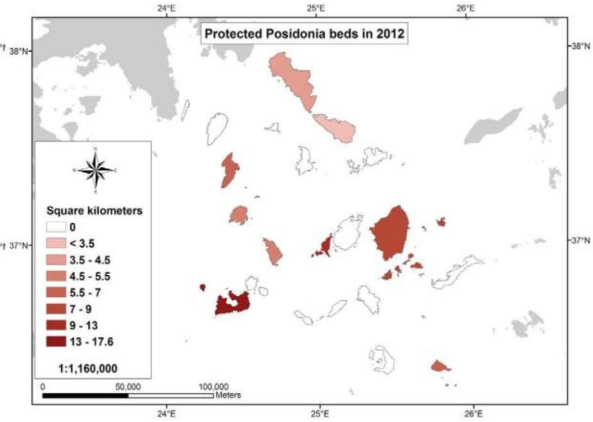

Figure 4.9. Protected Posidonia beds in 2012
Source: PEGASO, 2018 p.213.

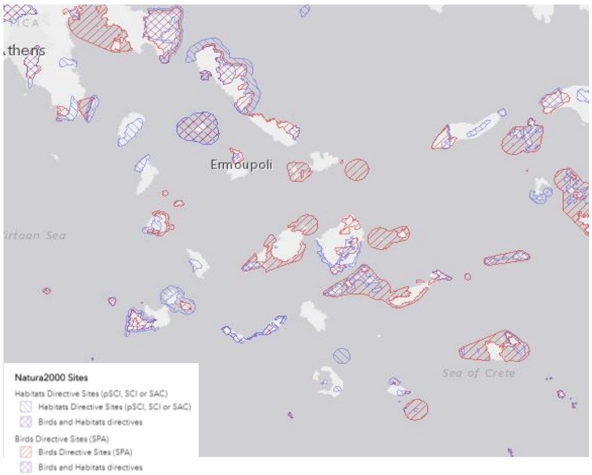

Figure 4.10. Natura 2000 sites in Cyclades
Source: PEGASO, 2018

4.1.6. Marine and Coastal tourism indicators:

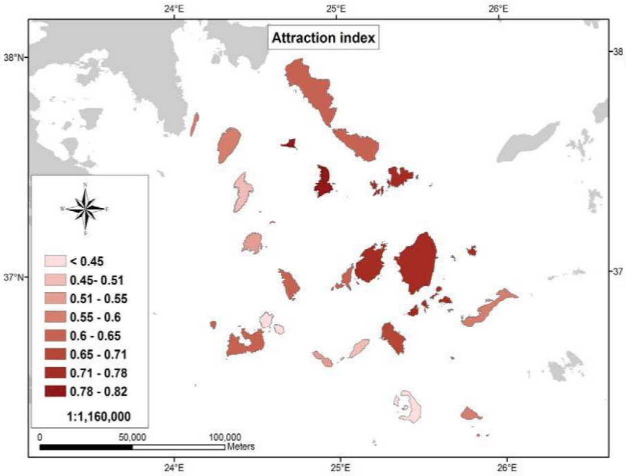

Figure 4.11. Index of attraction per island.
Source: PEGASO, 2018 p225.

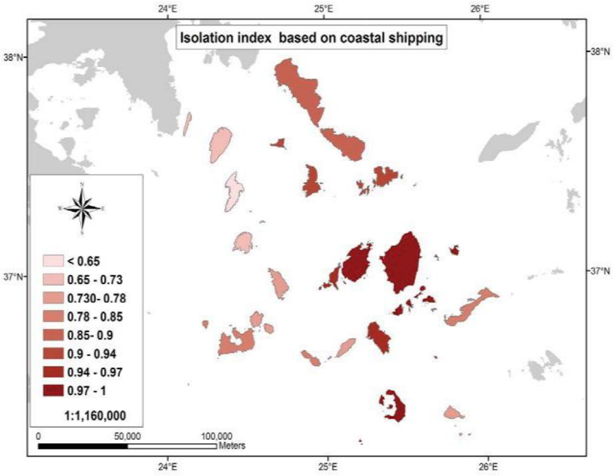

Figure 4.12. Index of isolation per island. 1:low isolation, 0:high isolation.
Source: PEGASO, 2018 p224.

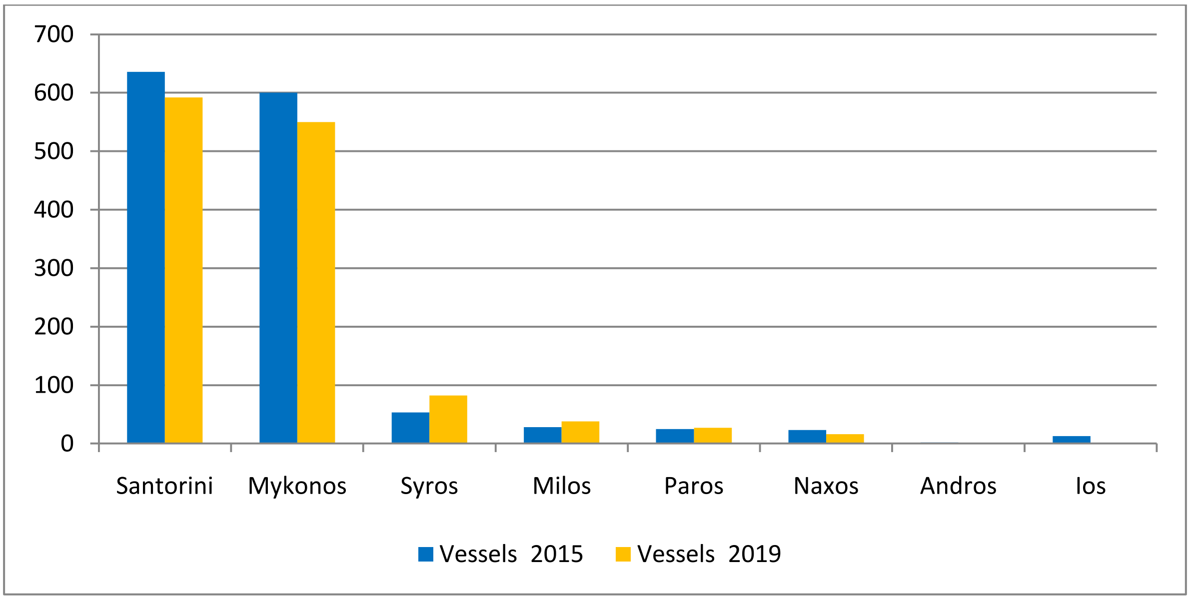

Chart 4.4 Evolution of cruise tourism – Arrivals of vessels

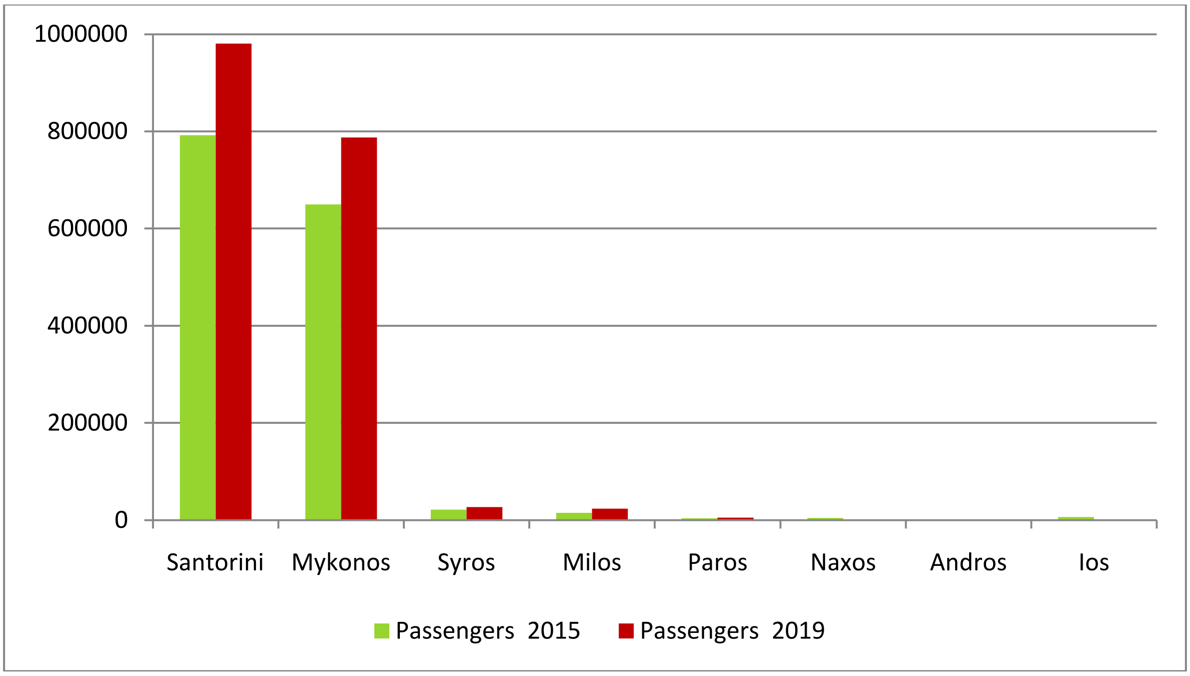

Chart 4.5 Evolution of cruise tourism – Arrivals of passengers

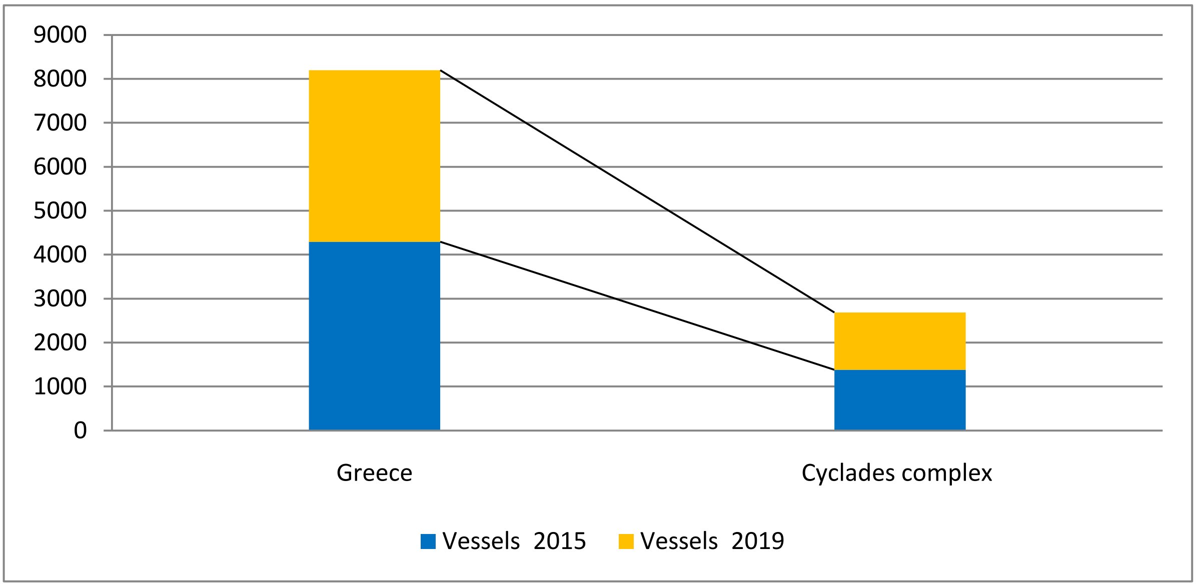

Chart 4.6. Comparison of cruise tourism between the whole Greece and Cyclades – Number of vessels 2015-2019

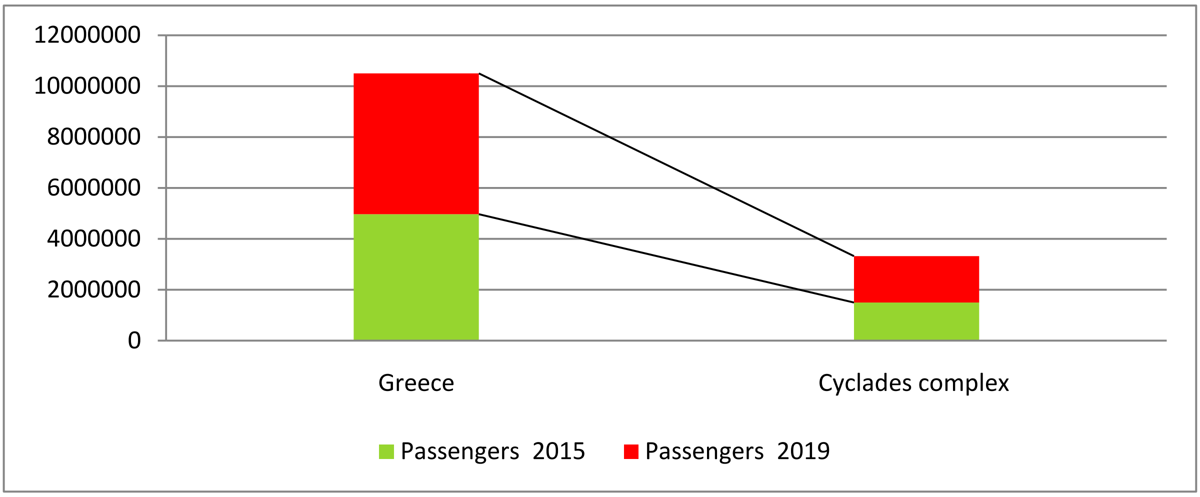

Chart 4.7. Comparison of cruise tourism between the whole Greece and Cyclades – Number of passengers 2015-2019

4.2. SWOT analysis results and evaluation

In the following sections are presenting strengths, weaknesses, opportunities and threats for each of the five main forces along with their significance towards a sustainable Blue Economy in Cyclades marine space. (Economou and Mitoula, 2020; Kyvelou and Ierapetritis 2020; PEGASO, 2018; SUPREME, 2018b; Depellgrin et al., 2018; Simboura et al., 2019; WWF, 2015a; EC, 2014d; Canu et al., 2011; EC, 2010):

4.2.1. Social force:

The creation of new jobs is a positive social consequence for the area. It can promote social justice; provide equal opportunities for local residents and especially for young people. Communities can grow and develop, and improve the quality of their habitants. There are already educational programs that raise awareness about circular economy and environmental practices. On the other hand there is lack of public participation of on decision-makings that constitutes obstacles to resolve problems and anticipate serious conditions in the future.

Strengths: New job positions (3), Fighting against alien invasive species through local gastronomy solutions by including them in the local markets (2), Increase the employment of young people in the area (3), Educational programs for sustainability (3).

Weaknesses: Visual landscape impacts of deploying activities (-2), Conflicts between users and uses (-3), Lack of adequate data for planning and monitoring marine activities at the local level of the islands (-3), Limited availability of resources (-2).

Opportunities: Stakeholder engagement for site selection of each activity (3), Training and information by Hellenic Marine center (2), Local actors such as fishermen can provide data (3), Promotion of the role of small-scale fisheries (3), Fishing tourism attracting visitors seeking genuine and authentic experiences (2), Fishing tourism enterprises most of them in Naxos and Syros, can act as alternative to massive coastal and cruise tourism (3), Raising awareness among local people, local businesses and visitors about marine conservation (3), Enhance marine careers by bridging the gap between education, science and industry (3).

Threats: Uncertainty in community acceptance (-3), Low public participation in almost all decision making levels (-3), Lack of trust and awareness from stakeholders (-3), Unemployment due to the national crisis has leaded many young people to leave the Cyclades area in search of opportunities elsewhere (-2), Promotion only for the tourism sector (-3).

4.2.2. Economic and funding

The political and economical crisis which was started in 2010, still affects the development of marine activities. Thus, there is lack of investments in innovation and entrepreneurs. However, European and national funding is great advantage to promote and support innovative ideas which will lead to population and economic growth for the Cyclades. Environmental taxes may reduce the taxes on labour and markets and integrate the polluter pays principle.

Strengths: GVA annual in Greece (3), Major control of resources by local communities (3).

Weaknesses: Overlap of economic activities (-2), Unbound fishing grounds (-3), Isolation between islands and the mainland (-3), Costs of marine installations (-2).

Opportunities: European and national funding (3), EU funding for the creation of training programs about new techniques and development of each marine activity (3), Environmental taxes (2).

Threats: Lack of investment in innovation (-3), Increasing competition into the Cyclades marine space (-3), Political and economical crisis (-2).

4.2.3. Technological tools

Technological innovation can promote and support collaborative partnerships between local communities, universities, local businesses and research centers. Smart technologies are not already applied into the operation of marine activities in Cyclades, ex. fisheries. However, this could be transformed in an advantage towards a sustainable development. Technological knowledge and techniques can increase the energy efficiency, reduce or control carbon-emissions, prevent accidents and pollution, and avoid illegal processes.

Strengths: Increasing number of R&D studies in marine technologies (3), Fuel saving technologies and optimization of fuel efficiency (3).

Weaknesses: Resources estimation in Cyclades is incomplete (-2), Capacity and knowledge on-how-to-do is not sufficient (-3), Old inadequate fishing vessels and equipments (-3).

Opportunities: Improvement of hatchery techniques (3), Smart applications for passenger services (3), Knowledge transfer and data sharing (2), Modernization of fishing fleet by EU or national funding (2), Competitiveness of small coastal and marine tourism enterprises could be improved through the ICT: promote translation services for maps and electronic leaflets, support on pollution prevention in sensitive areas, providing maritime cultural routes (2), Create alert signs through smart applications to avoid illegal uses (2).

Threats: Natural hazards (-3), Natural disasters (-3).

4.2.4. Legal factors

The MSP framework will be a great strength for the implementation of marine activities. It will set the rules and prevent the marine environment in Cyclades. There are still problems towards its implementation due to bureaucracy and political and economical conflict in the Greek legislation system.

Strengths: MSP Directive adaptation into Greek legislation (3), Guidelines and frameworks for specific activities such as aquaculture, tourism, and energy sector (2), Experience of other countries (2).

Weaknesses: Bureaucracy in Greek legislation system (-2), Lack of governance integration at different levels (-3), Lack of application of policies into the activities (e.g. the common fisheries policy by local fishermen) (-3).

Opportunities: EU policies application (3), Guidelines on minimizing impacts on marine ecosystems (3), Licenses to each marine activity (3), Potential cooperation and collaboration between local authorities (2).

Threats: Gaps in regulation about marine activities implementation and deployment (-3), coastal management plans occur only to Paros and Naxos islands (-1), Recreational activities are completely not regulated (-2), Use of illegal fishing methods (-3).

4.2.5. Environmental concerns

Environmental sensitive areas are acting as tourism attractions. A healthy sea will generate more jobs and income. The quality of bathing waters is excellent almost on every beach of the Cycladic island complex. There are a lot of opportunities towards. Risks exist on ecosystems and biodiversity. The land-based activities, especially in the biggest islands like Mykonos, Santorini, Paros and Syros are less than 10 km away from the coastal zone. Thus they are creating a possible pollution source. Tools like EIA and monitor processes can support the protection of the marine environment. Eco-design and environmental certifications of products and services could support sustainability in the area.

Strengths: High quality water status in Cyclades territorial waters (3), Good geographic position (3), Large number of blue flags on beaches and marinas (3).

Weaknesses: Land-based activities (-3), No limits to fishing efforts (-3), Visual pollution (-2), Unclear promotion of environmental friendly activities (-3), Uncontrolled fish caught (-3).

Opportunities: Increasing biodiversity (3), Clean energy technologies (3), Reduce carbon dioxide emissions (3), Climate change mitigation (3), Protect endangered species by raising awareness of fishermen towards them (2), Diseases prevention and monitor impacts of marine activities through smart technology (3), Establish sea bin clean methods of removing trash and micro-plastics from beaches and ports (3), Create marine litter collection stations (2), Enhance the plastic free trends to reduce their use in every day local life in Cyclades (2), Restore the richness of its living ecosystems (3).

Threats: Overfishing (-3), Risk of underwater life (-2), Risk of noise during constructions or maintenance procedures (-2), Unknown cumulative effects (-1), Marine debris (-3), Marine pollution from uncontrolled waste management from land-use activities (e.g. sewage from hotels, settlements and liquid wastes from pools) (-3), and sea-based activities (e.g. liquid wastes from vessels) (-3), carbon emissions from marine activities operations (-3).

According to the above, strengths, weaknesses, opportunities and threats are summarizing and calculated respectively: S = 39, W = -55, O = 87, T = -62.

The result is pointed in the coordinate system as presented below:

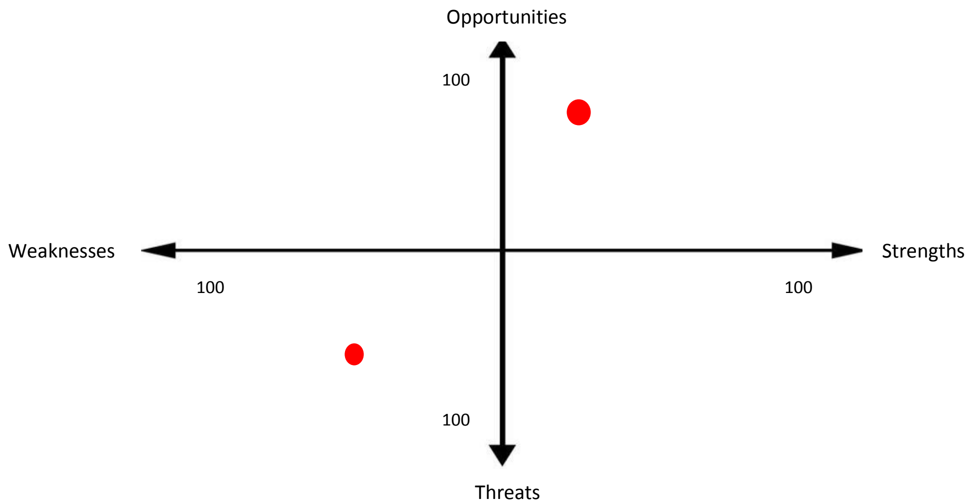

Figure 4.15. Coordinate system of the results of the SWOT analysis

Chapter 5

Discussion

The assessment was not fully completed due to the lack of data availability about Cycladic marine space. This is the reason why were used data both about Greece in general and some specific about Cyclades. Actually, data about Greece was adapted to Cyclades for their better evaluation. Most of the data used are an overestimation of the Blue Economy in Cycladic island complex. Despite this, in this stage of the study it considered that the results were satisfied. As more data will become more available in the future, the list of current indicators should be reviewed and additional ones will be essential too.

Blue Economy concept is steadily growing and creates new opportunities in Cyclades territorial waters. The goal is to transform its development mode to a sustainable one by achieving the equilibrium of both economic growth and ecological conservation. The evolution of data on GDP contribution and employment clearly confirms the central role that marine and coastal tourism sector plays on Cyclades economic growth. Despite this, the area has the appropriate conditions for the implementation of new activities by providing more jobs and creating new ones. Understanding the opportunities of Blue Economy in Cycladic island complex requires feasibility studies to address the different approaches about Blue Economy. For instance some people think that Blue Economy can leads only to economic growth from marine and aquatic resources, but others that can only conserve the marine environment (Eikeset et al., 2018). Better knowledge of the resources will be essential for estimating their health and their prompt use to achieve sustainable development. Aegean Sea is not yet surveyed. There are still knowledge gaps about environmental impacts related to each blue economy activity but also to the combined ones, as well as their spatial implications. Marine researches are fundamental in order to increase the knowledge and promote Blue Economy in Cyclades. The authorization procedures, the bureaucracy for licensing of each marine sector need to simplify and provide legal security, predictability and certainty for investments. Currently, there is lack of general framework and the activities are determined by sectoral policies. It is important to define the exact location, the size of each MSP area and the capacity building of each marine activity. Additionally, there is not a formal process for the engagement of stakeholders to the MSP process yet. The social acceptance is fundamental, but according to the law L. 4546/2018 they can only be involved in the preparation phase of MSP in Greece (EC, 2020b). Greece must address regulatory gaps with the establishment of legal and governance frameworks. The guiding framework will be completed by 2021 in Greece would bring together all current and future requirements for Greek seas and facilitate the corresponding opportunities (EC, 2020h).

The absence of MSP in the area is crucial towards the sustainable development. MSP is expected to boost the development of each marine activity by increasing more the GVA and person’s employment (EC, 2014d). Basic parameters are time and place of each activity in order to ensure both efficiency and sustainability to the most possible extent (Lazoglou et al., 2015). The environmental perspective of MSP can implement the ecosystem-based marine resource management. The economic perspective can offer clarity and certainty to users and potential investors. The social perspective can integrate authorities, groups, scientists and experts and consider their preferences as well as their diversity of values and interests between them (Kidd et al., 2020).

The application of Marine Spatial Planning and Marine Cadastre tools is an opportunity for proper development and growth towards the achievement of a Blue Economy vision in Cyclades (Coccosis and Beriatos, 2016). MSP is the main driver that highlights the potential opportunity in unutilized marine areas where blue economy sectors could be further developed (Papageorgiou, 2016a; Young, 2015). It can help to address the challenges arising in the marine spaces. It raises awareness for the role of sea in the economy of a state. Additionally, it promotes the potential innovation of activities into the marine space. A Marine Cadastre is defined as a single system which includes legal, technical and other information related to the marine space. It examines the rights, restrictions and obligations as well as limits of jurisdictions and utilizations according to each activity that exercised in the sea (Coccosis and Beriatos, 2016). It should be adopted in the study area by including legislation, environmental, cultural, socio-economic data and information in an integrated GIS database. The MSP should foster synergies rather tensions between activities and users while considering the future demands. Also, it is need to take into ensure an inclusive and transparent engagement of stakeholders. The involvement of many and different stakeholders in management and financial interests may create problems and delays, but their participation is essential to reduce conflicts and support decision-making (Economou et al., 2020).

The main lessons have already learned from existing successful MU applications are the demand for coordination, integration, simplicity and legal efficiency (Calado et al., 2018). Multi – Use MSP can achieve the marine cohesion. It is the balance between marine spatial efficiency, marine spatial quality and marine spatial identity. In fact, it provides economic efficiency and social equity on marine space. The development of marine space in Cyclades continuously evolves. It is a demand of maximize spatial efficiency and minimize conflicts or impacts. It should be considered as a dynamic integrated process with sustainable and smart solutions (Kyvelou and Ierapetritis, 2019). Potential combinations in Cyclades complex marine space could be (i) fisheries and tourism and environmental protection, (ii) aquaculture and tourism, (iii) underwater cultural heritage and tourism and environmental protection, (iv) offshore windfarms and desalination, and (v) renewable energy's structures (wind, solar, ocean) and aquaculture (Depellegrin et al., 2018).

Marine spatial efficiency can be measured by the number of enterprises of activity or sector, the number of tourist arrivals and visitors, the % age of complementary income derived from different sectors, the number of maritime clusters, etc. Marine spatial quality can be measured by minimizing environmental impacts, creative and smart solutions, the existence of green infrastructure and blue corridors, etc. Marine spatial identity can be measured by the population size, the existence of aesthetic and recreational resources, the local communities, the underwater and marine cultural heritage, etc. Kyvelou and Ierapetritis have presented an analytical set of assessment indicators to quantify the marine cohesion incorporated the SDGs indicators too. Moreover, marine cohesion might enhance the public choice mechanisms and should be considered as a priority in marine spaces (Kyvelou and Ierapetritis, 2019).

According to Papageorgiou, there is a need of a place-based approach for vulnerable communities such islands and insulars such as Cyclades. The approach focuses on addressing multi-level governance and building an adaptive capacity which will face the impacts of climate change (Papageorgiou, 2016a). It is also suitable for tackling the growing competition among sea uses (Papageorgiou, 2018). Governance is a requirement to address sustainability and equity in marine space (Bennett et al., 2019). On the other hand, the sector-based approach is focuses on addressing climate changes' impacts on each individual marine activity (Papageorgiou, 2016a). The place-based approach might become a complicated task for Cyclades complex due to existing disputes and conflicts with Turkey.

5.1. Objectives compare to previous researches

Kong et al., used the SWOT analysis as a powerful and feasible method for making regional marine sustainable development plan. Their study area could consider similar to Cyclades. It is a combination of mainland area with few small islands (Kong et al., 2012). According to Bieda et al., should assign significance on each strength, weakness, opportunity and threat through weights, in order to determine the most important or that with more impact. It should be based on questionnaire surveys carrying out among experts, authorities, local residents and other stakeholders who have interest in the marine area (Bieda et al., 2019). Due to lack of time in this dissertation were based on the authors opinion only, but the results was could be considered accurate and impartial.

Collie et al., contrasted the current set of experiences around the world with the formulaic guidance on how to conduct MSP towards a sustainable development. They reviewed worldwide sixteen plans of MSP, from North America, Northern Europe to China and Australia. Most of them differ in the level of stakeholders' engagement, the use of decision plus support tools (e.g. GIS) and the monitor-performance measures. The first perspective is that MSP should follow a step-by-step approach. The second one is that there is not a single recipe for a successful MSP (Collie et al., 2012).

The implementation of MSP in Cyclades could be influenced by the MSP in the Maltese Islands as they present similar conditions. Both Cyclades and Maltese islands are located in the Mediterranean Sea Basin and face the same problems. There is a lack of available data about their resources. Finally, they have a lot of administrative agencies that have jurisdiction rights over specific areas and uses. Deidun et al., considered about Maltese Islands that MSP cannot provide a solution on every challenge arises on a marine space. It role is to provide a transparent system that applies the principles of sustainable development, to protect and preserve the marine environment and to continue enjoy its economic growth (Deidun et al., 2011).

Frazão Santos et al., analyzed and discussed the affairs of the Portuguese Marine Spatial Planning process. They concluded that the assessment of MSP requires the use of socio-economic and environmental indicators in order to determine future possible advantages and disadvantages to achieve the best design on a marine space. It is a demand to set a clear goal and measurable objectives. The process is based on the level of contribution of each objective to the desirable goals.

MSP criteria differ between the countries but there exist common actions prevent or address the arising conflicts. The below actions should take into account for the designation of MSP in Cyclades. First, are the protection tools such as safety zones for shipping, ecological buffer zones, allowed activities and restricted areas (e.g. MPAs) (SEANSE, 2019; Economou et al., 2020). These can guarantee the conservation of marine biodiversity, produce economic benefits, and enhance alternative tourism activities (e.g. diving, yachting), plus increase commercial fish biomass (Appolloni et al., 2017; Wright, 2015). MPAs may be established different types of sites that aiming to conserve and protect the marine biodiversity, preserve the cultural heritage such as historical and/or archeological sites, perform scientific research, manage the natural resources, avert potential conflicts among users and provide recreational activities (Blæsbjerg et al., 2009; UN, 2020).

5.2. How to conduct Marine Spatial Planning

A simple strategy to integrate MSP should consider the following steps: (i) set objectives according to the socio-economic value of each marine space; (ii) enhance this value; (iii) identify the most suitable one; and (iv) ensure integration and cohesion of planning (Papageorgiou, 2018). The strategic goal is to achieve a holistic economic, social and environmental security by considering the different needs, possibilities and perspectives (Bolanou and Kiosusopoulos, 2014).

An important aspect of MSP framework is that of adaptivity. It should be a continuous and adaptive process that is carefully organized to generate, collect and exchange information, and make adjustments when is needed (Meiner, 2010; Blæsbjerg et al., 2009). A great example of MSP framework is adapted by Portuguese government. It includes two instruments, the situation and the allocation plan. In the first, are recorded the existing and potential human uses of the marine space as well as the natural and cultural sites. In the second, are defined the areas for new users and uses, and the process for their approval (Frazão Santos et al., 2015).

There are recognized three phases in the MSP process, planning and analysis, implementation, and monitoring and evaluation, in order to achieve the desired goals (Blæsbjerg et al., 2009).

A successful MSP is depended on the area and the type of activities that occurred there. The planning and analysis phase include the collection and recording of the current situation of environmental data such as natural resources, seabed condition, chemical and biological parameters, natural hazards; and the socio-economic data related to human activities such as aquaculture, coastal and marine tourism, renewable energy sources, ports etc. Marine research and databases spatial information are used to identify the archaeological underwater cultural heritage sites as well as the areas that are under or need protection e.g. Natura2000 areas (Economou et al., 2020; Ntona and Morgera, 2018; Coccosis and Beriatos, 2016; Papageorgiou et al., 2016a; Papageorgiou, 2016b). The availability, the reliability and the quality of sharing of data and knowledge are fundamental elements for proper plan too (García et al., 2018; Schäfer, 2009). The scientific and data gathering tools that assist MSP could be the EMODNET, an integrated database for maritime socio-economic statistics covering sub-portals such as bathymetry; geology; physics; chemistry; biology; seabed habitats; and human marine activities (EPRS, 2020), the European Atlas of the Seas and the Copernicus satellite that act as a monitoring service, provides space data and forecasts (Nicole and Vittorio, 2011).

The application of MSP is considered less appropriate and costly to the entire country, given the considerable length of its coastline and the monitoring mechanism required (ECS, 2011). Furthermore, this phase include the identification of optimal areas for the deployment of each activity and of the covered area for the implementation of MSP (Wright, 2015). The scope and goal of MSP depend on the specific conditions of each area (Meiner, 2010).

Vulnerable areas may require a comprehensive MSP with a typically horizon of ten to twenty years (Nicole and Vittorio, 2011). For other areas it is sufficient a general management of principles.

The implementation phase applies the appropriate regulations and plans for the operation or construction of each marine and coastal activity. Decision makers require guidance on how to zone the ocean for the multiple uses/users (Yates at al., 2014). The defined objectives should be able to provide a reliable framework for the management of marine activities. Also, they should allow negotiations in the case of conflicting sectoral interests (Nicole and Vittorio, 2011). The objectives of any environmental management should be SMART i.e. Specific, Measurable, Achievable, Relevant and Time-Bounded in order to determine whether the actions are successful and feasible (Cormier and Elliott, 2017; Coccosis and Beriatos, 2016). Moreover, the management measures needs to know whether the marine activities and their results has been or can be changed in a marine space (Cormier and Elliott, 2017). The entire process must be set up in a transparent manner and should be easy to understand it all stakeholders who will be involved, from the marine sectors to the general public and the local community too. All the documents and procedures of a MSP process need to be written in a common language too. Transparent manners ensure full information to all parties at every step of the process and therefore improve predictability and increase public acceptance (Nicole and Vittorio, 2011). In every marine space identified different views, values and attitudes of local people or NGOs, enterprises, authorities and everyone else who has an interest there. Intersecting marine operational boundaries for each activity requires understanding of ecological, geographical, socio-economic and legal parameters; and economic viability, operation and technology issues and challenges related to each one of them (Kyvelou and Ierapetritis, 2019). The concept of social innovation on Blue Growth strategy depends on creating cooperation, inclusiveness and trust between all of stakeholders (Eikeset et al., 2018). It acts as a supportive tool to eliminate and prevent marine conflicts, thus conserve marine ecosystems (Gkargkavouzi et al., 2019). In this stage it is important to be realized the coordination within established governance structures. The coordination could be both horizontal e.g. between marine sectors, and vertical e.g. between governance levels (Nicole and Vittorio, 2011). Good governance at national and regional level maintaining the coastal and marine areas in good condition and support the development of blue economy (Economou et al., 2020). Last, MSP should have the prompt regulation and be legally binding in order to be effective (García et al., 2019b). It is a requirement to clarify who would be the responsible body to execute the plan i.e. economic actors, public authorities, general public and who is held accountable for its implementation and enforcement (Nicole and Vittorio, 2011). In addition, the development of MSP requires financial support. A State is responsible for the implementation; therefore the cost depends on the public expenditure. Potential sources are European funding and/or income from green taxes by the government or the local authority (Coccosis and Beriatos, 2016).

Finally, the monitoring and evaluation phase is essential for achieving spatial planning (Blæsbjerg et al., 2009). MSP is an ongoing process that relies on data that can be change e.g. the climate, investor interest, politicians and their priorities. So the plan needs to be adopted over time, and should be flexible enough to react to those and allow revisions in due course (Nicole and Vittorio, 2011; Coccosis and Beriatos, 2016; Yates et al., 2014). Without knowing what is being achieved or not, it is not possible to engage an effective adaptive policy and management (Santos, 2018). Indicators are often used to describe observation and to monitor, and track changes. The temporal dimension should extend over twenty years, but with regular review, e.g. every five years, to ensure that the process remains dynamic and takes into account new data, uses, etc. (Blæsbjerg et al., 2009). A number of issues demand the engagement of stakeholders in MSP evaluation, in order to define the objective, the targets, and the value of evaluation, and their benefits as well (Carneiro, 2012). This phase includes regulatory or technological tools which are used in order to monitor each activity and to identify or prevent the degradation of marine environment (Economou et al., 2020). The Environmental Impact Assessment is such a well-established evaluating tool which is required by UNCLOS for each project or activity that is going to take place in a marine space. It is used to anticipate, assess and reduce its environmental and social risks, as well as to protect the marine and coastal environment and sustain their Good Ecosystem Services (Rodríguez-Rodríguez et al., 2016; Guerra et al., 2015; Meiner, 2010). Any activity that occurs in marine space may have positive and negative impacts. Aquaculture can affect the marine environment and its biodiversity through pollution, diseases and the escape of farmed fish. Marine biotechnology may pose threats to coral reefs and hydrothermal vents of removing organisms; but is required further investigation and knowledge. Marine and coastal tourism have potential negative impacts cause of pollution lead to habitat and biodiversity loss, and disturbance of marine animals; pressures on natural resources due to the increased demands of water, food and energy, etc. Desalination process may pull into the system fish or invertebrates or other marine organisms and killed them. Depending on the method used may returned back as residues (Ehlers, 2015; Tonazzini et al., 2019). Offshore renewable energy systems have mostly impacts during the construction and/or the operational phase such as underwater anthropogenic noise, collision risks, artificial lights, biocommunity changes displacement, flow alteration, and/or sedimentation; which may affect sea mammals, fisheries and invertebrates (Dalton et al., 2018b; Loukogeorgaki et al., 2018; Abhinav et al., 2018). However, there are also positive effects on local biodiversity as the offshore renewable energy structures can act as artificial reefs and enrich the biodiversity and the ecosystem. Furthermore, offshore devices and especially floating ones reduce the aesthetic impacts of installation in shallow water, and as a result of the combination the effect occurs only in one place. Last, it is interesting that these structures can perform as local fish aggregation devices; and such areas close to them can act as small local MPAs (Loukogeorgaki et al., 2018; Abhinav et al., 2018).

The steps of the MSP's development in the context of sustainable blue economy are summarized below: (i) collection and mapping of human activities, (ii) planning present and future human activities, (iii) ensure sustainable use of resources, (iv) define the sustainability parameters for each activity and marine space, (v) promote the importance of sustainability pillars, and (vi) define guidelines to the development of indicators for assessing the sustainability of human activities in marine space as well as its corresponding monitoring programs (Frazão Santos et al., 2014b).

5.3. Further study

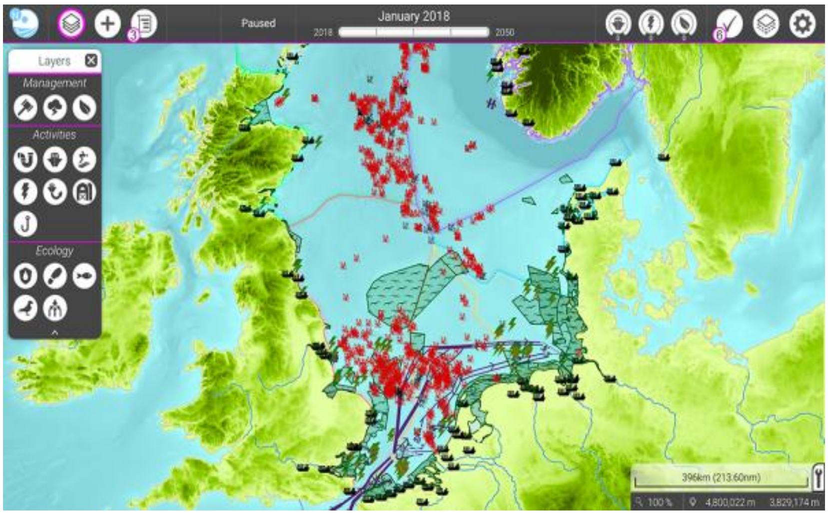

Figure 5.1. MSP Challenge Simulation Game
Source: https://www.buas.nl/en/research/projects/msp-challenge

In the next level of this master dissertation could be used the MSP simulation game, which is called MSP Challenge 2050. Fig 5.1 presents the layout of the program. It is a multi-dimensional, multi-player and computer based simulation game about integrated MSP (EC, 2018; Mayer, 2014). The game is developed in 2011 and owned by the Netherlands Ministry of Infrastructure and Environment and Signature Games. It could be considers as a useful GIS tool and is available upon request (Mayer, 2014).

GIS tools are important for the spatial analysis of marine activities towards their optimum situation of co-location and cooperation (Vasileiou et al., 2017). Islands should consider the land-sea interactions as well as environmental and socio-economic aspects of them, map the existing human activities on marine space and identify the future development both of the uses and the area (Lazoglou et al., 2015). Map visualizations can be used for the evaluation, monitoring and characterization of marine space of Cyclades (Meiner, 2010).

The game aims to involve all the stakeholders and policy planners with an innovative way. It succeeded to combine a role-play, game-technology, geodata and simulation models to create planning and decision making learning tool (Abspoel et al., 2018). It provides better understanding of the consequences and benefits for every option. These online planning methods introduce quickly the MSP process and promote the equal participation of several stakeholders and planners, as well as trust among them. It may facilitate the creation of transboundary data rather than raising awareness of cross-border processes (Tolvanen et al., 2019; EC, 2018). Actually, it gives insight into the challenge of sustainable planning of uses in the marine space (EC, 2018). The legal and technical information and knowledge along with rights, restrictions and obligations, can be converted into maps (Dalton et al., 2018b). The MSP Challenge 2050 still faces a lack of data especially in Mediterranean as it is in developing phase. Despite this, it could provide a crucial support to optimum designation of MSP in Greece and particular in Cyclades study area, in order to understand the process along with conflicts and opportunities in real time.

This GIS tool could be combined with AHP method in order to determine the suitable site for each marine activity in the Cyclades complex. It is considered as one of the most popular techniques on sustainable decision-planning. It is based on the collection and analysis of geospatial data and can be implemented through a GIS application. The hierarchy includes the goal of the plan on the top, the site-selection criteria related to socio-economic and technical factors, and the decision alternatives at the bottom. The implementation of the AHP depends on the comparison of the criteria selected in order to quantify their weights according to the overall goal (Vasileiou et al., 2017). A successful example of AHP method for a sustainable development plan can be founded in Kong et al. According to them it can serve as an efficient tool particularly for a regional sustainable development plan (Kong et al., 2012).

Furthermore, it is recommended to use another methodology tool, the DPSIR approach i.e. Drivers, Pressures, State, Impacts, Responses; in order to compare it with the results from the SWOT analysis. According to Frazão Santos et al., this approach could be an important and useful tool for apply to territorial waters area. It aims to the establishment of an action plan by defining management guidelines for each sector and activity that takes place into the marine area. These guidelines present a set of recommendations on how each marine activity can be conducted; also, to be compatible with other activities (Frazão Santos et al., 2014b). Drivers are factors useful to promote and support an MSP. They are presenting the human activities: commercial fisheries, recreational fisheries, aquaculture, marine mining, marine renewable energy, oil and gas exploration, coastal development, maritime transportation and ports, coastal and marine tourism. Pressures are presenting the damage of each activity: marine litter, selective extraction of species, input organic matter and invasive species, physical damage of benthos, sealing and underwater noise, physical loss, physical damage, introduction of microbial pathogens and sewage, underwater noise, introduction of non-indigenous species and waste disposal from vessels. State is presenting the level of health of marine ecosystem. Impacts are presenting the consequences of the changes in marine ecosystem: reduction of fishing activities, decrease of tourist attraction ((Calado et al., 2018; WWF, 2015c). Responses are presenting the measures that are required to prevent and mitigate negative impacts of human activities: defining protection zones for areas of significant natural ecosystems, defining zones for underwater archeological sites, promote underwater tourism (Economou and Mitoula, 2020; WWF, 2015c).

Better estimations regarding environmental impacts and benefits of implementation of marine activities require impact assessment tools such as cumulative or environmental impact assessment, risk assessment, marine ecosystem valuation, and scenario analysis. Those tools can help to evaluate potential pressures or positive effects on ecosystem components and should be considered for further actions (MUSES, 2017). For instance, the fishery and aquaculture and tourism combinations can promote ecotourism and ensure balanced use of fish resources by their sustainable production and consumption. Moreover, the combination of offshore energy devices can reduce the impacts on coastal areas and ensure better water quality for recreational activities. However, aquaculture impacts depend on the type and conditions of farming and need further investigation. Similarly, the combination of underwater cultural heritage, and tourism, and environmental protection has positive effects as cultural heritage can act as artificial reefs and enhance environmental quality and biodiversity. Last, the Multi-Use Platform of offshore wind farms and desalination have positive effects by providing and improving water availability especially due to high water demands during the summer tourism period and reduce the carbon footprint of desalination activities (Depellegrin et al., 2018).

Last, it should be studied the transboundary issues and challenges that may arise between each region inside Greece as well as between Greece and her neighboring countries. The concept of Transboundary Marine Spatial Planning (TMSP) has been emerged the recent years and mostly in EU. It recognize the importance of cross-border collaboration, available and accurate knowledge of nature of marine resources, data sharing and information, stakeholders participation and the promotion of synergies between marine sectors (Li and Jay, 2020). This concept demands the declaration of Greece's EEZ and could be succeed if only disputes in Aegean Sea will be solved. Further, it is crucial the co-operation with the non-EU countries accommodating in the Mediterranean Sea in order to achieve a concrete action (Economou et al., 2020; EC, 2009).

5.2.1. COVID-19 pandemic and oceans

Sustainable development requires being adaptive. The COVID-19 pandemic is an extreme condition which should take into account for further decision-making and actions. According to United Nations Report about sustainability, the corona-virus crisis will affect the achievement of SDGs by 2030 due to the unprecedented health, economic and social crisis. Worldwide, lives and livelihoods are under threat (UN, 2020). Especially, in EU the unemployment rate is forecast to rise from 6.7 % in 2019 to nine % in 2020 and then to fall to 8 % in 2020 (EC, 2020a).

To date, it has already affected small-scale fisheries and aquaculture enterprises as the global demand for seafood is decreasing and maritime transportation restrictions prevent their accessibility to the market. Thus, it will have a serious impact on the labour market (EC, 2020a; UN, 2020).

Recently, the European Commission Services made a preliminary assessment of COVID-19 economic impacts on the blue economy sectors and activities. The most negative impacts along with slower recovery are expected on coastal tourism, marine living resources (fisheries and aquaculture), shipbuilding and repair sectors. Sectors that expected to have negative impacts but faster recovery are the marine non-living resources, marine renewable energy, port activities, maritime transport and blue biotechnology. Finally, smaller impacts and prompt recovery are expected to desalination, maritime defense, submarine cables and marine research (EC, 2020a).

Chapter 6

Conclusion

The marine space can be presented as a mosaic of activities along with their effects, footprints and impacts on the marine environment itself. All marine states have the challenge to maintain their seas quality while at the same time maximizing their economic potential growth. Marine space management is an extremely complex procedure. It has to accommodate multi-sectors, multi-users, multi-uses and so on and to tackle their impacts to marine environment. Likewise, a good planning requires appropriate science knowledge, governance and management processes. Marine research is fundamental in order to increase the knowledge and promote Blue Economy in Cyclades and in Greece general.

The Blue Economy allows preserving healthy marine and coastal areas and ensuring the continuous delivery of goods and services. Claims and competitions for space and resources have a long-term negative effect to economic sustainability of the Cyclades marine environment. Hence, the diversity of activities and users on marine space has to be measured and guided. Of course, this procedure depends on the availability and accessibility of reliable information and data.

A sustainable blue economy needs to provide social, economic and environmental benefits for current and future generations e.g. food security, poverty eradication, livelihoods employment, healthy equity, political stability. Guidance is missing right now on what a sustainable Blue Economy looks like. There is a weak formulation on what needs to be done to ensure that Blue Economy is truly sustainable, not only in this case study area, but in the whole Europe as well. It is important to make sure that marine economic development leads to a sustainable and competitive blue economy. General steps that need to follow all marine spaces are: set the right objectives, tackle mistakes, compliance with regulations, reduce the impacts of marine-based and land-based activities, and utilize technological tools. A great challenge is concerned about how to translate principles into practice. The transition requires awareness on the value of marine environment; upgrade technologies on smart direction to fulfill the needs of marine activities by including environmental protection and scientific research. In addition, it is important to enable the environmental data sharing and availability.

The sustainability analysis of the Blue Economy in Cyclades leads to identify that the area faces challenges regarding its economy status and economic future in order to align the principles for a Sustainable Blue Economy. The goal is to meet the economic needs and interests considering the security of existing and creating new jobs to be environmental friendly or at least compatible to territorial waters of the Cycladic island complex. Blue Growth strategy is still at early stages in Greece. There is a need for data availability and a well-planned approach to marine space management of Cyclades complex in order to mitigate conflicts for marine resources and conserve marine ecosystems. Hence, the achievement of MSP is crucial for Cyclades and for Greece in general. Notwithstanding, it is a new concept and procedure, MSP is considered to be promising for addressing issues related to development and management in Greek marine space. Greece has vital interests on the marine environment and heavily depends on it. The application of a marine policy would encourage the growth of established and emerging marine activities and overcome arising conflicts and obstacles. Of course it constitutes a procedure that still needs time and effort to become as efficient and as regular as the Terrestrial Spatial Planning. There are differentiations between land and sea which affect the planning methodology and models such as the poverty and legal status, and the dimensions. The marine area is mainly public. There are different jurisdiction rights and sovereignty according the maritime zone. Last, it can combine various activities at different level (water column, benthos, surface).

MSP is a highly participatory planning procedure. Its comprehensive and transparent characteristics can promote balanced governmental decisions in the sense of sustainability. The existence of single uses or potential combinations with explicit spatial sector policies and demands increases the need for marine management and deployment of MSP into Cyclades Island’s marine space. Blue Growth can be maximized through MSP tool. The determination of where each activity should be permitted and the overall impacts would enable the wise use of marine space on the study area. Hence, it is not compromised the health of its marine environment. The private and public sector actors need to come together and seize the moment of opportunity.

The enhancement of mapping for marine habitats and species is required as well as data on socio-economic uses and ecosystem services in the marine space of Cycladic island complex. High resolution data are an increased demand on marine activities, particular about shipping, recreational activities, and commercial fishing. Existing sources of information, for example from the fishing industry or commercial vessels, could be used effectively and sharing of information across borders would enhance their data availability. User-friendly tools are needed to provide composite maps of habitats and species distributions in relation to the many human uses of the area and appropriate decision-support tools should be developed to apply this information in a management context.

6.1. Recommendations for a Sustainable Blue Economy in Cyclades marine space

Recommendations for a blue economy in the Cyclades complex marine space are the following (Plan Bleu, 2017a):

i. Enhancement of data availability and monitoring: National data linked to the marine space need to be provided according to common standards. Hellenic marine research centers could contribute to this process and create a free web platform for data exchange and transparency.
ii. Implementation of adequate economic instruments: Several key sub-sectors of the marine economic activities (fisheries, transport, tourism, etc.) are artificially supported by environmentally harmful subsidies that create market distortion, privatize economic benefits and externalize social and environmental damages. An exhaustive assessment of price signals in the blue economy sub-sectors needs to be undertaken to promote greener tax and fiscal policy reforms.
iii. Support for environmental and social innovation: Through strong investment in green technologies, sharing of best practices and promotion of social entrepreneurship, the subsectors of the marine-based economy can reduce drastically their environmental impact while at the same time ensuring socio-economic benefits to the local communities, such as job creation, food security and poverty reduction.
iv. Governance improvement and stakeholder’s engagement: Progress towards blue economy requires an enforcement of institutional frameworks and international agreements like the Barcelona Convention, UN Convention on the Laws of the Sea, Paris

Agreement, UN Agenda 2030 (Sustainable Development Goals), among others. It also needs adequate regulations, laws and policies to be developed and implemented at national and sub-regional level. Stakeholders involvement, open dialogues and transparent decision-making processes are also necessary to engage and commit with economic actors, local and regional authorities as well as civil society representatives.

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Appendix: Supplementary material

Supplementary data associated with this article can be found in the online version at: https://natura2000.eea.europa.eu/,
https://cycladespreservationfund.org/,
https://bluegrowth.io/solutions/smart-aquaculture,
https://safety4sea.com/cm-smart-marine-ecosystem/,
https://www.nature.org/en-us/what-we-do/our-insights/perspectives/smart-solutions-for-sustainability/,
https://www.afma.gov.au/fisheries-management/methods-and-gear/longlining,
https://www.researchgate.net/figure/Study-area-in-the-Cyclades-Archipelago-Central-Aegean-Sea-Greece-Points-represent-the_fig1_307701103,

https://webgate.ec.europa.eu/fpfis/cms/farnet2/on-the-ground/flag-factsheets/cyclades-flag_en,

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