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Article

Land-Based Multi-Level Spatial and Developmental Policy Directions and Their Implications in the Marine Environment: Case Study Northern Aegean Sea, Greece

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Abstract: European strategic policy directions towards a sustainable blue economy have strengthened interest in maritime investments, thus increasing sectoral competition for marine space. Emerging repercussions out of such a rising interest need to be handled by Marine Spatial Planning (MSP) as a means for: properly allocating marine space to diverse uses; managing conflicts and promoting synergies among them; and pursuing a multi-use perspective of this space. A critical stage of each MSP exercise is the exploration of land-based spatial/developmental directions and their current or potential repercussions in the marine environment in order for constraints but also perspectives in policy choices/maritime uses in the MSP context to be featured; and attainment of a successful coherence or coordination between land and marine spatial/developmental policies to be ensured, by analyzing Land-Sea-Interaction (LSI) and embedding it in the MSP. The latter is the focus of this paper aiming to illuminate critical issues emerging from land-based (terrestrial) policy frameworks for feeding MSP endeavors; and is accomplished in the Northern Aegean Sea, Greece. Towards this end, a multilevel approach is adopted, delving into diverse policy contexts at the local, regional and national/European level and aiming to attain more informed MSP decisions in the specific study region.

Keywords: land-sea interaction (LSI); marine spatial planning (MSP); land-based spatial policy; multilevel spatial and developmental frameworks; Northern Aegean Sea

1. Introduction

Today, the world as a whole witnesses large-scale changes, interlocking transformations in the geopolitical, economic, social, cultural, technological and policy domains, all contributing to the establishment of an increasingly *complex* and highly *uncertain* decision environment. The pace of change and the rising need for structural – eventually radical – transformations imply that the way to 2030 and beyond represents a critical juncture that forces society to both increase future preparedness and shape what comes next in a *proactive way*. Among the types of spaces, where *complexity* and *uncertainty* of their future trajectory is highlighted, lies the coastal and marine space. The escalating economic interest in these areas, coupled with their high vulnerability and exposure to the impacts of contemporary challenges (e.g. climate change) have raised research concerns and have placed them at the epicenter of the scientific discourse.

Complexity and uncertainty of future developments and problems related to coastal and marine space, as various researchers claim [1, 2], emanate from the fact that coastal and marine areas constitute peculiar types of places. In fact, peculiarity of *coastal space* lies on its function as the ‘meeting point’ of three discrete zones, i.e. marine, coastal and mainland, upon which intense mutual interactions – land-to-sea and sea-to-land – are realized [3]. Complexity and uncertainty of the coastal

space is thus tightly interwoven with its role as: the frontier of mainland and the interface of the interaction between mainland and marine space; and a land part that hosts a multitude of diverse natural ecosystems, being at the same time highly attractive to human activities that are closely associated with both the coastal and the marine space. Complexity and uncertainty of the *marine space* is mainly associated with the: diverse and vulnerable ecosystems this hosts and the valuable services these deliver to humanity; confined knowledge, mapping and documentation of this part of the planet (only 10% of the oceans has been explored) [4]; and policy-motivated, thus rapidly escalating interest in investing in maritime activities, which is gradually leading to a highly competitive and admittedly crowded marine environment [5]. Managing coastal and marine space under the circumstances of contemporary challenges that largely affect integrity and stability of this space – climate change, overpopulation of coastal areas, coastal urban sprawl, overtourism and overfishing, etc. [6,7,8] – is getting even more complicated. In fact these challenges further reinforce complexity of spatial and developmental processes, occurring in such areas; while the same holds for uncertainty as to their future trajectory. Concurrently, these challenges make urgent the need to formulate effective directions at various policy levels for ensuring integrity, health and sustainable management of the world's coastal and marine assets [9].

Towards this end, intensive policy initiatives have been undertaken during the last two decades at, among others, the level of the European Union (EU), having at their heart the delineation of a *European vision* for the seas and oceans. Such initiatives have led to the formulation and institutionalization of appropriate strategies, related policies and planning tools for implementing this vision [10]. The aim of the EU endeavors is to: create new, innovative, and effective ways for the sustainable exploitation of marine resources; alleviate conflicts and create synergies among maritime activities; promote coherent, holistic and integrated planning approaches for policy formulation that aims to achieve a smooth interaction between the coastal and the marine space; to name but a few. Along these lines, EU member states are invited to adopt related policies and prepare marine plans that can effectively manage their marine areas, in alignment with the provisions of the United Nations Convention as to the Law of the Sea [11]. In addition, policies addressing issues related to the integrated management of coastal space have also been established.

More specifically, on top of the EU's course in matters associated with marine space management lies Directive 2014/89/EU [12], perceived as a fundamental text for establishing a framework for Maritime Spatial Planning (MSP). By this Directive, MSP comes to the forefront as a means for a strategic, holistic and integrated approach to planning and management of maritime activities, with its primary objective being the sustainable exploitation of marine resources and space. MSP, established by this Directive, is actually realized as a political and highly inclusive process that aims to allocate uses in the marine space in order for social, ecological and economic goals to be attained [2]. Directive 2014/89/EU [12] defines the scope of MSP, the field of action, i.e. the marine waters of the member states in alignment with the provisions of the Law of the Sea, as well as the necessary provisions for drawing up and implementing MSP.

In seeking to conduct a Maritime Spatial Plan (MSP), Directive 2014/89/EU [12] explicitly articulates the need to consider the *Land-Sea Interaction (LSI)* [3,18]. In fact, in Article 6 of the Directive, LSI is grasped as one of the minimum requirements for MSP; while, as stated in Article 4, this obligation must be tackled at both the preparation and the implementation stage of MSP outcomes. In addition, Article 7 of the Directive 2014/89/EU [12] invites EU member states to grasp the benefits of, other than MSP, formal and informal processes dealing with LSI, with reference to the Integrated Coastal Zone Management (ICZM). Speaking of the Mediterranean Region in particular, LSI lies at the core of the ICZM approach, promoted by the relevant Protocol of the Barcelona Convention [19]. This gives prominence to a more detailed investigation of the connections between land and sea compartments; and supports the coherent and compatible allocation of land and sea-uses, highlighting the key economic sectors and activities that may affect integrity of coastal and marine resources [3].

LSI is in essence perceived as the *two-directional flows and processes* taking place between the mainland and the sea – land-to-sea and sea-to-land interaction [13] – being the outcome of both

natural (biogeochemical) and manmade (socioeconomic) processes [14]. Apparently these two categories are closely interrelated. Such interactions seem to be in fact rather tight, taking into consideration that almost all maritime activities have a land counterpart (e.g. ports for maritime transport, relevant infrastructure for marine energy production or aquaculture activities); while a range of land-based activities along the coastal land (e.g. tourism, recreational activities) are tightly intertwined with the marine environment.

The study of LSI is indispensable when seeking to achieve the sustainable use of maritime resources in the context of MSP and/or ICZM [15]; and aims to ensure that such studies attain proper integration and coherence of activities across marine and terrestrial areas [16,17], and a consistent co-development of landward, coastal and maritime activities [3]. In fact, getting insight into LSI aims at: informing MSP processes by properly identifying repercussions on the sea of land and land-based marine components of the coast; and taking them into consideration when planning in marine space. Or, stated differently, highlight land-originating problems or constraints that need to be addressed and/or emerging opportunities to be exploited in the MSP process [13]. It has here to be stressed the dynamic nature of LSI, taking the form of, among others, intricate and constantly evolving interconnections between socio-economic activities – both in the sea and on land – and the natural processes that span the land-sea interface [20]. This LSI's dynamic nature features its inherent complexity and uncertainty within a rapidly evolving (e.g. by means of technological evolution and newly emerging opportunities) or sometimes abruptly changing (e.g. a natural disaster) broader decision environment. Reconciliation of spatial and developmental choices with the good ecological health of marine resources and establishment of linkages among environmental, social and economic objectives attained through ICZM and MSP render them both highly valuable planning tools in pursuing sustainability goals in coastal and marine areas; and two critical and intertwined mechanisms through which LSI can be addressed [21,22].

Implementation of the MSP by the EU member states was due to be accomplished by March 2021. Greece, in this respect, has fallen rather short, having just recently articulated its National Strategy for the Marine Space (currently at the stage of institutionalization). According to this Strategy, the Greek marine space is – on the basis of certain criteria – split into four compartments (henceforth Marine Spatial Units – MSUs) (see Figure 3 in subsection 3 below). Furthermore, by chance of the INTERREG Program V-A ‘Greece – Cyprus’ (2021-23), a Marine Spatial Plan is carried out in one of these compartments, with the aim to define specifications for conducting marine spatial plans in the Greek context, and become a ‘pilot MSP study’ for the rest of Greek MSUs [23]. Based on this experience, the present article aims at highlighting the steps carried out in identifying LSI in this compartment and particularly the “land-to-sea” interactions’ part. Outcomes of this endeavor has provided inferences to be used as input for articulating and assessing distinct MSP scenarios for the specific marine compartment, being part of the Aegean Sea, Greece.

More specifically, the *focus* of the present paper is on the exploration of that part of the Land-Sea Interaction – land-to-sea part – that originates from the current and expected socio-economic evolution, taking place in the coastal mainland (land-based activities) in the vicinity of the study region; and the realization of the way these can feed or be integrated into the development of the MSP in progress in a specific study area, namely the Marine Spatial Unit 1 (MSU-1 in the following) (see Figure 3 in subsequent section). That said, the key research question lies on identifying the implications in MSU-1 of land-based plans and related policy decisions at the local (urban), regional/national and European level, so that the current and expected (future) developments in mainland (mainly local/regional spatial scales) and the broader decision environment (directions at the national/European level) for drafting the Marine Spatial Framework of MSU-1, to be sketched. Towards this end, *qualitative research* is conducted that is grounded in the exploration of a wide range of policy documents and related directions, emanating from the aforementioned spatial contexts. These directions feature respective developments in the coastal part of the mainland, which, in turn, can potentially affect, constrain, or even orient MSP choices in order for coherence of land and marine developments in the coastal and the marine part to be ensured. In this respect, challenges and critical

issues as well as expected future developments of the coastal mainland, surrounding the MSU-1, are identified, which need to be considered for drafting MSP choices in MSU-1 [23].

The *structure* of the paper has as follows: in Section 2 the methodological approach as well as the range of policy documents used as sources of relative information are presented; Section 3 delineates the current state of the study region (MSU-1); in Section 4 the main results of policy review that may have an impact on the study region are outlined; Section 5 sheds light on the key drivers of change that frame the MSP process in the study region; while, finally, in Section 6 some conclusions are drawn.

2. Materials and Methods

Marine Spatial Planning (MSP) is not carried out in a “white paper”. On the contrary, current land-based activities as well as policy directions for their future development at various spatial scales – local/regional, national, European etc. – have definitely a certain ‘footprint’ on the marine space; and need to be considered as a preliminary stage of the MSP process in order for their impacts and/or constraints these may imply to be identified; and related marine plans to be developed that are harmonically intertwining land-based policy directions. In order to grasp the way land-based current and future developments can affect MSP in the Marine Spatial Unit of the Northern Aegean – i.e., land policy developments that may have an impact on the marine environment, thus demarcating or restraining certain choices in the context of MSP in the specific marine area – a *methodological approach* is developed, having at its heart a qualitative, multi-level policy review (Figure 1).

More specifically, a thorough exploration of institutionalized policy documents is carried out, taking into consideration the:

- local level by means of various types of plans relevant to this level, namely plans associated with coastal municipalities adjacent to MSU-1;
- national and regional level by elaborating on policy documents cross-cutting the whole nation – nation-wide sectoral plans – or referring to adjacent to the study region NUTS2 areas – regional level; and
- European level, exploring policy directions that may have an impact or are framing spatial and developmental decision-making in MSU-1.

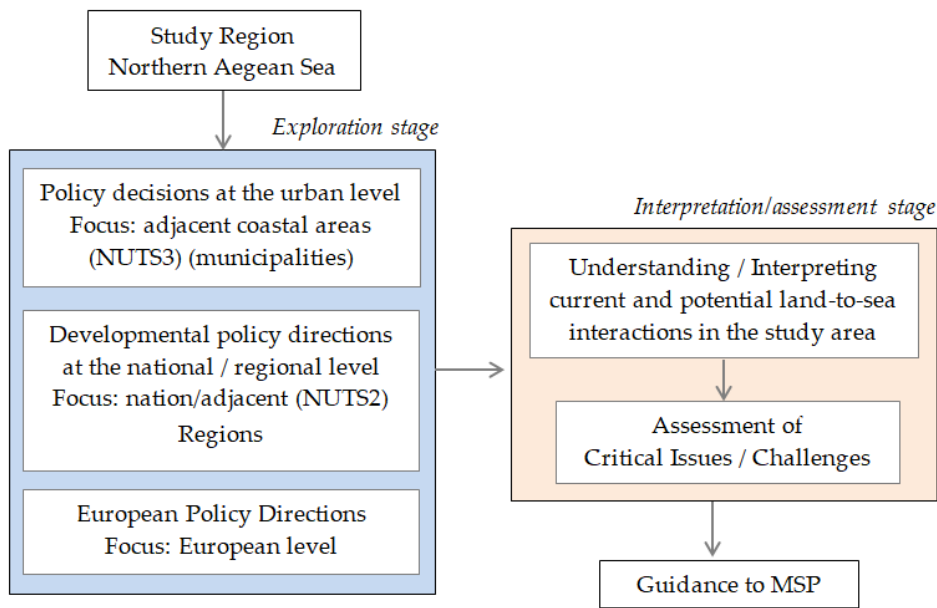


Figure 1. Steps of the methodological approach, Source: Own elaboration.

Speaking of the *urban level* (Figure 1), it should be mentioned here that in Greece, three legislative reforms were carried out in the last decades, namely in 1997 (the “Kapodistrian” reform), 2010 (the

“Kallikratis” reform) and 2018 (the “Cleisthenes” reform). The aim of these reforms was to gradually establish a more powerful and dynamic local administration architecture, by consolidating adjacent, functionally related administrative units. In this respect, there is not a one-to-one correspondence of the municipalities identified in this work and the respective number of urban plans. In fact, in certain municipalities, urban plans identified correspond to those conducted by “Kapodistrian” municipalities, currently merged to compose the new enlarged ones, predicted by the “Kallikratis” and “Cleisthenes” reforms.

Thus, in each of the coastal municipalities explored in this work (Table 1), one may find more than one general urban plans, reflecting actually those of the former “Kapodistrian” municipalities, currently unified to form the larger municipalities under exploration; and thus, representing planning efforts in smaller parts of the newly emerging municipalities. In addition, for the municipalities explored certain types of plans are missing, e.g. master plans of port development in those municipalities that dispose a port. In this respect, a wide range of planning documents for a total of 52 coastal municipalities that display a border with the marine study area and fall into five NUTS 2 Regions, are intricately explored at the urban level (Table 1). The scope of this effort is to grasp the repercussions of land-based regulations in the marine space of the MSU-1; and the inherent developments or constraints that should feed the effort of drafting the MSP process in this marine part of the Greek territory.

Next level of exploration is the national / regional one (Figure 1). At this level, medium- and long-term developmental policy documents are explored, originating from the (Figure 2):

- Partnership Agreement of Greece with the EU for the programming period 2021-27, as this is presented in the respective National Strategic Reference Framework (NSRF) and is downscaled to sectoral and regional programs.
- Public Investments’ Program of the Greek state with reference to the time span 2021-25, classified by ministry (sector of interest, addressing the national level) and region (programs addressing goals and objectives at the regional level).
- Strategic policy directions at the national level, addressing fields such as aquaculture, energy, tourism, transport, environmental protection of the marine environment, and digital transition.

Table 1. Type/number of policy documents explored at the urban level (NUTS3) (adjacent to the study area municipalities), Source: Own elaboration.

Region (NUTS2)	Nr of coastal municipalities (NUTS3)	Nr of policy documents explored	Type of policy documents explored
Eastern Macedonia & Thrace	11	24	- General Urban Plans
Central Macedonia	13	25	- Plans for Spatial and Residential Organization of Open Cities (spatial organization of periurban areas)
Thessaly	10	17	- Plans related to Residential Control Zones (building conditions & land uses in specific areas and/or natural sets)
Stereia Ellada	11	23	- Port Development Plans of main ports, falling into the study area
Northern Aegean	7	19	- Plans related to areas, falling into specific planning regulation regime
			- Plans associated with Industrial Areas / Parks



Figure 2. Sectoral and regional development Programmes explored in the light of their repercussions in the marine study region, Source: Own elaboration.

The scope of this exploration is to illuminate potential developmental directions or interventions predicted by these plans; and the way these are expected to affect developments in the land part of coastal regions that border the MSU-1 study area, demonstrating also related repercussions and/or constraints for the MSP endeavour.

The Sectoral and Regional Operational Programmes, falling into the National Strategic Reference Framework 2021-27, articulate the currently perceived strategy, main developmental challenges, and policy priorities; while sketching policy decisions and the desired developmental trajectory in various fields at the national / regional context, in alignment with the main goals of the EU for the respective programming period (2021-27). Getting insight into these Programmes delineates potential future priorities of the land and marine space, as well as relevant repercussions in MSU-1.

Concurrently, the Sectoral and Regional Development Programs 2021-25 (SDP and RDP respectively) are examined. These downscale nationally-defined interventions funded by the Public Investments Program of Greece; and have a complementary role to that of the Sectoral and Regional Operational Programmes 2021-27 in achieving sectoral and regional objectives of the Greek territory (Figure 2).

The sectoral (nation-wide) and regional operational and developmental Programmes explored in this respect, as well as the long term, nation-wide strategic directions in various fields, as articulated at the national level, are presented in Table 2.

Table 2. National, sectoral, and regional (5 studied regions bordering the MSU-1) operational and development Programmes explored, Source: Own elaboration.

Sectoral & Regional Operational Programmes, falling into the NCRF / Programming period 2021-27			Sectoral & Regional Development Programs funded by the Greek Public Investments Program / Programming period 2021-25			Long Term Nationwide Strategic Policy Directions	
Sectoral Programmes (SP)		Regional Programmes (RP)	Sectoral Development Programmes (SDP)		Regional Development Programmes (RDP)	Field of reference	
1. Competitiveness		1. Eastern Macedonia & Thrace	1. Ministry of Development & Investments		1. Eastern Macedonia & Thrace	1. Aquaculture	
2. Digital Transformation		2. Central Macedonia	2. Ministry of Digital Transformation		2. Central Macedonia	2. Energy	
3. Environment & Climate Change		3. Thessaly	3. Ministry of Environment and Energy		3. Thessaly	3. Tourism	
4. Transport		4. Sterea Ellada			4. Sterea Ellada	4. Marine Transport	
5. Civil Protection		5. Northern Aegean			5. Northern Aegean	5. Marine Environmental protection	
6. Fishery, Aquaculture & Ocean						6. Digital transition	

7.	Human resources & Social Cohesion	4.	Ministry of Infrastructure & Transport
		5.	Ministry of Sports & Culture
		6.	Ministry of Agricultural Development & Food
		7.	Ministry of Ship-ping & Insular Policy
		8.	Ministry of Tourism

Finally, at the European level, a thorough exploration of policy directions and strategic guidelines of the European Commission is conducted, illuminating issues that are – directly or indirectly – affecting marine space (sectoral fields) (Table 3). As such are considered fishery/aquaculture, offshore energy, coastal and maritime tourism, maritime transport and port infrastructure, as well as protected areas and underwater cultural heritage. Delving into dimensions of respective policy documents provides the chance to grasp developments of the broader decision environment, within which MSP is conducted.

Table 3. Policy directions at the European level deemed to frame the decision environment within which MSP endeavour in Northern Aegean Sea is conducted, Source: Own elaboration.

Theme/Sector	Policy document	Document title
European Green Deal	COM (2019) 640 final [26]	“The European Green Deal”
Climate Change	COM (2021) 82 final [27]	“Forging a climate-resilient Europe - The new EU Strategy on adaptation to Climate Change”
Environment	COM (2020) 652 final [28]	“On a general Union Environment Action Programme to 2030”
Fishery Aquaculture	/COM (2020) 381 final [29]	“A farm to fork strategy for a fair, healthy and environmentally-friendly food system”
Energy	COM (2020) 741 final [30]	“An EU strategy to harness the potential of offshore renewable energy for a climate neutral future”
Tourism	COM (2010) 352 final [31]	“Europe, the world’s No 1 tourist destination — A new political framework for tourism in Europe:
	COM (2014) 86 final [32]	“A European strategy for more growth and jobs in coastal and maritime tourism”
Transport	COM (2020) 789 final [33]	“Sustainable and smart mobility strategy – Putting European transport on track for the future”
Tourism Transport	&COM (2020) 550 final [34]	“Tourism and transport in 2020 and beyond”
Digital Transition	COM (2024) 81 final [35]	“How to master Europe's digital infrastructure needs”
Blue economy	COM (2021) 240 final [25]	“On a new approach for a sustainable blue economy in the EU - Transforming the EU's blue economy for a sustainable future”
	Directive 2008/56/EC [36]	“Establishing a framework for community action in the field of marine environment policy (Marine Strategy Framework Directive)”

3. Delineating the Study Region – The Northern Aegean Sea

The National Strategy for Marine Space, coupled with the related Marine Spatial Plans, constitute the Marine Spatial Planning (MSP) system of Greece as a coherent, multilevel framework for sustainably managing marine areas and related resources [24], in alignment with the European

direction towards the sustainable blue economy [25]. MSP is carried out in marine waters that fall under the sovereignty of the Hellenic Republic or within which the Greek state exerts sovereign rights or jurisdiction under the United Nations' Convention as to the Law of the Sea [11]. In accordance with the National Strategy for Marine Space, development and implementation of Marine Spatial Plans are predicted to be implemented in four distinct and properly demarcated Marine Spatial Units (MSUs) (Figure 3).

In the present work, the focus is on MSU-1, namely the Northern Aegean Sea (Figure 3), the study of which towards the preparation of a Marine Spatial Plan is conducted in the context of the INTERREG V-A 'Greece – Cyprus' Project. MSU-1 has an area of 66.813 km² and a coastline of 4939 km long. It has borders with four mainland Regions (NUTS2) of the Greek territory, namely the Regions of Eastern Macedonia & Thrace and Central Macedonia to the north, and the Regions of Thessaly and Sterea Ellada to the west; it embraces the islands' complex of the Northern Aegean Region; while to the east it displays borders with Turkey. In addition, MSU-1 owns a significant *geostrategic position*, largely determined by its dual nature and respective role as a [38]:

- 'Bridge' of both the Greek and the European territory to the Middle East and Asia.
- Sea transportation 'passage' for maritime transport towards the Marmara and the Black Sea.

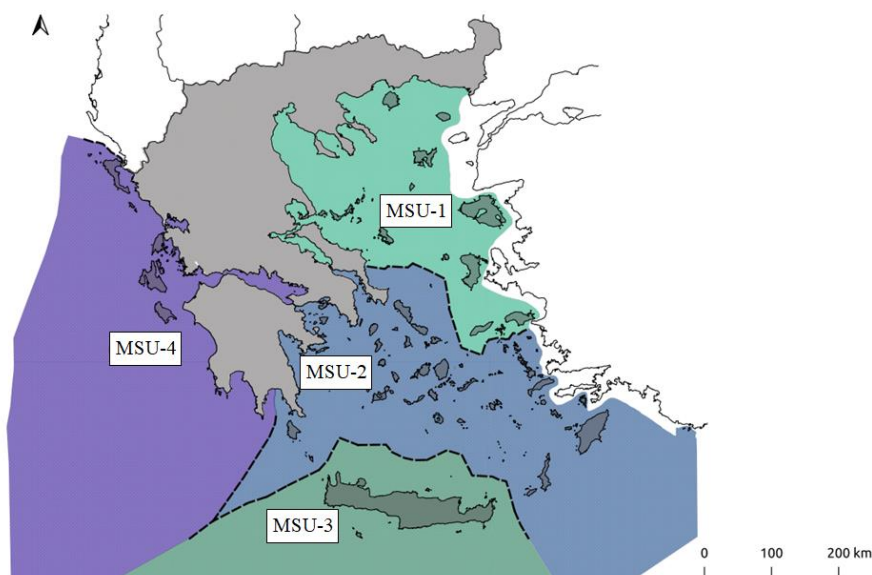


Figure 3. Compartmentalization of the Greek marine space into four Marine Spatial Units (MSUs) for conducting Marine Spatial Plans, Source: adopted from [37].

Indeed, the location of the MSU-1 on the eastern border of both Greece and Europe as a whole renders this area part of the international maritime axis that connects Europe, Asia and Africa. In addition, MSU-1 is also part of the vertical axis connecting the Mediterranean and the Black Sea. However, the geographical proximity of MSU-1 to the Middle East renders this area scenery of social and political tensions, occurring in the broader region of the Eastern Mediterranean, e.g. refugee crisis and related population movements through the Mediterranean Sea routes.

Prevailing *marine uses* in MSU-1, apart from maritime transport, are fishery and aquaculture, oil extraction in the northern part (marine area of Kavala and Thasos) as well as coastal and maritime tourism.

As far as *fishing activity* is concerned, the number of landing ports in the area as well as the catch volume collected is indicative of the activity's intensity. In particular, fishing infrastructure in the area comprises 23 landing ports and numerous fishing shelters, with the largest part of catches being collected in the fishing area of the northern part of MSU-1 (Central Macedonia as well as Eastern Macedonia and Thrace Regions). In addition, aquaculture in MSU-1 is also developed, displaying fish farms, shellfish farms and spirulina production. Large concentrations of fish farms can also be identified in the eastern part of Sterea Ellada Region (Euboea gulf), the coasts of the eastern part of

Eastern Macedonia and Thrace Region and the island of Lesvos in the Northern Aegean Region; while Thermaikos gulf in Central Macedonia Region presents the highest concentration of shell cultivation activities.

In addition, offshore *oil and gas production facilities* exist in MSU-1. These are located in the Gulf of Kavala and have been in operation since 1970. Further to the oil extraction, interest has already been expressed in marine Renewable Energy (RE) exploitation. Currently, offshore wind farms are established in the marine area of Alexandroupoli (Region of Eastern Macedonia and Thrace) and Limnos Island (Region of Northern Aegean), while relevant applications for the further deployment of RE activities in these areas are at the licensing stage.

Tourism is a remarkable sector in the MSU-1, especially in its coastal and island borders, taking diverse tourism forms both of mass and alternative nature. Most well-known and crowded places are currently the: Chalkidiki resort (Central Macedonia Region) and Skiathos Island (Region of Thessaly). The rest of coastal and island regions are classified as alternative tourism destinations or areas under tourist development. However, the dynamic development of the tourism sector in Greece in general and the borders of the MSU-1 in particular – coastal part of mainland but also insular territories – is gradually accompanied by a more intense use of marine space for maritime transport and other tourism-based marine activities, e.g., yachting / cruising and related infrastructure. These imply a certain increase of the footprint of tourist areas in the marine space. Relevant yachting infrastructure (marinas) is mainly concentrated in the Region of Central Macedonia, while in the rest of the regions, bordering the MSU-1, such infrastructure and related activity seems to still have a low presence. Speaking of the cruising activity, no remarkable growth of the sector has yet been noticed in the area, despite the eight ports located in MSU-1 and aiming at hosting relative activity.

Regarding the environmental and cultural value of MSU-1 resources, worth mentioning are marine and coastal areas with distinguishable *environmental value*, already being recognized as protected ones by national and international treaties. These include Posidonia meadows (expanding in 284 km² in MSU-1); 60 coastal and marine areas marked as Special Protection Areas (SPA) and Sites of Community Importance (SCI), incorporated in the NATURA 2000 network (expanding in 977 km²); 4 coastal wetlands that are included in the Ramsar Convention; 178 small island wetlands in coastal locations (most located in the islands of Lemnos and Lesvos, Northern Aegean Region); 1 National Marine Park in the Northern Sporades area, being the largest marine protected area in Europe (approx. 2220 km²) (Region of Thessaly); while finally 35 Landscapes of Particular Natural Beauty are identified in coastal locations of MSU-1. As to the *cultural assets*, the area is marked by an extremely rich and remarkable underwater cultural heritage stock, consisting of 39 underwater archaeological sites in various marine locations and a large concentration of them around the coast of Lesvos Island (Region of Northern Aegean). Indicative examples are the Peristera ancient shipwreck in Alonissos Island, dated back to 425 BC, where is also inaugurated the first Underwater Museum that is open to recreational activities (Figure 4a); and the Roman shipwreck in Prasonisi that is located in Chios Island and is dated back to 100-1 BC, (Figure 4b).

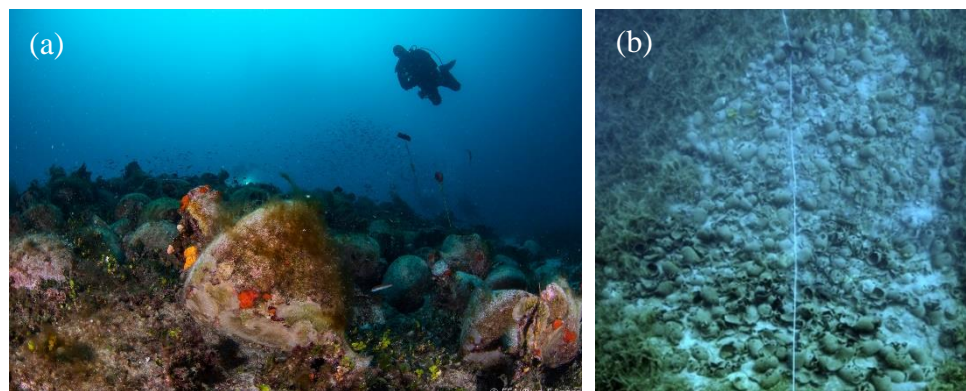


Figure 4. Extraordinary cultural resources located in MSU-1. (a) The Peristera ancient shipwreck – 425 BC – “the ‘Parthenon’ of shipwrecks”, Alonissos Island, Region of Thessaly. Source: [39], (b) Roman shipwreck - 100-1 BC, Prasonisi, Chios Island, Region of Northern Aegean. Source: [40].

Speaking of the *spatial organization* of MSU-1, the marine environment has definitely influenced the development of residential networks and urban centers of the bordering coastal area, with strong interdependence relationships being established between the marine and the coastal area. In fact, the marine space has influenced the formation of coastal residential development; while, conversely, this development affects the marine environment through the creation of new maritime uses, establishment of maritime interconnections, etc., all exerting considerable and of diversifying type and intensity environmental pressure, depending on the coastal urban configuration, bordering the MSU-1 [38]. More specifically, most coastal urban centers across the land border of MSU-1 accommodate ports – e.g. Thessaloniki, Volos, Alexandroupoli (see Figure 5) – with high traffic volume; or develop as tourism resorts, hosting extensive built infrastructure – e.g. region of Chalkidiki –, with direct repercussions in the marine part. Particularly, the concentration of large urban centers in the northern coastal zone bordering MSU-1 (Figure 5) largely intensifies the need for locating a variety of uses in the nearby marine space (commercial and passenger transport, recreation, tourism, yachting, cruising, energy, etc.). This, in turn, leads to severe pressures and degradation of the marine environment (e.g. the metropolitan center of Thessaloniki).

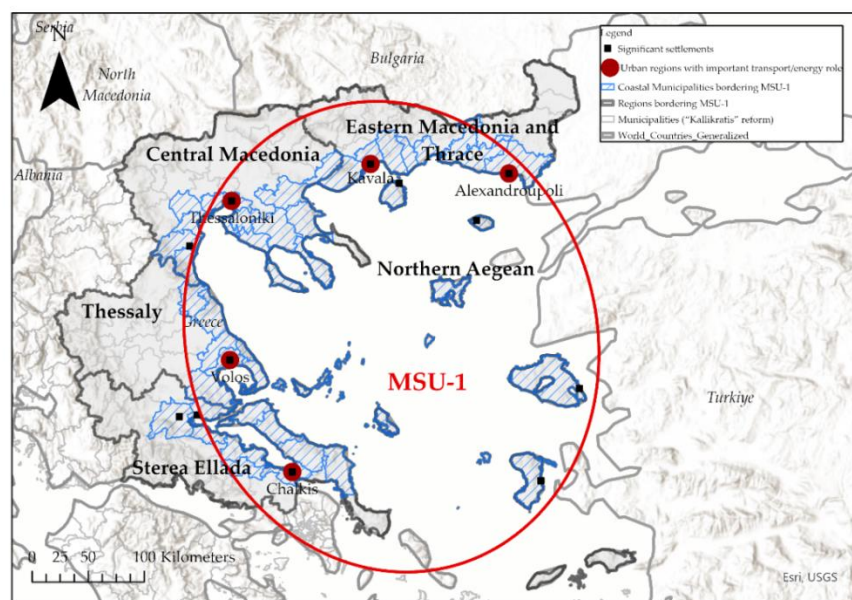


Figure 5. Coastal municipalities (NUTS3) explored (marked with blue line) at the border of MSU-1 as well as large urban centres located in the adjacent to MSU-1 coastal zone, Source: Own elaboration.

The main, rather contradicting, uses of the coastal part bordering MSU-1 but also of the marine part – i.e., maritime transport, fishery/aquaculture, oil extraction, land/maritime tourism and coastal urban development – as well as the fragility of its natural and cultural resources due to coastal overloading, clearly stress the necessity for a holistic and integrated planning of marine space. This has to: take into consideration, among others, the land-to-sea interaction, i.e. directions or pressures exerted from the bordering coastal part; target conflicts' mitigation and synergies' creation of different maritime uses; and definitely ensure future sustainability objectives of this space. Towards this end, in the following section the key dimensions, arising from policy frameworks at different spatial scales (coastal urban constellations, national/regional and European) that may affect, constrain or even orient MSP effort in MSU-1 are highlighted; and are used for delineating distinct marine spatial entities these policies demarcate as critical input to subsequent steps of the MSP process.

4. Main Results of Policy Review

In the climate change era, coastal areas lie at the heart of interest of many researchers' work on the ground of their vulnerability, overpopulation, overtourism, extreme urban sprawl and an irrational use of coastal – both land and marine – resources [41-45]. These rapidly evolving changes in the coastal land [46] have severe consequences on the marine environment, results that are gradually demonstrated in the study area as well. In fact, in many parts of the surrounding the MSU-1 coastline the aforementioned coastal overload is present; while this is expected to further escalate in the near future as a result of medium-term planned interventions and mostly the current energy crisis that renders this area the crossroad of large energy infrastructure networks. More specifically, assessment of the repercussions of the mainland policy directions that are going to affect the marine environment and need to be addressed or are somehow framing the MSP process of MSU-1, as these emerge from the study of the policy framework and directions at the various spatial scales (local/urban, national, regional and European), are discussed in the following.

4.1. The Local (NUTS3) Level

In the coastal area surrounding MSU-1, institutionalized urban plans as a whole are to a significant extent either outdated or inapplicable. This condition affects directly and/or indirectly the marine area, mainly through the pressures originated by the: unregulated construction; increased demand for tourist facilities and vacation homes; absence of basic infrastructure (e.g. drainage); intensity of maritime transport (passenger and commercial); productive activities (coastal industrial activity, fishing, aquaculture, etc.); and port infrastructures. Most importantly, the current directions as to the marine part, resulting from the underlying urban plans, are minimal, despite the impacts urban areas are having on the near marine area.

More specifically, in the *Region of Eastern Macedonia and Thrace*, the cities of *Alexandroupoli* and *Kavala* (Figure 5) are the most influential coastal urban areas, since their ports – and their potential future expansion / diversification of activities – constitute focal points of the interface of the coastal and marine space. In addition, maritime transport has an impact on the marine area, considering the tourist flows towards the islands of Thasos and Samothraki, further intensifying the traffic load handled by these ports. The rest of the coastal front is characterized by an irregular construction pattern mainly due to vacation residences, while the existence of two environmentally-significant natural ecosystems along the Region's coastline (National Park of Eastern Macedonia - Thrace and National Wetland Park of the Evros Delta) calls for specific protection of the respective marine space.

In the *Region of Central Macedonia*, a variety of critical urban hotspots are identified, rendering almost the entire coastal and marine area of this Region a vulnerable space, under significant pressure from anthropogenic activities. In particular, the city of *Thessaloniki* (Figure 5) constitutes the metropolitan center of the region, taking the form of an expanded urban complex, largely oriented towards the sea. The port of Thessaloniki, namely a transport hub of international scope, is located close to the coastal front, covering a significant part of the urban context. A well-known tourist destination of this Region is the wider area of Chalkidiki, marked by extensive tourist infrastructure and vacation homes deployment, built-up saturation, intense coastal urbanization and overtourism. These attributes seem to be further fostered by current institutionalized urban plans, with obvious negative effects on the coastal and especially the marine area. The metropolitan identity of the city of Thessaloniki is source of relevant pressures on marine space and an escalating demand for maritime uses. This fact, coupled with the highly demanding – in terms of coastal and marine resources – mass tourist model in Chalkidiki, seem to be the defining factors for the future of the surrounding marine environment in the Region of Central Macedonia.

In the *Region of Thessaly*, urban planning in the coastal and island municipalities (the Sporades complex) is also insufficient. The largest urban center, with an important cargo and passenger port, is the city of *Volos* (Figure 5). Port activities as well as activities of large industries along the coastline are negatively affecting the marine area. In the rest of the Region's coastline, bordering MSU-1, important coastal wetlands co-exist with industrial concentrations, port facilities and tourist activities, causing negative consequences in both the coastal and the marine environment. The

Sporades islands' complex – islands of Skiathos, Skopelos and Alonissos – is quite significant from an environmental point of view, disposing distinct wetlands. However, intense tourist activity renders the coastal and marine environment of this insular complex quite vulnerable, especially due to the expanding tourism infrastructure, drying and embankment trends, dumping of waste and garbage, etc. The current directions, deriving from the underlying urban planning context, basically concern regulation of this complex only within the National Marine Park of Alonissos, located in this Region.

In the *Region of Central Greece*, the city of *Chalkis* is the main urban center of the part of this region that borders MSU-1 (Figure 5). The coastal area of the region, especially in the Euboean and Malian Gulfs, shows intense activity of the primary and secondary sectors, mainly due to aquaculture and industrial activity, as well as tertiary activity related to tourism. The two ports of Chalkis and Stylida are of commercial nature, serving mainly industrial activities of the Region; while the passenger ports of Kymi (island of Euboea) and Skyros serve mainly passenger transport to tourist areas. The currently institutionalized urban plans, relevant to coastal municipalities of the Region, seem to effectively respond to the intense pressure for tourist and vacation residences.

Finally, coastal municipalities in the *Northern Aegean Region*, as a predominantly insular Region, traditionally demonstrate a tight relationship with marine space. In all islands of this Region that fall into the MSU-1, institutionalized urban planning seems to lead to more satisfactory outcomes. However, it should be noticed that most of these plans are rather recent (time span 2014-2018) in order for quite safe judgments as to their effectiveness to be made. The prevailing uses in coastal municipalities relate to tourism-recreation zones, linearly expanding in the coastal front as well as in Special Protection Areas. As far as port infrastructure is concerned, delays in the approval of related master plans do not allow to clearly defining the role and scale of impacts of existing ports. Critical are also provisions for the establishment of smaller harbors and fishing shelters, serving respective activities in the area.

Out of the aforementioned results, of critical importance for the MSP in the Northern Aegean Region (MSU-1) are:

- the ports of Thessaloniki, Alexandroupoli and Kavala, being highly extroverted hubs of maritime transport – recently of energy as well – and a bridge connecting the Balkans and the EU to the East, while Thessaloniki port is also developing as a cruise terminal,
- the ports of Volos and Chalkis as nodes of supralocal nature for productive activities, such as freight transport, industry and aquaculture,
- the area of Chalkidiki and the Sporades islands' complex as highly-rated tourism destinations, already exhibiting intense coastalization trends and tourism overload to the detriment of the remarkable natural environment and underwater cultural resources these dispose, all highly affecting or constraining maritime uses, while acting as pollution sources, largely affecting quality of the MSU-1 marine environment.

4.2. The Regional (NUTS2) Level

Regional Operational Programmes, falling into the NCRF / Programming period 2021-27 as well as Regional Development Programs funded by the Greek Public Investments Program / Programming period 2021-25 incorporate various sectoral and spatially-defined interventions in their effort to pave a sustainable future for the Greek Regions. Relative policy decisions at this level (NUTS2) imply new developments in the land part that may affect or condition maritime uses in MSU-1.

More specifically, of critical importance for MSU-1 is the *fishing and aquaculture sector*. In fact, the right balance among environment, aquaculture and tourism in future developments of the sector is sought in the aforementioned regional programs, an issue quite critical for MSP in MSU-1, setting sustainable aquaculture among primary objectives for serving, among others, subsistence of marine mammals in the area that are protected under the International Convention ACCOBAMS. Currently, this sector is placing a heavy burden (marine pollution) on marine ecosystems that needs to be restrained. This holds especially true for the Regions of Eastern Macedonia and Thrace, Northern

Aegean and especially Sterea Ellada, where the aquaculture sector is a major maritime activity and a critical part of local economic development. MSP in MSU-1 has to take into account the strong presence of aquaculture in specific areas; and investigate prospects for mitigating its impacts on the marine environment and ensuring the harmonious coexistence with tourism and transport activities.

Speaking of the *energy sector*, Regional Programmes' directions are mainly focusing on a transition to new forms of energy production and particularly to the exploitation of Renewable Energy Sources (RES), emphasizing deployment of relevant investments. This is particularly relevant to areas of the Northern Aegean Region; and is also in alignment with directions at the national level, promoting islands' weaning off fossil fuels and improvement of connectivity of island regions to the energy network of the mainland. This, in turn, implies that MSP in MSU-1 needs to consider both potential investments in *offshore wind* or *solar farms* in the marine part and existing/future submarine energy routes among the islands and between the islands and the mainland. Further to that, MSP in MSU-1 has to consider the exploitation of underwater oil and natural gas deposits, located in the Thracian Sea, Region of Eastern Macedonia and Thrace.

In all regions bordering the MSU-1, *tourism* is the prevailing sector in the coastal part, rendering this part and respective activities a source of stress and pollution of valuable marine ecosystems and a cause for deterioration of underwater cultural heritage (UCH). Coastal and marine ecosystems and UCH protection is an issue that cuts across all regional policies and sectoral priorities at this level, rating high objectives related to the harmonious coexistence of diversifying activities of the coastal and marine space. Same holds for the preparation of MSP that needs to take into account tourism developments in the coastal part and restrictions these may cause in MSP choices on the marine counterpart, thus ensuring integrity of marine natural and cultural resources.

Finally, the *transport sector* is of major importance for the Regions under study, developments of which are largely affecting MSP decisions in MSU-1. More specifically, of key relevance to MSU-1 and related MSP is the Port of Thessaloniki, a main marine transport hub of national and supranational relevance (recently a planned energy hub as well) in south-eastern Europe; and an important transit centre of pan-European scope, placing considerable traffic burden in MSU-1. In addition, in the northern part of MSU-1 are located two very important – of national scope – ports, those of Kavala and Alexandroupoli. The latter is also considered as the 'energy passage' to Balkans and Europe. In related regional plans, their potential role as transport but also evolving energy hubs is stressed, a fact that has to be taken into account in MSP of MSU-1. Their role is expected to be further reinforced, perceived as two hubs that will establish the linkage between the Aegean and the Black Sea (Sea2Sea part of Trans-European Networks). Same holds for insular ports in Northern Aegean Region, planned to be upgraded and expanded, in order to accommodate, among others, cruise ships (e.g. Chios Port); and the creation of new ports for removing isolation of islands (e.g., the new Passenger and Commercial Port of Sigri in Lesvos). Relevant ports' upgrading interventions are also predicted in regional plans of the Region of Thessaly, designating the increase of marine traffic that needs to be considered in MSP of MSU-1.

4.3. The national Level

At the national level, the sectoral policies promoted seem to be in harmony with the EU directions, stressing the importance of "*connectivity*" in terms of transport, energy and digital infrastructure.

More specifically, the issue of islands' *transport connectivity* in current national policies is prioritizing maritime transport arrangements and upgrading of regional port facilities in support of maritime activities, tourism and local population. Maritime transport is also expanded to incorporate seaplane services, a process that is gaining particular momentum after the new, more favorable conditions for their establishment and operation, as well as the lifting of flight restrictions in the existing waterways, introduced by the Law 4568/2018 [47]. Such a development implies more dense and intense sea transportation linkages as well as the establishment of sea plane transportation infrastructure/ports. Further to the previous facts, interest in the location of Floating Storage and Regasification Unit (FSRU) for liquid natural gas (LNG) is raising, especially after the Russian –

Ukraine crisis. This interest creates new demand for maritime uses for deploying related floating infrastructure, pipelines for linking this infrastructure to mainland, as well as related mainland handling facilities. Such new developments in MSP terms can, apart from the specific maritime uses (Figure 6a), be translated into a considerable increase in maritime traffic and the necessity to determine new sea routes, coupled with the need for modernizing/expanding traditional ports' infrastructure in order for this new demand to be accommodated. A quite distinguished example is the FSRU infrastructure in the port of Alexandroupoli (Figure 6b); while an already licensed FSRU is expected to be established in the port of Thessaloniki, Region of Central Macedonia. In addition, a FSRU is at the licensing stage and is expected to be located in the port of Volos, Region of Thessaly. Such a FSRU network development in the borders of MSU-1 render related ports important *energy hubs*, serving the demand for natural gas of Balkans, but also other European countries; and having, as such, quite important repercussions in the adjacent marine space in, among others, transport and energy terms.



Figure 6. Port of Alexandroupoli, (a) The Gastrade Independent System of Liquid Natural Gas (LNG) in Alexandroupoli, Source: [48]; (b) The nodal position of FSRU in Alexandroupoli as a new energy gateway for Greece and Europe, Source: [49].

As far as the *energy sector* is concerned, MSU-1 is currently undergoing intensive developments in energy infrastructure, which may have a strong impact on the MSP process. Apart from the aforementioned FSRU network development in the border of MSU-1, of top policy priority in Greece is the transition from oil to alternative forms of energy production, by harnessing wind and solar potential and using natural gas as a “bridge” fuel. Towards this end, new provisions regarding the simplification of RES licensing procedures are established, aiming to: promote strategic investments of coastal wind and photovoltaic installations in properly selected locations; and regulate the wider environment within the framework of MSP. The setting of *wind farms* is prioritized in this respect, with policy directions converging in the location of relevant infrastructures on the seafront of Aegean islands, part of which fall into the MSU-1. This potential is expected to be utilized for the energy upgrading/independence of island regions, as formulated through Law 4872/2021 [50]. In addition, within the strategic objectives of the Independent Power Transmission Operator for the period 2021-2030 lay the interconnection of non-interconnected islands with the National Electricity Transmission System, prioritizing thus *energy connectivity* objectives. These new facilities and connections imply the installation of subsea infrastructure and energy transmission networks, the development of which must be taken into account in MSP of MSU-1 for assuring safety of provision and compatibility with other uses. In addition to the deployment of submarine energy transmission pipelines, research and possibly extraction of hydrocarbons is also predicted in MSU-1. Such activities are already active at the northern border of MSU-1 (area of Kavala) as well as in the wider area of the Thracian Sea, where research activities are in progress with the aim to identify deposits; and are relevant to the MSP (sea surface, water column and seabed).

Submarine optical fibres are also predicted to be installed, broadening *digital transformation perspectives* of insular regions and improving *connectivity* capabilities in this respect, an issue that also needs to be handled in the context of MSP in MSU-1.

In addition to connectivity objectives, national policies emphasize the importance and increasing attractiveness of Greek islands as tourist destinations, paving the way for further broadening the potential of the *tourism sector* in these regions. Along these lines, alternative and experience-based tourism is gaining importance, with priority being given to the recently institutionalized *diving tourism* [51]. Such an alternative form is grounded in the abundance of natural and underwater cultural heritage, spread at the bottom of the Aegean Sea in general and the Northern Aegean part in particular; and implies the demarcation of related maritime uses for its protection and sustainable exploitation. In addition, *cruise tourism* is also gaining ground, calling for ports' upgrading/expansion, with relevant consequences in the marine space, as well as a further escalating traffic volume at certain time slots. The diversifying needs of both types of tourism activities – diving and cruise tourism – need to be taken into account in the MSP of MSU-1, properly accommodating these newly emerging perspectives and related uses / infrastructure in a sustainable and conflict-alleviating way.

Moreover, following the directions of the European Commission [52,53] and the European Green Deal [26] for a sustainable and competitive *aquaculture sector*, Greece has developed a long term strategic plan for aquaculture development (2021-2030), taking into account the specific conditions of the country, the current state of the aquaculture sector and the leading position Greece holds in this sector in the Mediterranean Region. According to this plan, aquaculture is prioritized and will be further strengthened by use of technological advances that aim at reducing the sector's environmental footprint. Future potential aquaculture production sites in the MSP of MSU-1 need to be circumscribed in conjunction with other current or expected uses.

Finally, the protection of the *marine ecosystem* is of particular priority in the Greek context, with all nation-wide policies converging towards the need to achieve an environmental balance, while pursuing the objectives of the European Green Deal and protecting biodiversity. Although a significant part of the natural environment is placed under protection through respective national legislation, relative data unveil certain weaknesses as to the actual implementation of dedicated policy measures, thus endangering the essential protection of the marine environment. The MSP in MSU-1 should take into account provisions for the protection of the marine environment and proceed with allocation of uses that ensure the good environmental condition of the seas.

4.4. The European Level

At the European level, a number of policy initiatives are in force, reflecting the protagonist role of the EU towards a climate-neutral and sustainable future in land and at sea. Key fields of such initiatives that are of interest in marine space in general and the MSU-1 in particular are shown in Figure 7 and are shortly described in the following.

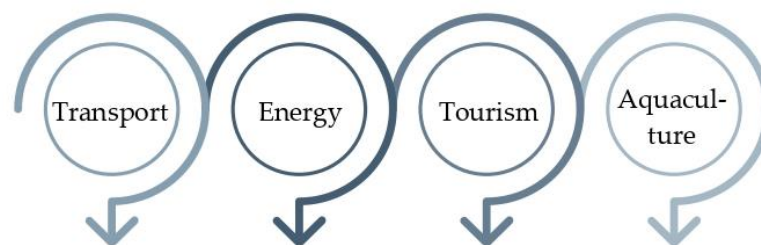


Figure 7. European policy initiatives explored in the context of MSP in MSU-1, Source: Own elaboration.

Transport and port infrastructure

Maritime transport in the EU is defined through a number of sectoral plans and Programmes, highlighting the role of *ports* in the local, regional, national and European development process; the environmental dimension of ports; but also the positioning of new forms of maritime transport, such

as waterways as a means for more efficient maritime connectivity. More recent EU policies in this field place significant emphasis on maritime transport, with a specific focus on the sustainable operation of maritime transport means and the promotion of 'greener' transport options, in alignment with decarbonization guidelines provided through the European Green Deal. The significance of such goals is evident, when considering the implications of the rising inland and short sea shipping [33]. Responses towards more sustainable and efficient maritime transport emerge through: relevant investments in research in this direction; promotion of multimodal transport, with ports presented as hubs within a multimodal transport network; and integration of technological innovations into maritime transport and port infrastructure that benefit environmental protection [25]. Synergies' creation of transport and ports' infrastructure with other sectors is also a distinct element of current policies. Along these lines, promotion of offshore electricity generation emphasizes the role ports can play as energy hubs for: integrated systems of electricity and other renewable energy and low-carbon fuels; circular economy through collection, transshipment and disposal of waste from ships and other port industries; as well as ship decommissioning, communications (submarine cables) and industry (as industrial co-operatives) [25].

Energy

At the European level, the energy sector has become particularly important due to the steady commitment of the European Commission to climate change mitigation. Towards this end, the European Green Deal has reaffirmed the ambitious intention of the European Commission, to "transform the EU into a fair and prosperous society, with a modern, competitive and resource-efficient economy, where: there are no net emissions of greenhouse gases in 2050; and economic growth is decoupled from resource use" [26] (p.2). Within such a context, green energy and the exploitation of RES, coupled with the gradual decarbonization, secure and cost-effective energy supply take on a central role. More specifically, the European Green Deal emphasizes the necessity for greening the energy sector by harnessing offshore wind power generation, stressing thus the potential of oceans in support of a modern, resource efficient and competitive economy. This view is further stressed in the "EU Strategy for harnessing the potential of offshore RES for a climate-neutral future" [30], targeting to render offshore renewable energy a core component of Europe's energy system by 2050, according to the peculiarities of each single European sea basin (e.g., diversifying geological conditions, maturity of offshore renewable energy development); while also adopt a multi-use/multi-purpose, holistic and integrated approach that is capable of promoting coexistence of offshore installations with other marine space uses. In addition, a new approach to the sustainable blue economy in the EU was proposed in 2021 [25] aiming, among others, at promoting a sustainable mix of ocean energy (floating wind, thermal, wave and tidal energy) that is effectively supported by ports as *energy hubs*. This view, firstly articulated in COM(2020) 789 final [33], stresses the future-oriented multifunctional nature of ports as hubs of multimodal transport and energy.

Tourism

Tourism forms the backbone of the economies of many European states, while is considered as an important pillar of the European economy as a whole [31]. This role is grounded in the value of Europe's natural and cultural, land and seascapes. However, coastal and marine assets have so far been the main motive of travelers, establishing thus the prevailing mass tourism model of the European territory. The importance of the sea and the water element in general, coupled with the resulting benefits from their exploitation with a focus on marine and coastal tourism are extensively described in the European context [32]; capitalizing on heritage-based tourism, underwater archaeological parks, as well as nature or health tourism in coastal destinations. The importance of the sea element in marine and coastal tourism is thoroughly discussed in the Communication of the European Commission "A European strategy to stimulate growth and create jobs on coastal and maritime tourism" [32]. In this discussion, the need for promoting *coastal / maritime and cruise tourism* by establishing synergies at a transnational level among the EU member states is stressed. In particular, in order for the good environmental condition of the European seas to be attained, special emphasis is placed on the development of ecotourism and the removal of the sector's seasonality by

attracting visitors throughout the year. In addition, significant attention is paid to spatial planning issues, with reference to the implementation of the Barcelona Convention Protocol on the Integrated Coastal Zone Management and Marine Spatial Planning for ensuring the sustainable development of the EU's coastal areas. Further to that, the promotion of sustainable coastal and marine tourism calls for a variety of policy measures, among which fall the upgrading of existing port facilities through innovative solutions. Moreover, in paving the future of tourism beyond 2020, the EU Communication, "Tourism and Transport 2020 and beyond" [34], claims that coastal and maritime tourism can lead to the supply of innovative and experience-based local tourism products, thus supporting business activities outside the tourist season and promoting all year round leisure opportunities for visitors. Corresponding references are made through the relevant communication on "A new approach for a sustainable blue economy in the EU – Transforming the EU's blue economy for a sustainable future" [25]. This change is to be reflected in the new tourism policy, which is currently being formulated and is expected to emphasize green and digital adaptation and remodeling of tourism, in alignment with the 2019 European Green Deal [26].

Aquaculture

The growth of aquaculture in alignment with sustainability objectives is early articulated at the EU level [52]. The fisheries and aquaculture sector nowadays lies at the heart of European agri-food policies, consisting of a key pillar for the just transition under the European Green Deal [26]. In addition, the "Farm to Fork" strategy [29] stresses the importance of the sector for tackling climate change. Towards this end, efforts towards the protection of the environment and preservation of biodiversity are strengthened; while also the reduction of use of pesticides, fertilizers and antimicrobial substances is pursued to the benefit of both the consumers and the marine environment. The European Commission aims at reinforcing the potential of sustainable fishery products as a low-carbon food source, while adopting a zero-tolerance approach to illegal, unreported and unregulated fishing [26]. Accordingly, of key importance are the "Strategic guidelines for a more sustainable and competitive aquaculture in the EU for the period 2021 to 2030" [53], seeking to push forward nutritious, healthy and of low environmental footprint food. This also addresses developmental and employment opportunities of coastal/insular areas; while, concurrently, preserves ecosystems and biodiversity, contributes to climate change combat and serves contemporary dietary trends. With respect to biodiversity protection, the European Commission intends to draw up an action plan to align fishery with the objectives of the 2030 Biodiversity Strategy. This will, inter alia, focus on limiting the use of fishing gear that is more harmful to biodiversity, including the use of tools in contact with the seabed. This target is expected to be implemented through the use of the new European Maritime, Aquaculture and Fisheries Fund (EMFF), i.e. the EU Maritime and Fisheries Policy Fund for the 2021-2027 Programming Period. Finally, of key importance are the "Strategic guidelines for a more sustainable and competitive aquaculture in the EU for the period 2021 to 2030" [53], aiming to promote a more sustainable and competitive aquaculture that keeps an important role in nutritious, healthy and of low environmental footprint food provision. As such, it can feature future development and employment in coastal areas, while preserving ecosystems and biodiversity.

5. Emerging Key Drivers of Change Framing MSP Endeavor in the Study Region

Taking into consideration the current and expected outcomes of policy guidelines at the various spatial scales, with particular emphasis on the local and the national/regional policy directions, already embedding – the one or the other way – the European ones, it seems that four distinct marine subregions can be roughly designated in MSU-1 – henceforth Marine Development Zones (MDZs) – also unveiling a varying intensity and type of land-to-sea interactions. Such a categorization – displayed in Figure 8 –, is based on the following *criteria*:

- spatial and developmental perspectives of each single MDZ and policy choices at the various spatial levels that feature the dynamics of these subregions;
- closeness among islands inherent in MSU-1;

- proximity of islands falling into MSU-1 to the mainland;
- functional relationships already established within MSU-1;
- alignment with the structure of the administrative system at the various spatial scales.

More specifically, *MDZ-1* lies at the border of the Greek state and the EU, in close proximity to Turkey. It incorporates part of the marine area of the Northern Aegean Region, within which the Regional Units of Lesbos, Limnos and Chios are located. MSP of MDZ-1 needs to consider the current productive structure of islands falling into this zone – mainly tourism, fishing and aquaculture – but also the policy directions guiding its future developments. Policy review at the various scales, in this respect, unveils as main *key drivers of change* in MDZ-1 the:

- Expansion of ports' infrastructure as well as ports' network (new ports deployment in the area); and the upgrading of Mytilene port infrastructure, classified as one of international interest. Predicted is also the rising of transport intensity/routes, an issue that can affect other sectoral uses in the MDZ-1.
- Expansion of renewable energy infrastructure for exploiting the wind potential by means of offshore wind parks' location. In particular, based on the wind potential of MDZ-1, production licenses for offshore wind farms have already been issued in the sea areas of Limnos and Agios Efstratios; while applications for the installation of additional ones are also under evaluation.
- Maritime (diving) and cruise tourism. A number of remarkable marine and coastal ecosystems are dispersed within MDZ-1, mostly related to a large number of institutionalized small island wetlands as well as an extensive network of marine archaeology, favouring diving tourism. Predicted is also the strengthening of cruise tourism and related port infrastructure upgrading for serving this activity.
- Fishery and aquaculture sectors. Taking into account the European and the national directions towards a competitive and sustainable fishery and aquaculture sector as well as its long tradition in MDZ-1, locational issues of the sector, conflicts / complementarity with other activities as well as issues of marine protection need to be carefully assessed in MSP in this specific sub-area.

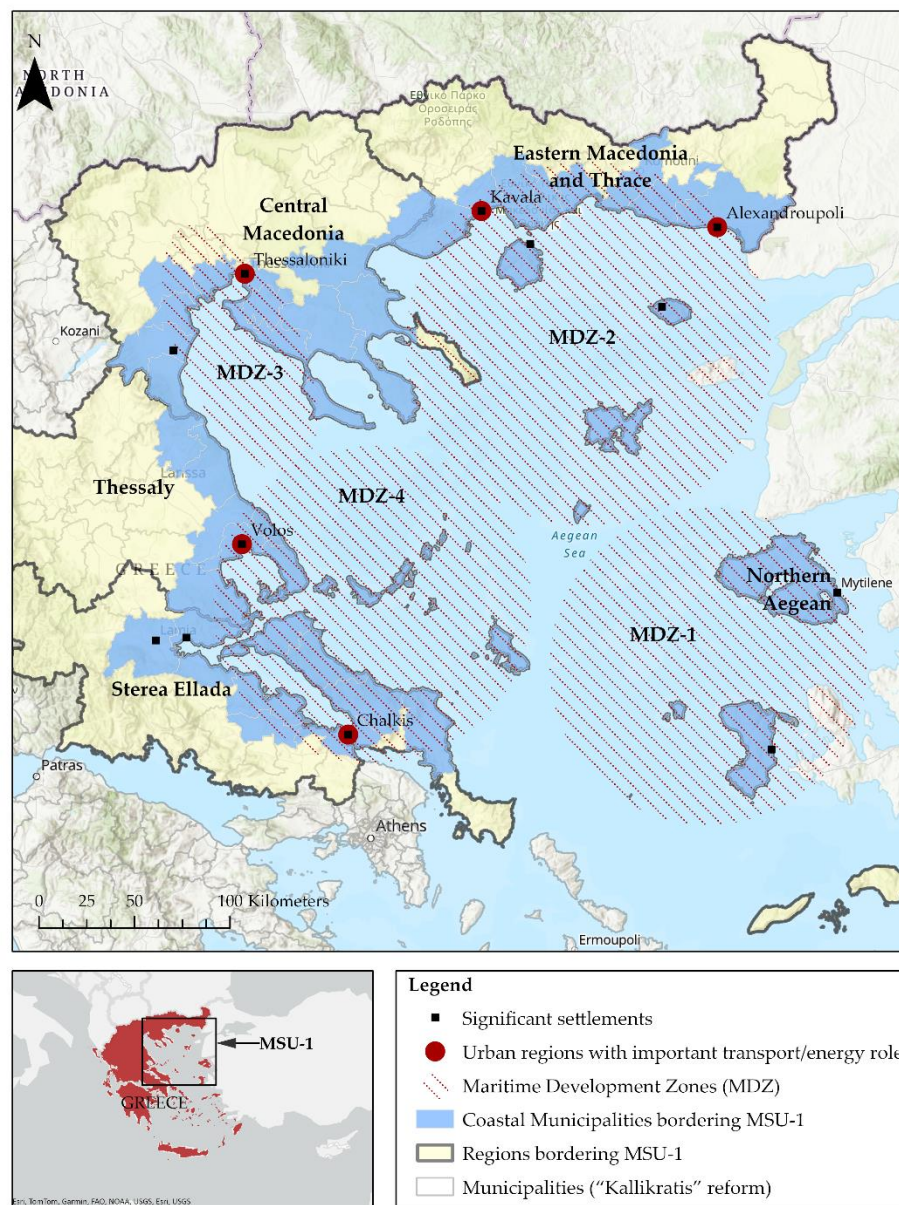


Figure 8. Indicative subregions (in circles) of distinct features for feeding the MSP process of MSU-1, Source: Own elaboration.

MDZ-2 incorporates the marine zone adjacent to the Regional Units of Evros, Xanthi, Rhodope, Kavala and Thasos Island (Region of Eastern Macedonia and Thrace). It is marked by its geostrategic position at the northeastern end of Greece, being a 'passage' for countries of the Balkan Peninsula to North Aegean Sea, and a border to Turkey. MSP of MDZ-2 needs to consider the current productive structure of this zone – fishing, aquaculture, tourism, and hydrocarbon extraction – and the policy directions guiding its future developments. Multi-level policy review demonstrates as main *key drivers of change* in MDZ-2 the:

- Extraction of hydrocarbons as well as the dynamics and potential in the field of offshore renewable energy production due to the predicted development of relevant pilot projects in this specific marine subregion.
- Location of the FSRU in the marine area bordering the city of Alexandroupoli that renders this urban center a nation-wide energy hub. This is coupled with the deployment of an underground natural gas warehouse in the marine area of Kavala. Both result in a rising burden in the marine

environment and confine choices of MSP due to port infrastructure expansion, increasing maritime transport load, deployment of land and submarine infrastructure, etc.

- Ports of Kavala and Alexandroupoli, classified as ones of international interest; and their broadening role as both transport and energy hubs of national and European scope. As such, relative land and marine infrastructure interventions are predicted; while this role is expected to severely impact the type and intensity of transport load, maritime routes and expansion of activities in both ports.
- Maritime (diving) tourism. A significant number of marine antiquities are dispersed in MDZ-2 marine area, calling for the delineation of relevant maritime uses for their protection and sustainable exploitation.
- Environmental protection. A number of remarkable marine and coastal ecosystems are also identified in MDZ-2, among which fall the prominent examples of the Evros Delta and Nestos Delta National Parks.

MDZ-3 incorporates the marine zone neighboring the Regional Units of Chalkidiki, Thessaloniki, Imathia and Pieria (Central Macedonia Region). The distinguished position of MDZ-3 as a 'passage' to the sea of Balkan countries and northeastern Europe; the commanding presence of the metropolitan center of Thessaloniki; and the highly rated and congested mass tourist profile of Chalkidiki, form the developmental physiognomy of MDZ-3. MSP in MDZ-3 needs to take into account the current structure of this sub-region and the policy directions guiding its future developments. Multi-level policy review delineates the following main *key drivers of change*:

- The evolving role of the port of Thessaloniki from a maritime transport hub of international scope to a transport and energy hub, based on the planned FSRU installation. This is expected to affect both the marine (transport routes, congestion, maritime infrastructure etc.) and the land environment (expansion of land infrastructure and range of activities, establishment of onshore cargo handling facilities, etc.), with evident implications or constraints for the marine part.
- Maritime (diving) and mass tourism. A significant number of marine antiquities are dispersed in the marine area of MDZ-3, calling for respective maritime use demarcation. In addition, certain constraints to MSP of MDZ-3 appear in the area of Chalkidiki, where mass tourism is the prevailing activity.
- Environmental protection. A number of remarkable marine and coastal ecosystems can be identified in MDZ-3, with a prominent case being the National Park of the mouths of the rivers Gallikos, Axios, Loudia and Aliakmonas; and the Kalochori lagoon.

MDZ-4 features the marine area adjacent to the Regional Units of Magnesia, Island complex of Sporades, Boeotia, Fthiotida (Region of Thessaly) and part of the Regional Unit of Evia, including Skyros Island (Region of Sterea Ellada). This marine subregion is characterized by its central position in the Greek state; the tourist identity of its coastal and insular parts; and the particularly important natural and cultural resources, located in the National Marine Park of Northern Sporades. Prevailing productive activities in MDZ-4 are tourism, fishing and aquaculture. MSP provisions in MDZ-4, apart from its current profile, need to consider *key drivers of change* that are identified by contemporary multi-level policy directions and incorporate the:

- Planned installation of FSRU in the port of Volos, which will strengthen position of MDZ-4 in the country's energy map. Such an intervention renders Volos a transport and energy hub, with evident repercussions in terms of port infrastructure and transport load expansion, range of port activities, deployment of land and submarine pipelines, etc.
- Steadily rising interest in setting up offshore wind farms and taking advantage of the significant wind potential of the region (installation of offshore wind farms in the marine area of Kymi are already at the stage of application assessment).
- Upgrading of peripheral ports falling into MDZ-4 that improve connectivity between the mainland and the islands located in this marine subregion. Examples are the ports of Chalkis as well as Kymi and Styrida, all falling into the two adjacent to MSU-1 Regions of Thessaly and Sterea Ellada.

- Seaplane transportation. Establishment of a network of seaplane ports, four of which are predicted to be located in Evia Island and one in Skyros Island (Region of Sterea Ellada).
- Maritime (diving) and mass tourism. MDZ-4 is marked by the abundance of underwater cultural heritage assets, while it hosts the first underwater museum in Peristera Island. Both raise issues of demarcation of relevant maritime uses for the protection and sustainable exploitation of those valuable resources. Mass tourism in MDZ-4, already flourishing especially in the Sporades island complex and the coastal part of the Region of Thessaly, raise also issues or set constraints to MSP choices.
- Environmental protection. MDZ-4 is home to a number of remarkable marine and coastal ecosystems, with the National Marine Park of the Northern Sporades being a prominent case. Compatibility of this Park with adjacent maritime uses is critical in this respect.

6. Discussion and Conclusions

The study of current and expected developments that can affect the future state of the coastal / marine environment, as these are demonstrated by policy analysis at the various spatial levels, witnesses that significant changes are going to take place in MSU-1 from both a developmental and a spatial point of view.

More specifically, these are associated with *maritime transport*, highlighting the nodal role of Thessaloniki, Kavala and Alexandroupoli ports as *maritime transport hubs*. These are gradually gaining international interest and are forming the northern port axis of Greece, with steadily rising importance in the context of Trans-European Transport Networks (TEN-T). Furthermore, their role as *energy interfaces* is stressed, rendering these ports both transport and energy hubs; a fact that is expected to lead to an increase in the frequency and intensity of maritime transport load in MSU-1. This maritime transport load is expected to further intensify due to the strengthening of port infrastructure in island regions in general, as well as the planned development of maritime linkages that address connectivity improvements of island regions both among islands and between islands and the mainland.

In addition, given the recent geopolitical developments and more specifically the war between Ukraine and Russia and the significant impacts this crisis entails in the unimpeded natural gas supply of the EU, the role of Greece in general and MSU-1 in particular as a *hub for Liquid Natural Gas* (LNG) transportation by sea is strengthened, further intensifying relevant maritime transport burden in the area. More specifically, the estimated changes in the route of natural gas render Greece a *transit hub*, i.e. a fact that raises issues of dedicated uses both in the sea (floating storage infrastructures in hubs, submarine pipelines serving LNG flow to land, etc.) and the coastal land (related port infrastructures); while raising intensity of maritime transport of natural gas to the floating storage tanks.

Maritime uses in MSU-1 are further expected to be affected by strategic decisions at the national level in the field of energy. In particular, Greece's medium (2030) and long term (2050) strategic energy plan, featuring a decarbonized energy mix with a focus on renewable energy production, is expected to take advantage of maritime space and promote relative *floating energy production infrastructure* (e.g. offshore wind or photovoltaic farms) in the Aegean Sea in general, including MSU-1. Locational choices of relevant infrastructures in the marine space are crucial for attaining their harmonious coexistence with other maritime uses (fishing and aquaculture, coastal and maritime tourism and maritime transport); while risks inherent as to the balance of marine ecosystems and biodiversity by such locational choices must be carefully assessed.

Additional pressure on MSU-1 seems to be exerted by *tourism*, namely a very important economic activity in coastal and island territories bordering or falling into MSU-1; and a sector significantly affecting quality of both the coastal and the marine space. Concurrently, tourism activity delimits the range of options of MSP in MSU-1 (e.g. maritime uses near coastal areas with intense tourist development), confining thus potential MSP choices. On the contrary, the underwater natural and cultural wealth of MSU-1 opens new perspectives for the development of alternative, experience-based tourist products in this area – e.g. diving tourism – with a significant developmental outcome,

especially in isolated insular areas. At the same time, it calls for demarcating relevant maritime uses. Identification of potential maritime – natural and cultural – heritage hubs and delimitation of relevant uses consists of a pillar for the protection of this heritage from other uses, but also a lever for opening up new developmental perspectives of the, usually lagging-behind, insular areas.

Last but not least, *fishing and aquaculture* are perceived as important sectors in coastal and insular areas bordering MSU-1, and a dominant activity of the island's tradition through centuries. Demarcation of appropriate maritime uses for the unimpeded implementation of these activities is a critical factor for the economic flourishing of these areas and employment support of local population, while it also constitutes a pillar for food sufficiency of island regions.

Taking into consideration the value of marine space as a vital ground in pursuing the EU's green and blue objectives and the way these objectives have been embedded – in one way or another – in the national/regional but also, in several cases, in the urban context, it seems that MSU-1 will be a rather *crowded future seascape*. Unfortunately, the decisions for many of these future interventions (e.g. FSRU) have been promoted in the absence of MSP for the Greek Seas in general and the MSU-1 in particular. This is due to several reasons, with political ones as well as governance of land-sea interactions being the most prominent. In any case, such crowded marine spaces, as seems to be the future of MSU-1, call for more thorough marine spatial planning efforts that incorporate carrying capacity constraints and recognize the limits to growth, the way these raise in the marine space.

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