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Land – Sea Interactions' Analysis: Results-Based Survey Questionnaire Design For Romanian Coastal And Maritime Stakeholder's Community

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Abstract: The evaluation of professional-participants' acting in socio-technical domain related to Marine Spatial Planning (MSP) and the exploration of LSI (Land-Sea Interactions) as main complex approach in MSP need to be addressed in the context of Romanian multi-actor network of the involved maritime and coastal stakeholders. Questionnaire-based research can approach LSI in an integrated manner, combining the expert opinion on many aspects about the complexity of land and sea processes in various specific and measurable interactions. The present analysis of the expert opinion questionnaires, combined within an analysis of LSI processes and outcomes, its shows that the comparative assessment in real and perceived environments can proved an effective and promising advance on semi-quantitative methods of professional MSP planners. Despite surveys' questionnaires are qualitative methods to assemble information regarding knowledge, facts, and expert opinions from a stakeholder community, it can provide also a semi-quantitative data and information, which can be used for further research, on different relevant MSP features and aspects related LSI within Romanian coastal and marine areas.

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1. Introduction

Under the EU MSP Directive, Member States need to develop their own MSP policies and cooperate to promote the sustainable use of marine and coastal resources. The MSP is a transversal policy tool, part of the EU's Integrated Maritime Policy, designed to provide an integrated and coordinated approach in a cross-border context to the public authorities and stakeholders. An integrated planning of human activities in the coastal and maritime areas is necessary to provide a secure framework for maritime activities to generate growth while avoiding potential conflicts over the use of marine resources. To support the implementation of Directive 2014/89 / EU of the European Parliament and of the Council establishing a framework for maritime spatial planning, the European Commission has approved some projects aimed to support the implementation of the Directive, to create the institutional background, the strategic objectives, and a vision for the Black Sea area, considering the land-sea interactions. Romania has entirely transposed EU Directive 2014/89 of the European Parliament into the national legislation by the Law no. 88/2017 on the approval of Government Ordinance no. 18/2016 on maritime spatial planning.

The various aspects related to the LSI and the implications of these aspects in ICZM (Integrated Coastal Zone Management), MSFD (Marine Strategy Framework Directive) and WFD (Water Framework Directive) are essential in the marine spatial planning process. The sea offers a wide range of goods and services essential for human existence: food, transportation, trade, cultural and spiritual aspects. The continuous urbanization of coastal areas requires the knowledge of the complex connections between human activities and marine environment, regarding the sea as a source of blue growth (Piante & Ody, 2015). Land-sea interactions are constantly shaping the human activities. Beyond the obvious economic and social aspects, the Sea has an essential role in regulating the climate issues (Santos & al. 2016). The processes that take place on the shore, create various pressures on the marine environment due to the port activities, tourism development, river sediment transport and contaminants discharge from agriculture. In turn, the sea acts on land through a series of natural and anthropogenic processes: sea level rise, extreme storms, the dispersion of contaminants from offshore activities (Schlüter et. all, 2020). An important part of the LSI analysis is the involvement of stakeholders in the whole process of marine spatial planning and the creation of a methodology designed to facilitate the analyze of opportunities and risks in key sectors like energy, fisheries and aquaculture, transport, tourism, urban development, and environment. The

understanding of the MSP aims and objectives and the expected results from the Land-Sea Interactions addressing the compatible uses, is highlighted among several stakeholders. The general evaluation of the seaward pondered (land-based) interactions shows that the environment is mainly reflected as a principal priority, but also the ecological impact was considered as main landward (sea-based) influences of the marine natural environment, as well the offshore related activities.

2. Literature Review

According to (Alvarez-Romero, 2011) "Land-sea connections include land-sea processes, the natural flows occurring between realms; cross-system threats, which originate in one realm and affect another, and socioeconomic interactions associated with management decisions to maintain or restore land-sea processes and to prevent or mitigate cross-system threats".

The land-sea interactions, economic, social, and environmental aspects, as well as safety aspects, including navigation, maritime hydrographic activity, monitoring activity are important issues in maritime spatial planning methodology development (Schultz-Zehden, 2008).

The involvement of key stakeholders in marine spatial planning is essential due to the MSP aims to achieve the three important objectives (social, economic, and environmental) and should reflect as many expectations as possible, opportunities or conflicts that arise in the MSP area (Ehler & Douvere, 2009).

In addition to the challenges already facing the MSP, climate changes will be an additional and evolving issue (Santos et. al., 2016).

The marine environment is a complex ecosystem that includes a network of ecosystems. All these work together and interact with the human component being a decisive element in ensuring the ecosystems integrity, their restoration and functioning. Maintaining the productivity and biological diversity of marine/ coastal ecosystems requires an integrated management of human activities, designed for a long period of time (Ehler & Douvere, 2007).

3. Research Methodology

The analysis-based results of a Land-Sea Interactions series of questionnaire in the study of Romanian and Bulgarian transborder area were conducted using a descriptive and exploratory methods (Stancheva, 2021). The questionnaire, which it was addressed to stakeholders grouped in public and private entities, outlined several aspects regarding Land-Sea Interaction. The analyzed sample consisted of 38 entities, 3 private and 35 public. Data processing and obtaining the indicators used

in the statistical description was performed using an exported results' Excel sheet of the SPSS program.

The questionnaire was design in three parts, first information section, second Land – Sea Interactions and third, Sea – Land Interactions. The questionnaire interpretation was considering the stakeholders' expertise on LSI relationship integration with ICZM in the MSP, comprising the perspective of them involvement in governance of the land and/or sea sectors at national level.

Thus, the questionnaire's approach encompasses the identification of the LSI relevant involved entities within the Romanian maritime spatial domain in its both marine and coastal areas, as well the stakeholder perceptions on both LSI interactions. Following the processing and questionnaire interpretation, several analyzes resulted, which were grouped into 3 large analyzes:

1. Considerations of the public and private entities perceptions on Land-Sea Interactions within the spatial domain of Romanian coastal area in the context of Maritime Spatial Planning;
2. Assessment of the participants perceptions incorporating seaward LSI influence as well as land-based activities' impact on marine environment in the context of Romanian Maritime Spatial Planning implementations;
3. Assessment of the stakeholder's perception regarding marine environment and sea-based activities influences on the Romanian Black Sea coastal area.

4. Results

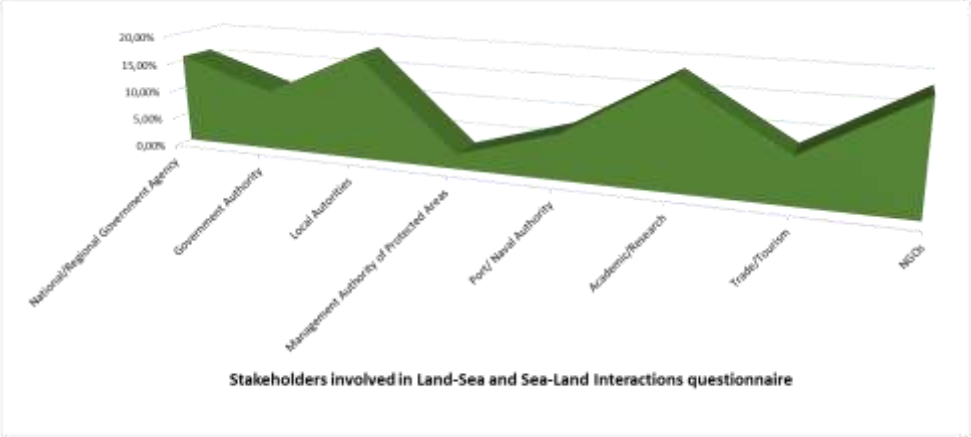
The questionnaire was design in three sections. The first section comprises general information, the second and third sections are dedicated to the LAND – SEA and respectively the SEA – LAND Interactions. After the identification of involved entities relevant for LSI within the Romanian spatial domain in its both marine and coastal areas, the stakeholder perceptions study was developed in relation with the significant priorities for Land-Sea and the main impacts for Sea-Land Interactions, in relation to the three measures/dimensions of sustainability: environmental, economic, and social.

4.1. Considerations of Public and Private Entities Perceptions on Land-Sea Interactions in the Context of Maritime Spatial Planning

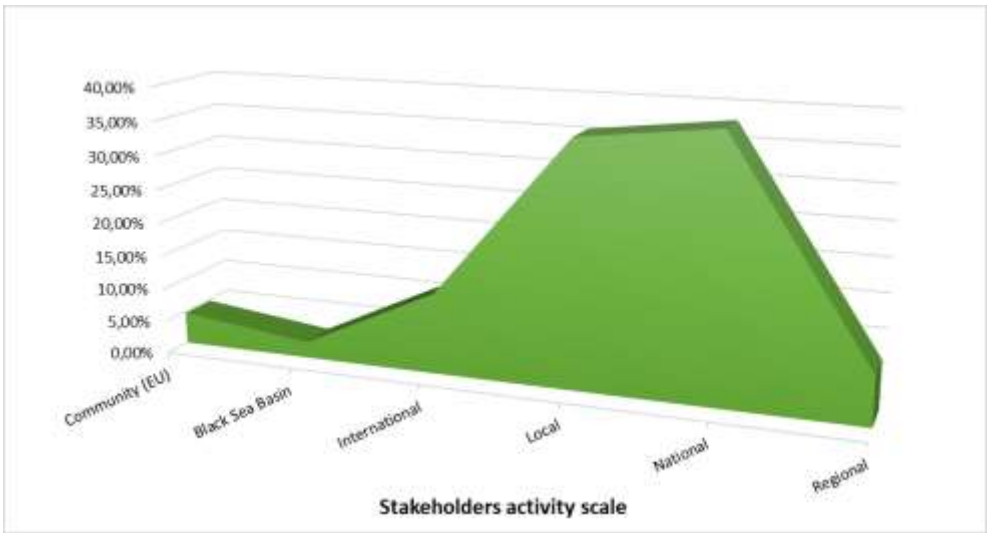
The proposed stakeholder acting in Romanian coastal zone were selected from the one's existent in the compound of the National Committee of the Coastal Zone, considering that in Romania the approach to LSI is not assimilated within MSP approaches, prevailing certain aims of Maritime Spaces Planning indistinct

delineated. The Maritime Spatial Plan does not overlap with the Master Plans of Coastal Management and Coastal Protections, thus the interactions existent between the maritime space and its afferent coastal zone are inconsistent considered for the natural processes and, uses and activities, in both conducts of two-ways, the land-sea and sea-land interactions (Alexandrov et. all, 2018).

The responding entities were national/regional government agencies, government authorities, local authorities, protected areas management authorities, port/naval authorities, academics/research institutes, non-governmental organizations, tourism authorities and others, including 3 private entities.



Participants' activities were mainly focused on the national and local scale (74% in common ground).



4.2. Participant's Perceptions Assessment Incorporating Seaward LSI Influence and the Land-Based Activities' Impact on Marine Environment in the Context of Romanian Maritime Spatial Planning Implementations

These analyses made possible the identification of certain key data for mitigation and integrated-based management actions for main importance domains:

Marine Fishing was considered as an intensively present activity in the marine coastal areas. It has a strong economic priority (64.1%), to be regulated properly, as well its ecological impact (57.5%) on the water-mass of the coastal area, since fishing vessels operate at the sea both near the shore and offshore and often, they "lose" the gears with severe consequences on marine ecosystems (ghost fishing).

Coastal and lagoon Aquaculture, or intensive fish or shellfish farming involving organic material/solids and nutrients discharge in the marine environment or dangerous exotic species (like African catfish) and is recognized as potentially causing ecologic degradation rather an economic or social priority, probable due to its low representation at storm exposed Romanian littoral, with various challenges regarding economic sustainability (Gheorghe et. all, 2017).

Fishing in the coastal lakes has appreciated to more than 50% as an ecological priority rather than is social or economic ones for the coastal community, being a source of marine litter that is discharged in the coastal environment.

Use of natural resources as ecosystem service was considering as having 70% ecological priority than its economic (63%) and social (55%) ones, due to their effects on the environment, and overexploitation trends.

Agriculture and Animal farming beyond environmental pressure statute, due to its economic significance are considered as Economic priority (75% of general opinion) and social priority (60%). The importance of the agriculture in Dobrogea region rural areas along the coast due to chernozem soil type predominance needs low usage of fertilizers, with low potential of impact on coastal natural areas providing important habitats for the life cycle of species dependent on the marine environment due to lack of rivers (in a semi-arid region) but farming often is affecting ground waters and drinking water sources.

Industrial activity even is linked with low water quality and pollutants loads as ecological priority (of 58%), it was evaluated as economic (80%) and social (74%) priority within Romanian coastal area.

Renewable energy industry with a strong ecological priority (76%) and extension interdiction in the offshore areas, the activity has a strong economic priority (80%), tacking in consideration its remarkable development (more than land 5000 pieces of installed wind-propellers), requiring a designation of large inland areas, together

with extension of electrical-grid for energy distribution, as infrastructures on the coast, far from shoreline.

Extraction of oil and gas, despite its economic priority (69%), the activity was categorized at 50% ecological priority consideration, involving several support actions associated with high technological risks, related to refrainment of raw materials, transportation of fuel, and interdiction of the gas extraction through fracture method in the Romanian coastal area.

Port activity and associated coastal protections as principal activity related to maritime transportation the activity was ranked to 82% economic priority and 76% ecologic priority due to its involvement at Constanta City socio-economic importance, supporting jobs and transportations and housing/urban development sectors. But the extensions of ports as marine obstacle were the main cause of coastal erosion, as a significant issue and risks with a strong socio-economic impact, as they can destruct coastal infrastructure, generated by coastal sediments drift interruptions along the coast, thus requiring in consequence protection works extensions as corrective actions and important financial support to strength the coastal protection infrastructures in the context of climate change.

Transport considered as connected to maritime transport Danube-Black Sea channel/Danube River transport is including a very relevant demands in terms of space on land, inland port facilities and land connectivity infrastructures, thus connecting land and marine ecosystems through transport vectors from land to sea with an evaluated relative ecological importance (of 55%) but with large (more than 80%) of socio-economic priority.

Tourism and recreational activities, with a continuous increase significance, the activity is reduced at three months by the seasonality of temperate climate. Touristic activity was considered as a large priority activity for regional and local coastal economy (77%), despite its low level of maritime-related activities and local employment, and its ecologic pressure (73%) on the natural ecosystem, in relation with deterioration of water quality, marine litter massive/punctual sources, loss coastal habitats and high changes in salinity regime (tripling of sewage water input during summer season).

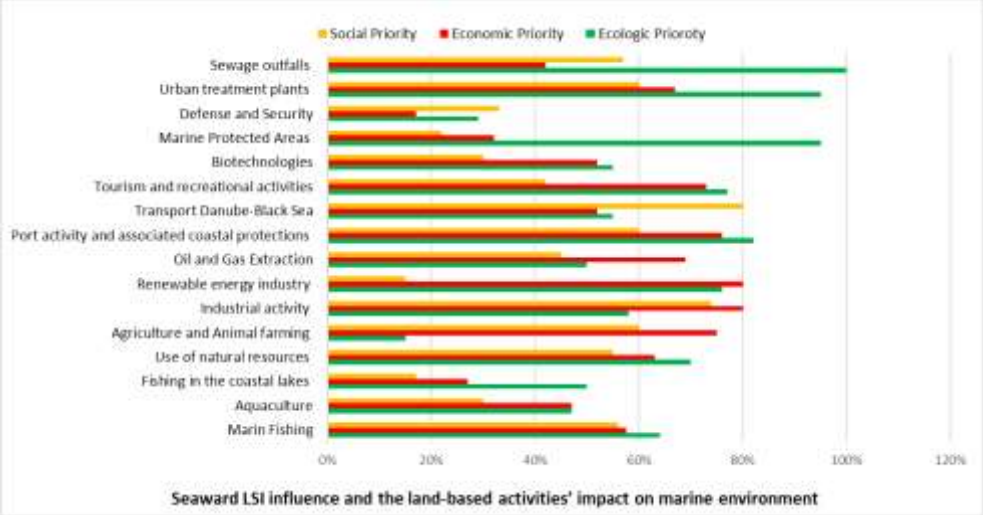
Biotechnologies was ranked with 55% ecological priority, considering its impact on coastal and marine ecosystems/biodiversity reduction by exploitation.

Marine Protected Areas as national parks, onshore or with offshore boundaries, were considered 95% with large ecological priority, due to them purposes in coastal and marine conservation in relation with the marine environmental protection having regional sustainability goals.

Defense and Security areas were categorized positive in relation with social aspects priority (medium 33%), despite its large negative impact on marine ecology (29%).

Urban treatment plants as well as residues/wastewater discharge, despite the extension and modernization of the associated infrastructure were ranked with large 90 and 95% Ecological priority, tacking in consideration its negative impacts on the environment, including marine chemical and biological pollution and pollution of the sea bottom along coastline.

Sewage outfalls was considered as principal coastal pressure with strong impact causing deterioration of water quality, including water quality of the bathing areas, due to its input/loads from concentered land-based sources, and in consequence graded with 100% ecologic priority, despite of its 57.1% large and 42.8% medium socio-economic priority.



Seaward LSI influence and the land-based activities' impact on marine environment

4.3. Assessment of the Stakeholder's Perception Regarding Marine Environment and Sea-Based Activities Influences on the Romanian Black Sea Coastal Area

This analysis was asking an extra effort due to the complex interactions encompassed. Thus, certain main processes and impacted capacities of activity were delineated for Romanian coastal and maritime areas:

Soil/coastal erosion is one of the most significant processes under direct influence of the climate change in relation with wind force, wave's hydrodynamics, and sea level rise, but also with the anthropic unbalanced sediment supply is a main cause. Impacts of coastal erosion on coastal ecology was considered a large one (67.6%), due to the loss of coastal and marine habitats (biodiversity) and loss of landscape attractiveness, effects on touristic or transport infrastructure protection or for protection/re-constructions, with significant socio-economic efforts.

Environmental degradation is produced by the intensification of marine originated factors, being linked to marine and coastal (land - sea interface) habitats due to intense sediment deposition/erosion processes changing and transforming coastal wetlands, lagoons and Danube Delta saline regime or producing the intrusion of salty water in coastal aquifers. Natural landscape specificity and coastal biodiversity can be affected. Thus, the environmental degradation was rated with large ecological and social impact (circa 95%).

Hydrogeological instability of coastal cliffs erosion (landslide under wave or ground water influence) or underwater alluvial slope collapse (including Danube) can be accelerated by landward LSI, thus determining negative impacts on ecology but also in social aspects (both having an evaluation rank of circa 85%).

Transport of river sediments is a natural process, not a continuous one, being strongly influenced, within a transitional (between land and sea) system of Danube Delta, by the fresh-salty water interface dynamics at the river mouth, linked with river hydrological regime and sea state, including sea-level rise.

Floods as exceptional or seasonal events even is a characteristic of an impacted environment (now only medium ranked at 57%) by storms and precipitations regimes, which strongly influence the coastline dynamics through discontinuous sediment dynamics, and from these consequently impacting the coastal tourism and beach management/coastal protection activities with strong economic (57.1%) and social (71.4%) impacts at Romanian coast.

Marine originated flooding represents a secondary economic and social importance LSI because it is the coastal wetlands of Danube Delta Biosphere Reserve, as a seasonal natural process without strong impacts on human activities which locally and regionally are not well represented in the area.

Tectonic activities are a landward LSI due to the risk of earthquakes, tsunamis, remodeling of the coasts, and coastal shapes/relief, such as the sand barriers, river bars, stream beds in relation with the coastal habitats/environmental impact, but also with coastal infrastructure/heritage, having a terrific social impact (80%) on human life and coastal economics (65%).

Seawater aquaculture/mariculture is an extensive/artisanal/in early-stage industry at Romanian littoral, in Eforie North touristic resorts without affecting hydrodynamics around the farm but using the sheltered conditions of Constanta Port south jetty. The Aquaculture increases various challenges regarding economic priority due to its low impact, even this perception is largely considerate as an environmental issue (around 64%) without social importance (39%). Because the domain is new but in an advanced research stage, that involves the exotic/freshwater species accommodation within a wide exposed shore and strong variable saline

regime of the western Black Sea, in the present climate changes effects, it will have several challenges due to its moderate social priority.

Marine fish procurement within small industrial fishing efforts is determined by social preferences (45%), and it is impacted directly by marine weather/wave's regime and associated hydrodynamics at sub-mesoscale. The professional and recreational fishing at sea, river, and lagoon afferent to the Danube delta coast, were qualified according to a large economic priority and impact (63%), due to its degree of seasonality on a corridor of river-influenced fish migrations.

Oil and gas Extraction from the sea as an intense pressure in the present, generated by new stokes discoveries at higher depths of continental slope of the Romanian shelf, this interaction have s strong impact on economics (79%) bigger than environmental one (55%) due to its associated risks of the accidental oil spills, potential navigation accidents (risk of collision between ships and marine mammals) in an easy setup water waves/sea-state. The sector represents a risk also for the interaction of coastal land-based activities, categorized in a medium range (45%).

Infrastructures of the Romanian seaside is related to the coastal infrastructures represented by the maritime ports of Constanta, Midia and Mangalia, in direct linkage with the development of the European maritime traffic corridors and maritime activities (fisheries). Positive large impact on the economy (71.4%) is compensated by an ecologic priority for green ecological infrastructure improvements (ranked at 85.7%).

Submarine cables and pipes requires an assessment of involved LSI as highly relevant human economic activity with a large priority (60%), under the influence of marine and coastal hydrodynamics and anoxic regime extension at lower depths of the western Black Sea.

Dredging and storage of materials having an increased risk of dissipation or suspension caused by hydrodynamics intensely impacted by climate change, there are maritime activities ranked with large ecologic priority of mitigation of about 55%, despite its large/medium 45% economic priority/activity at "sea" interacting with "land".

Sea ports are affected directly by extreme wave regime under present climate change, its extreme storm return periods at 100% are expected to consistently affect some of those coastal/maritime transport hubs with significant implications on coastal infrastructure maintenance serving maritime activities with economic (90%) and social (61%) priority, particularly within ports jetties or defense breakwaters with ecological large effects of 50% in adjacent areas.

Maritime tourism activities, such as cruise tourism or leisure boating, represent, in particular, a medium social priority (58%), being in the same time an increased source of pressure (75% cumulus of large and medium ecological priority of

mitigation) on the coastal natural ecosystem of the western Black Sea Basin, causing water quality issues (sewage), marine litter/diffuse solid waste, shoreline and landscapes specificity damage, loss of biodiversity (species and habitats), changes in noise level/pollution as well.

Maritime recreational and sporting activities interactions among sea and land uses and activities, are linked with a specific infrastructure/installations or support activities expanded to the sea as well, thus under sea state variability categorized with large economic priority in the Romanian waters.

Marine biotechnologies have an economic with large (51%) significance, as services, information with large ecological pressure (72%), representing the human advanced research on the marine environment remedies with medium social priority of 50%, through sea-based activities of under the great challenges of new climate change.

European designated marine protected areas related to most of the vulnerable marine and coastal habitats related to large ecologic priority graded at 88%, is very influenced by sea-based human activities as fishing, navigation and littering, drilling/oil extraction and afferent activities, having large negative social impacts (55%).

Marine defense and security were perceived as having low ecologic significance, rather than social one (42%), based on employment in military maritime sector, in relation with intensity of landward influences of sea state/regime, impacting the sea water characteristics, as well as coastal sediment texture.

Wastes coming from diffuse source landward, due to shipping, cruise tourism and extraction industry aggravating water and noise pollution, as well as increasing solid plastic wastes and various marine litter, thus having an outsized (ranked at 80%) ecological and social impact, due to its contamination of the coastal water and habitat quality with damage of landscape attractiveness, and coastal tourism and beach-based activities in consequence.

Extreme events (storms, floods, tsunamis) from deep sea can involve huge energy of the interactions from sea to the land, in the case of involvement of a large economic (71.4%) and social (100%) priority for a rapid action for defending is crucial, and its associated medium ecologic priority of adaptation (85.7%) to extreme weather conditions inducing marine flooding events is responsible of infrastructure improvements for mitigation of effects on coastal tourism and marine protected areas/MPAs.

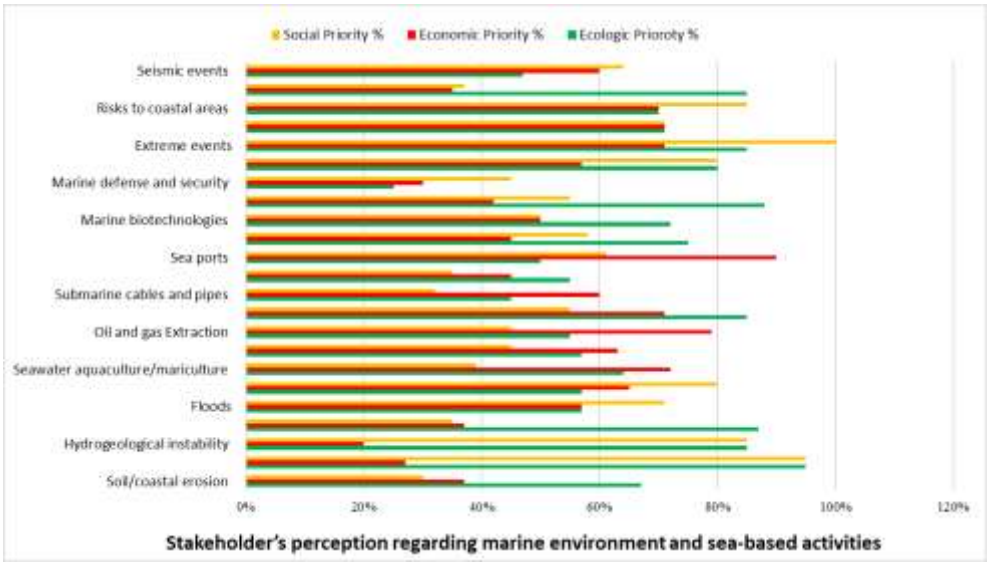
Sea level rise (global and local) as a climate changes indicator, it is associated with coastal erosion, intense storm surges induced linked with the occurrence of extreme events, by future climate changes thus exacerbating the existing hazards. The proposed large ecologic and social priority of action, placed at 71.4%. The economic

priority of this key LSI interactions can be considered in vulnerability and hazard assessments at medium 71.4% priority as well, because loss of coastal infrastructures related to tourism/housing facilities is leading to significant economic loss).

Risks to coastal areas (coastal erosion, floods/ saline marine intrusions) has a large ecologic, economic, and social significance (70-85%), based on the intensity of landward influences, thus bringing severe movements of goods, services, information, and people through coastal areas, with a vulnerable infrastructures, environment, cultural heritage, and economic activity.

Algal bloom and its extreme case, **Eutrophication** are both under the influence of underwater light regime as well under nutrients loads enforced by the up-welling phenomena, as a consequence of changing in wind predominance relative to the Romanian shoreline/coast orientation. Due to its ecological impact (85.7%) on coastal biodiversity related to extreme anoxic regime, these LSI are well monitored by CMEMS.

Seismic events are well monitored on Romanian shelf by Emso-Euxinus network focused on seismic risks. This interaction can spread both from land to the sea and from sea to the land depending on its epicenter. Seismic events have strong impacts on social (64%) and economy (60%) despite its effects the coastal/inland environment in case of tsunami. But the tsunamis are rare if not impossible events due to a extremely wide shelf and the placement of the continental margin at around 200km seaward, which can dissipate the impact of a long-wave through breaking far from the shoreline.



Stakeholder's perception regarding marine environment and sea-based activities

5. Conclusions

Despite their limitations of a questionnaire-based survey, designed for stakeholder community acting in coastal and maritime Romanian zone, the subsequent analyses were developed in relation with the key priorities for Land-Sea and Sea-Land Interactions' main impacts, towards a qualification relative prepared to the three significant dimensions of sustainability: environmental, economic, and social. Therefore, the results of the questionnaire survey were appropriately interpreted within a successive evaluation based on selection of several degree of impact on the environment or the socio-economic activities. In the selection of the LSI keys components encompassing land or maritime economic activities and natural processes involved in the two-way interactions, it was considered the stakeholders' expert perspective, having certain implicit mitigation actions for significant identified impacts.

The general evaluation of the seaward pondered (land-based) interactions shows that the environment is mainly reflected as a principal priority, and the ecological impact was considered as main landward (sea-based) influences of the marine natural environment, and offshore related activities, as well (Mateescu, 2017).

Furthermore, several responding entities were given emphasis to those existent interactions between the maritime space and its afferent coastal zone, considering as inconsistent the changes of the natural processes, marine resources uses and socio-economic activities, in both ways conducts' interaction, the land-sea and sea-land interactions.

Afterwards, both LSI interaction were pass through a number of criteria to be identified in order to delimitate the area of LSI analysis in the specified Romanian zone of interest, in correspondence with a semi-qualitative scale, considering "functional scope" of LSI, dependent on physical characteristics, human activities and natural and anthropogenic processes, as well as on the maritime governance aspects.

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