Economics in Marine Spatial Planning

Subjects: Environmental Sciences

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There has been a rapid increase in the use of Marine Spatial Planning (MSP) worldwide, partly due to the continued loss of marine biodiversity and habitat. The sustainability of marine resources is threatened in all regions of the world by major events such as climate change, marine pollution, and overfishing, as well as illegal, unreported and unregulated fishing both on the high seas and in country waters.

Keywords: marine spatial planning ; decision support tools ; economic analysis

1. Introduction

Amidst growing threats posed by climate change and pollution in our oceans, the expanding utilization of marine zones for diverse activities such as fishing, transportation, and recreation holds the potential to negatively impact the habitats of marine life, biodiversity, and the vital food security of numerous coastal communities worldwide. Consequently, this issue has ignited a heightened consciousness regarding the need for responsible management of marine areas, both within national jurisdictions and on the high seas [1][2]. Over the past two decades, marine spatial planning (MSP) has become one of the most widely adopted management approaches used to address serious damage to marine areas while improving the well-being of people whose livelihoods are directly linked to these areas. When adopting an MSP strategy, policymakers typically identify a variety of reasons, ranging from environmental and biological to political, socio–economic, and national security.

2. Economic and Social Aspects of MSP

2.1. Main Socio-Economic Aspects Included in MSP

In a recent study, a strong observed interconnection between ecosystems and marine spatial planning (MSPs) was emphasized, drawing on ecosystem-based management [3][4][5][6][7][8][9]. This underscores the pivotal significance of interactions within an ecosystem, not only for MSPs but also for other spatial planning strategies [10].

The integration of human activities into MSPs involves a critical aspect: defining undertakings within the marine environment. Socio-economic factors considered typically include traditional pursuits such as fishing, shipping, transportation, and tourism, alongside emerging sectors such as offshore wind energy, mariculture, dredging, mineral extraction, and biodiversity conservation. MSPs often encompass elements such as land use and zoning, social indicators (e.g., population, age, measures of livelihood sustainability), and economic parameters (employment, monthly income per inhabitant) [11][12][13].

Over recent decades, MSPs have evolved from simple zoning plans to complex, integrated, adaptive, multiple-use planning [14][15]. Important regulatory changes, such as the European Union (EU) Directive 2014/89/EU on MSP, have significantly shaped these initiatives [16][17][18].

The European Maritime Spatial Planning Platform highlights the importance of incorporating socio-economic aspects into MSP to reduce or avoid conflicts between economic and non-economic functions and pressures. It also emphasizes the need to consider socio-economic information in MSP data and assessment tools, land–sea interactions, and MSP for blue growth, as well as the challenges and recommendations for integrating socio-economic input into ecosystem-based MSP [13].

The World Bank provides a comprehensive and integrated investment framework for the blue economy through MSP, aiming to reduce investment risk, improve investor certainty, and address environmental and social issues. The World Bank's guidance note Applying Economic Analyses to Marine Spatial Planning offers tools and data for a robust economic analysis of the MSP process, highlighting the potential benefits of such analyses in fostering livelihoods, attracting finance, and drawing financing for marine projects within the blue economy [19].

The literature highlights a challenge in MSP, where socio-economic aspects are not consistently considered, with a predominant focus on environmental dynamics. However, recent developments indicate a growing prominence of social aspects in MSP considerations [20][21]. Concepts such as social sustainability, social equity, social dimensions, and ocean justice are gaining recognition, supported by case studies in various regions [22][23][24][25][26][27][28][29][30][31]. Despite the breadth of the subject matter, **Table 1** provides examples of the socio-economic aspects addressed in the analyzed case studies.

Table 1. Examples of social and economic aspects considered in MSP.

A. Uses of space, economic activities development, and well-being of coastal communities
Population of the area
Activities development in the marine space
Gross value added (GVA) by sector of maritime activity
Contribution of the sea economy to the GDP
GDP/capita of coastal residents
Employment rate of coastal population
Employment in maritime sectors
Poverty, family well-being, gender, health, and education levels
Conflicts in the use of maritime space by type and frequency
Distribution of the income in the economies onshore
Numbers of users of the space (e.g., tourism and recreational activities)
Community and citizen participation
B. Preservation of social and spiritual values related to ocean
Sites and protection of cultural heritage (also underwater heritage)
Seascape and landscape
Establishment and protection of culturally significant areas for the immaterial cultural values (e.g., definition of cultural values, identification of places of cultural significance, establishment of the relative importance of places of cultural significance)
C. Social justice, ocean equity, and social sustainability (recognition, representation, and distribution)
Acknowledgment of and respect for pre-existing governance arrangements and history
Acknowledgment of and respect for the distinct rights and diversity of needs, worldviews, and lifestyles
Access to the resources and benefits distribution (distribution of benefits, risk and harm of decisions, as well as access to resources, with a particular emphasis on vulnerable groups)
Equity and fairness of the systems (e.g., equality and inequality changes across communities and groups)
Livelihood sufficient, living standards (e.g., education and employment opportunities)
Safety and security (e.g., protection against climate change events)
Democratic governance and meaningful inclusion of sociocultural values (e.g., participation in decision-making, consideration of individual and group values)

Source: Summarised by authors in [20][21][23][25].

2.2. Different Uses of Socio-Economic Aspects in MSP

Social and economic aspects can be included in MSP for different purposes and in different stages, such as planning, development, maturation, and implementation. To include these aspects, multiple strategies can be followed, and DSTs can be used.

The active involvement of all stakeholders in the planning process stands as a central strategy for effectively incorporating socio-economic aspects into MSP, a subject extensively examined [32]. From the engagement of local actors to navigating conflicts among influential entities, including both companies and governments, the convergence of stakeholders presents one of the most intricate challenges for MSP. A Danish case study underscores the importance of understanding power dynamics within MSP, shedding light on how these dynamics shape winners and losers [33]. Through discursive analysis of planning-related documents, regulations, and news reports, the study unveils the mechanisms of power at play and their impact on the MSP process. Notably, the study highlights that those sectors capable of providing more data gain power advantages due to the emphasis on data acquisition and stringent timelines.

Another case study, focusing on the Northeast Ocean Planning process in the US, particularly in Massachusetts Bay, emphasizes the imperative to assess the democratic and inclusive nature of MSP processes to ensure effective participatory engagement [34]. A current study delves into the deeply ingrained traditions and values within planning teams, referred to collectively as planning culture, across three Northern European countries (Denmark, Norway, and Germany), elucidating how planning culture influences MSP [35]. Other case studies further scrutinize stakeholders' social and economic values and perceptions concerning new marine environment situations, such as the introduction of human-made structures [36].

The socio-economic dimensions are not only considered during planning and evaluation but also play a crucial role in monitoring phases. A framework of analysis through the EU-funded MESMA project facilitates monitoring and evaluation in diverse marine areas across Europe [17].

Cross-border resource management poses a unique challenge for MSP, requiring the harmonization of different political, economic, and social perceptions and objectives across multiple jurisdictions. Many studies have explored various aspects of transboundary MSP, such as defining management authorities, establishing international good practices, and providing evaluation frameworks for institutional integration [37][38][39][40].

Numerous case studies shed light on specific initiatives related to cross-border cooperation, including the SINMORAT project in Spain, Portugal, and France [41], transboundary MSP in the Bay of Biscay [42], and collective action in the Baltic Sea MSP [43]. These initiatives offer insights into challenges and solutions related to social acceptability, ecological and social/management scale mismatches, and joint risk assessments.

A critical aspect of MSP involves securing adequate funding for establishment and management. Economic analysis plays a crucial role in attracting funding, considering long-term policies and financial sustainability throughout the planning, monitoring, evaluation, and revision phases [39]. Funding sources range from government budgets and private sector financing to innovative mechanisms such as blue bonds, foundation funds, and trusts [14]. The importance of aligning funding mechanisms with MSP objectives is emphasized to ensure financial support and sustainable implementation.

Incorporating new activities into marine space, such as marine renewable energies, is a significant challenge addressed by various case studies. These studies analyze factors such as anticipating pressures on ocean energy [44], legal challenges and opportunities [45], institutional barriers, planning priorities in a climate neutrality era [46], and local stakeholder opposition [47].

2.3. Socio-Economic Aspects in the MSP Decision Support Tools

In the context of MSP, the effective utilization of DSTs is crucial due to the dynamic nature of maritime space and the diverse interests and conflicts among stakeholders. A comprehensive global review analyzed 34 DSTs employed in 28 MSP initiatives. The findings revealed varying levels of complexity, applicability, and challenges such as limited functionality, tool stability, costs, and the consideration of economic and social decision problems [48]. DSTs should address spatial and temporal dynamics, and be multifunctional, user-friendly, and freely accessible. Geospatial DSTs, utilizing technologies such as GIS/spatial analytics, global navigation satellite systems, earth observation, and others, play a central role in data collection, planning, and environmental monitoring [49].

A study explores the impact of regulatory frameworks, specifically the Directive on MSP, on spatial and non-spatial DST development. The study highlighted the importance of addressing challenges related to uncertainty and incorporating artificial intelligence. [50]. Geospatial technologies, encompassing various tools such as LiDAR, radar, and sonar, are essential for the development of DSTs [49].

DSTs are instrumental in data collection, planning, and monitoring, encompassing socio-economic aspects for detecting areas of specific human uses and pressures [48][49][50]. They facilitate the development and comparison of alternative scenarios for identifying 'least-cost' solutions and conducting benefit–cost analysis for management measures.

The use of DSTs relies on cumulative impacts assessments (CIA) or cumulative effects assessments (CEA). Challenges include avoiding double counting and addressing complexities and confounding impacts. Innovative models, combining human pressure data and GIS platforms, provide visual representations to support decision-making [51][52].

Various methods, such as the Delphi method, soft systems methodology, and Bayesian modeling, are employed in MSP management [27][35]. Initiatives such as ocean accounting (OA) integrate economic information into MSP, organizing ocean information to support the integrated consideration of social, environmental, and economic values [53].

End-user perspectives on DSTs in MSP emphasize the importance of tool-user interaction and a publicly accepted MSP workflow. Users seek tools with multifunctionality, integrity, and ease of use. Challenges include the underrepresentation of socio-economic information in spatial data, often presented qualitatively and in non-spatial formats [54]. To address these challenges, a participatory mapping approach is proposed [55], collecting stakeholders' knowledge and opinions and translating them into spatial data for a comprehensive representation.

3. Application of Economics to Inform MSP Decisions

Examining the potential trade-offs between current and future competing uses of ocean space in monetary terms is integral to effective MSP. Cost and benefit estimation should encompass the full implications of MSP actions, incorporating intrinsic and nonmarket values [56]. Resource allocation in MSP often involves trade-offs, as a portion of marine space allocated to one activity, such as a wind farm, may preclude allocation to other uses, such as oil extraction [57]. Economic desirability, from a social standpoint, is contingent upon overall benefits outweighing costs [57].

Policy-oriented economists utilize models of social conflict to explore how MSP can facilitate win-win situations and resolve conflicts among ocean users. A trade-off analysis focused on alternative ocean uses for the Massachusetts Ocean Management Plan assessed conflicts between offshore wind energy, commercial fishing, and whale-watching sectors, and revealed the potential for preventing losses to the incumbent fishery and whale-watching sectors while generating extra value for the energy sector [7].

Apart from CBA, economic tools such as participatory assessment and spatial software packages such as Integrated Valuation of Environmental Services and Trade-offs (InVEST) 3.9.0 (https://ecosystemsknowledge.net/resources/tool-assessor/invest-integrated-valuation-of-ecosystem-services-and-trade-offs/) are employed to assess MSP's impact on biodiversity and ecosystem services. For instance, in Belize, InVEST was used to analyze trade-offs resulting from alternative Integrated Coastal Zone Management Plan scenarios, aiding decision-making in favor of informed management [58].

Evaluating potential contributions to jobs and incomes generated by various MSP sectors involves using input–output economic tools. A novel study utilized IMPLAN modeling systems to calculate the economic contribution of Washington State's marine sectors, offering insights into the economic impacts of alternative scenarios on both the coastal region and the entire state [59]. Adaptive management, recognized as crucial to MSP evolution, has been effectively employed in countries such as China, Australia, Norway, Germany, Belgium, the Netherlands, and the United States [60][61].

An essential economic question focuses on MSP's role in achieving blue economy goals. An impact pathway assessment helps identify critical policy entry points to reduce agrochemicals or plastic waste in the ocean in Costa Rica [62].

Understanding the true costs and benefits of MSP implementation involves identifying beneficiaries and cost bearers under different scenarios. Considering the differentiated impact on indigenous groups, local communities, and businesses, as shown in Washington's MSP process, helps reduce conflicts and enhances buy-in [59].

Effectively evaluating MSP outcomes is crucial for design and implementation. Causal links between MSP and measurable outcome indicators should be established, considering impacts on poverty dimensions, livelihoods, food security, and wealth generation. Learning from the experience of evaluating MPAs, which has shown economic cases for public investments to improve biodiversity and economic development, can inform MSP evaluation strategies [2][63].

Several economic tools have been identified in the literature as effective in addressing gaps in MSP. These tools aim to integrate economic considerations into the planning process, ensuring the sustainable and inclusive development of marine resources. Some of the key recommendations and case studies from the literature include:

European Maritime Spatial Planning Platform: The platform discusses DSTs in MSP and their present applications, gaps, and future perspectives. It highlights the importance of DSTs in assisting planners with various stages of the MSP process, such as refining goals and objectives, evaluation, and monitoring. The study suggests that future DSTs should consider both spatial and temporal dynamics of the marine environment [42].

The World Bank's MSP Toolkit: The World Bank provides a comprehensive toolkit for MSP, emphasizing the integration of economic considerations to support sustainable and integrated development of economic sectors in healthy oceans. The toolkit includes guidance on applying economic analyses to MSP, which is essential for attracting investment, fostering livelihoods, and improving food security [19].

Several case studies have been conducted to assess the economic impacts linked to MSP using various economic tools, such as input–output techniques. These case studies, such as the German Baltic Sea, Belgium, and the North Sea and the Skagerrak Strait of Norway, provide practical examples of how economic tools have been effectively utilized in the context of MSP [11].

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