Chin. Geogra. Sci. 2024 Vol. 34 No. 4 pp. 599−617
https://doi.org/10.1007/s11769-024-1440-y

Springer Science Press
www.springerlink.com/content/1002-0063

Adaptive Integrated Coastal Zone Planning: History, Challenges, Advances, and Perspectives

WANG Xinyi[1, 2], SU Fenzhen[1, 2], WANG Xuege[1, 3], PAN Tingting[1, 2], CUI Yikun[1, 3], LYNE Vincent[4], YAN Fengqin[1, 2]

(1. *State Key Laboratory of Resources and Environmental Information System*, *Institute of Geographic Sciences and Natural Resources Research*, *Chinese Academy of Sciences*, *Beijing* 100101, *China*; 2. *College of Resources and Environment*, *University of Chinese Academy of Science*, *Beijing* 100049, *China*; 3. *School of Geography and Ocean Sciences*, *Nanjing University*, *Nanjing* 210023, *China*; 4. *Institute for Marine and Antarctic Studies*, *University of Tasmania*, *Tasmania* 7004, *Australia*)

Abstract: Coastal zones are dynamic, rich environments, now densely populated, and increasingly challenged by human and climate-change pressures. Effective long-term integrated coastal zone planning is needed to ensure sustainable environmental protection and economic development. In this study, we reviewed the history of coastal zone planning since its birth in the 1950s based on the literature retrieved from the Web of Science (Core Collection) from 2000–2023, then summarized the tools and spatial allocation methods commonly used in the planning process, and finally proposed potential solutions to the challenges faced. The results show that after decades of development, coastal zone planning has changed from a decentralized activity to a targeted and integrated one, with an increasing emphasis on the ecosystem approach and the use of multiple planning tools. Spatial analysis techniques and environmental modelling software have become increasingly popular. Linear programming and overlay analysis are common approaches when performing spatial optimization, but land-sea interactions and planning in the marine parts still lack in-depth analysis and practical experience. We are also aware that the challenges posed by the integration of administrative hierarchies, scoping and conservation objectives, stakeholder participation, consideration of social dimensions, and climate change are pervasive throughout the planning process. There is an urgent need to develop more flexible and accurate spatial modelling tools, as well as more efficient participatory methods, and to focus on the holistic nature of the land-sea system to create more resilient and sustainable coastal zones.

Keywords: Integrated Coastal Zone Management (ICZM); coastal zone planning; spatial optimization; ecosystem-based management

Citation: WANG Xinyi, SU Fenzhen, WANG Xuege, PAN Tingting, CUI Yikun, LYNE Vincent, YAN Fengqin, 2024. Adaptive Integrated Coastal Zone Planning: History, Challenges, Advances, and Perspectives. *Chinese Geographical Science*, 34(4): 599−617. https://doi.org/10.1007/s11769-024-1440-y

1 Introduction

Coastal zones, comprising shallow seas and variable-land buffers (Lu and Ai, 2001), interface humans to coastal ecological services including: carbon storage, biodiversity conservation, hydrological regulation, and marine resources. It is estimated that with despite its small footprint of 7.6% of ocean areas, coastal zones contribute 30.0% of global marine primary productivity, more than 80.0% of marine resources, and 50.0% of blue carbon sink (IPCC, 2022). Under pressures from population growth, climate change, and accelerated sea level rise, coastal living resources are now seriously affected by land-based activities. Degradation of coastal

Received date: 2023-11-15; accepted date: 2024-03-06
Foundation item: Under the auspices of National Key R&D Plan (No. 2022YFB3903604), the Youth Innovation Promotion Association of Chinese Academy of Sciences (No. 2023060), Key Project of Innovation LREIS (No. KPI001)
Corresponding author: YAN Fengqin. E-mail: yanfq@lreis.ac.cn

ecosystems is accelerating, and impact ranges are expected to continue to expand in the future (Moser et al., 2012; Neumann et al., 2015; Fletcher and Winton, 2021; Dai et al., 2022). Many coastal administrative sectors require coordination boundaries and management responsibilities, including responses to catastrophes such as severe flooding and storms (Chua, 2010). Without effective, coordinated and rapid responses, impacts will only worsen.

Traditional separated national planning and local implementation causes conflicts which goes against adaptive management for sustainable development (United Nations Environment Programme, 1995). Integrated Coastal zone Management (ICZM) is a decision-making process for the sustainable management, development and conservation of coastal environments and resources. ICZM aims to resolve conflicts between environmental, economic, and social elements through integration of departmental functions and transparent decisions (Lu and Ai, 2001; Wang et al., 2014). ICZM has been recognized as the preferred approach to addressing the challenges of climate change and achieving sustainable regional development.

Coastal zone planning is the intermediate link and tool of ICZM. It comprises conceptual objectives and implementation plans within an overall management framework. The key aim of these processes revolves around optimizing the location of human activities in space and time, avoiding conflicts between regional land uses, supporting long-term investment decisions, promoting integrated ecological protection networks (Kay and Alder, 1999). Currently, coastal zone planning has been successfully implemented in a large number of coastal nations such as China, the United States, Netherlands, and Australia (Douvere, 2008; Smythe and McCann, 2018; Warnken and Mosadeghi, 2018; Yue et al., 2023;). These include reducing the risks associated with rising sea levels (Popova et al., 2019), establishing sustainable blue economies (Liu et al., 2023), protecting cultural heritage (Ounanian et al., 2021), developing tourism resources (Pineda et al., 2023), and preserving ecological environments (Dhiman et al., 2022). While where have been some experiences gained from numerous coastal zone planning projects, additional systematic summary and insight are needed. It is essential for coastal environmental protection and resource utilization, especially for what we should do under climate change.

Bibliometric analysis is a quantitative method of analyzing literature by capturing its characteristics to assess the current status or gaps (Karimi and Khalilpour, 2015), and is widely used in the fields of management (Anugerah et al., 2022), environmental sciences (Zhang et al., 2024a), and ecological security (Liu et al., 2022). This method provides a clear overview of past and future research trends. We searched the Web of Science (Core Collection) for all publications in the field of coastal zone planning from 2000–2023. This study aims to provide a comprehensive description of the current state of knowledge on the topic of coastal zone planning based on bibliometric analysis and literature review, including the history of development, current problems and challenges, and ultimately to propose future trends. This study could provide some references for sustainable development of coastal zones under climate change.

2 Data and Methods

2.1 Data

Raw data used in this study were obtained from Web of Science (Core Collection) (https://access.clarivate.com/) with the ALL = Coastal Planning OR Marine Spatial Planning AND Integrated Management (searched from 1 January 2000 to 31 December 2023), with a total of 6096 publications met the selection criteria. It needs to be clarified that although the review is based primarily on a summary of the literature within the search period (2000–2023), we also cite the initial literature in the historical review section. In addition, for some recent advances, we referenced several 2024 articles (with available online dates before 31 December 2023).

2.2 Methods

This article presents a comprehensive analysis of the current state of knowledge on the topic using a combination of bibliometric analysis method and literature review. For all retrieved papers, we first used CiteSpace investigated and visualized the trends in annual publications, the countries with the largest contributions, the most productive journals, and the evolution of hot keyword. The analysis yields a scientific knowledge graph in the form of nodes and lines, as well as keyword contribution network and emergence map to further explore the evolution of popular research topics (Chen et al., 2015).

Subsequently, we meticulously reviewed and summarized the practical experience and conclusions of each article. The literature review is divided into four parts (Fig. 1). Firstly, we reviewed the history of coastal zone planning. As an important component of ICZM, evolution of coastal zone planning is closely related to ICZM. Secondly, we summarized the commonly used planning approaches to fully understand the content of planning. Thirdly, we analyzed the current challenges and issues still to be solved. Finally, based on the research trends and methodological theories in each section, we proposed future research efforts.

3 Bibliometric Analysis Results

3.1 Descriptive analysis

In terms of types of literature categories, the 6096 publications can be categorized into 11 document types. As shown in the Fig. 2, 'Article' was the most prevalent type, accounting for 83.2% of the total publications, followed by 'Proceeding Paper' (16.0%), 'Review Article' (4.4%) and other types (e.g., Book Chapters, Editorial Material and Data Paper).

Articles related to coastal zone planning experienced a significant growth in the number of publications and citations from 2000–2023, especially during 2017–2021. It indicates that the field is receiving increased attention, which mainly relates to the attention given to the urgent challenges in recent years.

The most productive country in the field during 2000–2023 was the USA, with 1190 publications (19.5%), followed by China (18.2%), the UK (10.9%) and Australia (9.4%) (Fig. 3a). China has seen a significant increase in the number of publications since 2008, and other developing countries like Brazil and India have also witnessed a gradual increase in their contributions to publishing over the last decade. Overall, developed countries have accumulated relatively mature experience in theoretical exploration and practical activities of coastal zone management and spatial planning since the 1950s. *H*-index indicates 'high citations', which means that a researcher has a total of *H* articles that have been cited at least *H* times. The number of papers issued and the *H*-index in papers published are more prominent, exerting greater global influence. Recently, due to the increase in funding and attention, developing countries are also actively promoting relevant research and exploring coastal zone policies which suit their national conditions (Fig. 3b).

3.2 Hot keyword evolution

The most frequently occurring keywords in 6096 publications were 'management' and 'climate change' (Fig. 4). In the last two decades, countries around the world have experienced large-scale economic development. Threats of sea level rise and human activities have increased the vulnerability of coastal zones. More attention was paid to 'governance', 'protected areas', 'resilience', 'adaptation', and 'urbanization' over time. This shift suggests

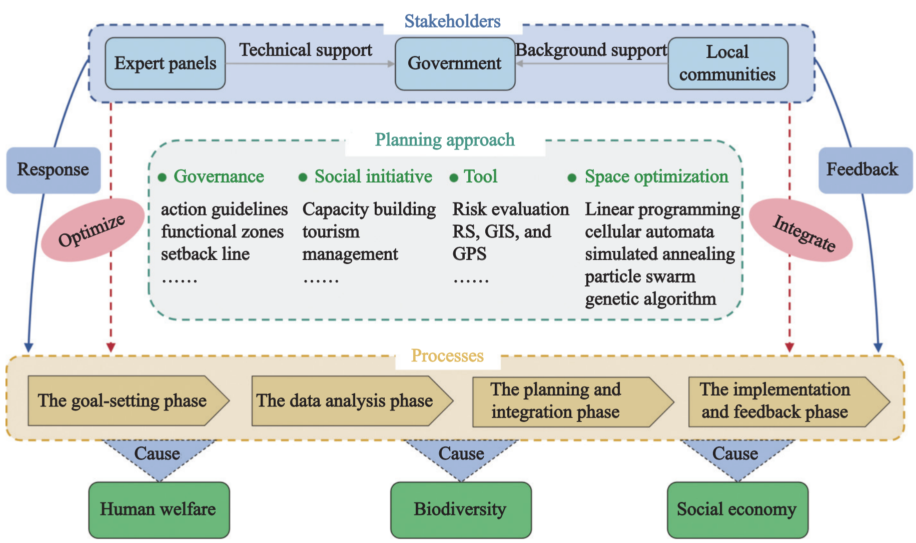

Fig. 1 Framework diagram illustrating the elements and linkages of the coastal zone planning process. RS, GIS, GPS are Remote Sensing, Geographic Information, System and Global Positioning System, respectively

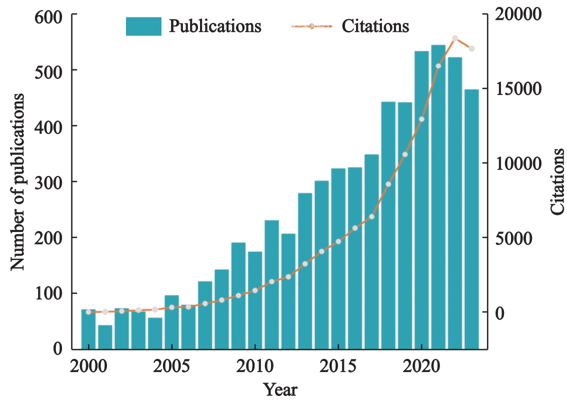

Fig. 2 Distribution of publication and citation quantity on the coastal zone planning during 2000–2023

that people are actively exploring more adaptive and ecologically resilient approaches to coastal zone management in the face of increasing climate change risks, and that this integration is not only reflected in the breadth of the challenges ahead, but also in the diversity of groups involved in planning and the diversity of metrics used to evaluate planning. 'Integration' is not only reflected in the breadth of the challenges ahead, but also in the diversity of groups involved in planning and the diversity of assessment indicators.

4 History of Coastal Zone Planning

Here we summarize coastal zone planning development (Fig. 5), key approaches, and spatial optimizations.

4.1 Development of coastal zone planning

We outline the development stages by referencing the timing of the Coastal Zone Management Act of USA and the United Nations' Agenda 21. The enactment of these two policies marked the beginning of a new era in coastal zone planning (Caviedes et al., 2020; Thom, 2022; Botero et al., 2023).

4.1.1 Birth (the 1950s– the mid 1970s)

Rapid the 1950s post-war development of supported by road, rail and shipping, using wood, coal, and resources, caused pollution, contaminated water, and soil. Conservation and environment protection were treated independently. Initial global efforts under the 'Convention on Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972', or 'London Convention', limited the dumping of wastes at sea through proscribed lists of substances that could be dumped, might be dumped, and were banned (such as nuclear waste) from being dumped. 'Integrated Management' was first introduced the Coastal Zone Management Act of USA (CZMA) in 1972, to address complex issues across the land-sea (Fig. 5).

4.1.2 Developing period (the late 1970s–1990s)

Here, issues across policies and actions confounded implementations. In 1978, a Canadian conference (Shore Management Symposium) emphasized sectoral cooperation, access to information, and public participation (Fig. 5). UK enacted laws, including a Fisheries Act, during 1970 to 1987 (Ballinger, 1999; Wang et al., 2014). As desired outcomes became clearer, conflict resolutions shifted towards process integration. For example, in 1973, France made coastal zone conservation recommendations (Piquard, 1973). In 1979, Australia

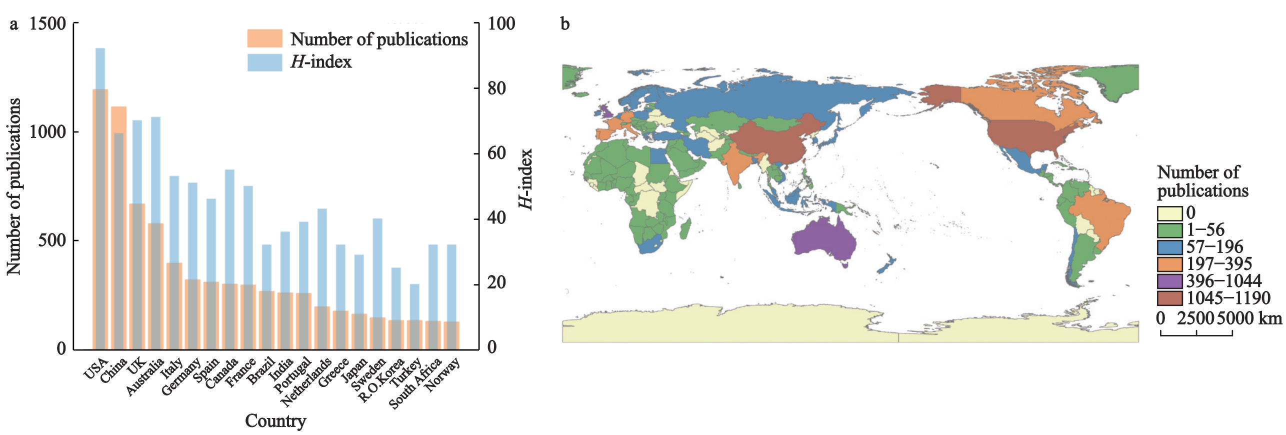

Fig. 3 Distribution of publications on coastal zone planning for different countries. a. The basic information of the top 20 most productive countries; b. global distribution of publications. Fig. 3b is drawn based on the standard map with approval number GS(2016)1666 downloaded from the website of the Ministry of Natural Resources (http://bzdt.ch.mnr.gov.cn) and the base map has not been modified

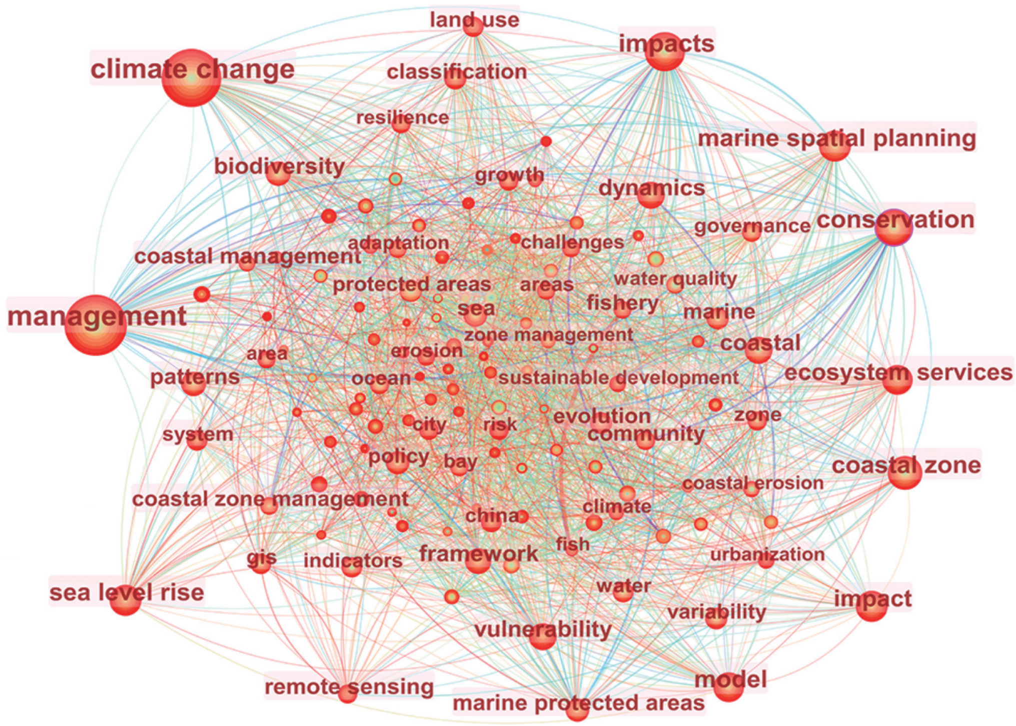

Fig. 4 Keyword co-occurrence network for coastal zone planning during 2000–2023. The size of each node reflects the frequency of keywords. The closer the color of the node is to red, the more recent the co-citation of the keyword is. And the thickness of each line reflects the intensity of co-citation

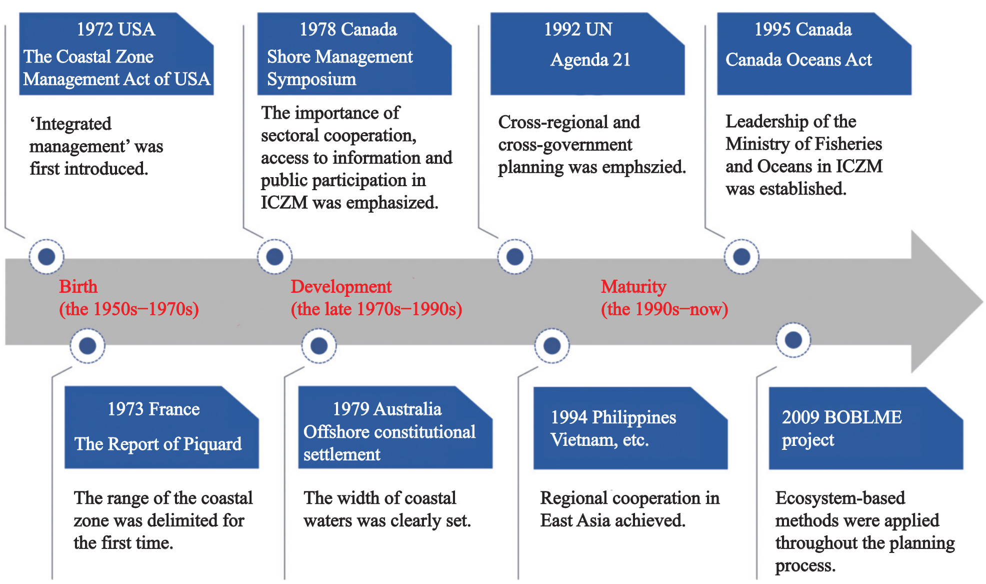

Fig. 5 Timeline of coastal zone planning from the 1950s to now globally. The figure shows influential events that have occurred globally since the birth of coastal zone planning in the 1950s. UN: United Nations; BOBLME project: Bay of Bengal Large Marine Ecosystem project

set local jurisdictional responsibility at three nautical miles offshore in the 'Offshore constitutional settlement: a milestone in cooperative federalism'. In 1980 and 1986, CZMA has undergone the most significant amendments, particularly with regard to government funding for planning and management projects.

4.1.3 Mature period (the 1990s–now)

In 1992, United Nations' Agenda 21 was adopted by many countries which implemented cross-regional and cross-government planning (Wang et al., 2014) (Fig. 5). In 1994, Philippines and Vietnam launched 'Building Partnership in Environmental Management for the Seas of East Asia' (Chua, 2010). In 1998, Costa Rica, Burley, and other central American countries implemented the Regional Environmental Program for Central America in 1998 (Caviedes et al., 2020).

Major countries planned larger governance scales and more rational allocated resources to overcome the shortcomings of fragmented management (Pittman and Armitage, 2016). In 1996, European Union (EU) demonstrated ICZM across 35 regions including Baltic Sea, North Sea, Atlantic Ocean, and enacted coastal zone protection for all European waters (Shipman and Stojanovic, 2007). Canada instituted the world's first Law of the Sea, separated federal and provincial jurisdictions, divided national park functional areas, and provided methodological and technical support for coastal zone planning (Li, 2011; Li and Zhang, 2014). Beginning in 1994, Australia's 'Large Marine Domains' planning involved a systematic hierarchy of biodiversity management units across State and Commonwealth waters (Last et al., 2010), supplemented by 'Key Ecological Features' for priority management (Lyne et al., 2007).

After 2000 'Ecosystem-based Management' replaced 'Integrated Management' (Kay and Alder, 1999; Pittman and Armitage, 2016) by including preventive measures, sustainability, and spatial connectivity, to extend productivity and species connectivity (Aswani et al., 2012; Guo, 2013; Pittman and Armitage, 2016). This approach was applied at various scales (Eisma-Osorio et al., 2009; Flannery and Ó Cinnéide, 2012; Caviedes et al., 2022) and themes (Christie et al., 2007; Wongthong and Harvey, 2014; Sierra-Correa and Cantera Kintz, 2015; Gracia et al., 2018; Elango and Arul, 2022). These projects usually involve a complete system-based spatial assessment across a range of scales as the first step. Ecosystem-based planning methods can then be incorporated at the appropriate level and scale to investigate integrity and stability of ecosystems across the hierarchy of scales. Common measures include delimiting the planning boundary according to the ecological boundary, ecosystem compatibility matrices, ecosystem functions and thresholds (Gilliland and Laffoley, 2008; Aswani et al., 2012). A successful example is the ambitious FAO's 'Bay of Bengal Large Marine Ecosystem' (BOBLME) project of 'eight countries connected by one ecosystem'. System-science collaborative workshop was used to identify 29 marine provinces across the Bay of Bengal and shared-trans-boundary issues such as fisheries, threatened species, nurseries, productivity, corals, riverine/sediment flow, common threats, vulnerabilities, and to enable a shared understanding from sound ecosystem principles (Dai et al., 2022). Similar regional system studies identified trophic systems of Australia's North-West Shelf (Neumann et al., 2015), and nested-scale hierarchical habitat mapping (Moser et al., 2012).

4.2 Various planning approaches

Various planning approaches aim to promote stakeholder collaboration and identify vulnerabilities and hotspots in coastal ecosystems. Here we summarize three common approaches.

4.2.1 Administrative approaches

Governments clarify the protection subjects and responsibility subjects by legislation. A clear legal framework ensures effective implementation of management measures such as permits, licenses and education (Kay and Alder, 1999). Generally, strategic plans and special acts are drafted by the federal government. Local governments are bundled together under the leadership of the federal government, and are responsible for specific planning schemes and enforcement. Based on the analysis of legislative hierarchical relationships, many studies widely believe that appointed department and enhanced institutional arrangement are effective for promoting integration (Enemark, 2005; Taljaard and Van Niekerk, 2013). For China, adding more coordination mechanisms and setting simple operational guidelines are feasible ways to optimize integration mechanism (Wu et al., 2012).

Conservation planning focuses on the spatial allocation of conservation resources to different actions (e.g., protected areas, aquaculture, industrial development), so a system of functional zoning planning to set priorities for action across realms is one of objectives of coastal spatial planning (Álvarez-Romero et al., 2011). A lot of studies have explored specific methods for dividing coastal areas into ecological space, living space and production space based on land suitability evaluation (Rahman and Szabó, 2021; Wei et al., 2021). In the early phase, the main methods were multi-objective decision-making methods, such as linear programming (Sadeghi et al., 2009) and gray linear programming (Zhang et al., 2023), and multi-attribute decision-making methods, such as hierarchical analysis (Gao et al., 2021) and weighted overlay analysis (Ferretti and Pomarico, 2013). Linear programming method and gray linear programming method convert land allocation into a linear optimization problem involving complex calculations. Multi-attribute decision-making method calculates suitability score based on the established indicator and therefore contains more subjectivity and uncertainty (He et al., 2009). Recently, many studies combine indicator evaluation with Geographic Information System (GIS) and Artificial Intelligence (AI) technology, in addition to spatial unit trend simulation (Sitzia et al., 2014) and ecological niche model assessment (Akpoti et al., 2020). The Setback line is also a method for land use control, and the retreat distance is usually determined usually based on the maximum ecosystem service value of the coast and local erosion rate (Lu et al., 2015; Qiao et al., 2020).

Compared to compulsory legislation, action guidelines and instruction manuals can provide more flexible and extensive guidance information, which usually cover different implementable options available to planners and their application scopes. For example, the 'Towards a European: Integrated Coastal Zone Management Strategy' proposed by the European Union in 1999 provides general principles and cooperative recommendations for management activities in European coastal areas (European Commission, 1999).

Administrative approaches have been criticized mainly for the lack of flexibility, implementation difficulties, weak enforcement and low adaptability. Highly centralized national models often face problems in balancing economic development and resource allocation. The devolution of authority would give stakeholders more decision-making power and promote the flexibility of governance as well as the freedom of local policies, a phenomenon that has become increasingly prevalent in coastal regions across Southeast Asia and South America (Chang and Lin, 2016; Dunning, 2020). In addition, current functional zoning of coastal areas relies mainly on planimetric planning, which is prone to disputes over boundaries (Schwartz-Belkin and Portman, 2024). Three-dimensional zoning offers the possibility of more precise protection actions. However, despite some existing research, this approach has not yet become widespread (Duffy and Chown, 2017).

4.2.2 Social initiatives

Stakeholder participation and the human dimension are the cores of coastal zone planning (Smythe and McCann, 2018). Deepening mutual understanding and communication is essential to building wide governance networks. Community cooperation is a powerful tool to enhance the level and quality of stakeholder participation, helping to resolve conflicts over cultural, economic and environmental issues (Pomeroy and Douvere, 2008). It involves not only asking stakeholders what they think about the project, what they need, and what benefits they might receive, but also involving them in the assessment and regulatory process. Some participatory tools such as focus group discussion, question trees, and preference rankings can be helpful. In addition, social and economic benefits are possible from tourism management to improve tourists' travel experience, leisure opportunities/facilities, landscape planning, and promoting regional/local cultural assets (Kay and Alder, 1999). Capacity building and education contribute to stakeholder awareness of coastal management and help them to actively participate in the planning process.

However, the effectiveness of these approaches can be easily influenced by other factors, such as imbalanced stakeholder groups, lack of tools to guide discussions, funding, *etc*. Particularly when strong regulatory and participatory frameworks are lacking, simple consultation and community management approaches can lead to ineffective stakeholder engagement and poor protection in non-jurisdictional contexts.

4.2.3 Planning techniques and tools

A variety of spatial analysis techniques are used throughout the entire planning process. In the data collection phase, Remote Sensing (RS) and Global Positioning System (GPS), footprint analysis, Spatial Data Infrastructure (SDI), *etc*., help decision makers to understand the basic background conditions of coast. In the data analysis phase, tools such as GIS, machine learning, and Cumulative Effects Assessment (CEA) are used to evaluate the risk of human activities on the natural environment. In the decision-making phase, spatial decision support tools adapted to different planning objectives have been developed. The Marxan platform is based on simulated annealing algorithm to predict possible geographic distributions (Kirkpatrick, 1984; Ball and Possingham, 2000), and is widely used in siting problems for coastal park (Fernandes et al., 2005; Chen et al., 2022) and offshore wind farm (Virtanen et al., 2022). Ecopath improved limitations of Marxan software in addressing population connectivity, allowing for the robust assessment of ecological processes (Polovina, 1984; Christensen and Pauly, 1992; Stamoulis and Delevaux, 2015). Other GIS-based spatial decision-making tools are also widely used as parts of decision support systems, such as the Integrated Valuation of Ecosystem Services and Trade-offs (InVEST) model (Sharp et al., 2015), are applied for assessing the scenic quality of coastal landscapes (Wang et al., 2023), tourist visitation rates (Pafi et al., 2020) and wave energy effects (Zhang et al., 2024b); the AkvaVis tool was developed for aquaculture (Gangnery et al., 2021); the Coral Reef Scenario Evaluation Tool (CORSET) was applied for coral reef coral reef management (Melbourne-Thomas et al., 2011a; 2011b); the MarineMap and the OceanMap were applied for integrating spatially explicit socioeconomic data (Pattison et al., 2004).

Stamoulis and Delevaux (2015) believed that current problem is that the models tend to be designed for specific problems and regions, with poor extensibility and adaptability. Most of the current tools are not embedded with remote sensing technology module and spatiotemporal resolution of the outputs is coarse, which limits the application of decision-making tools at small regional scales, especially for issues related to the definition of planning zones, the mapping of ecological elements and pollution monitoring. In addition, affected by ambiguous data needs, mismatched collection sizes and data discrepancies, most tools lack mechanisms for modelling changes in ecosystem dynamics under external pressures, and are limited to assessing changes in historical ecosystem services. Machine learning and deep learning are good tools for predicting and analyzing spatio-temporal data dynamics. The integration of AI and GIS will provide more efficient, accurate and intelligent solutions for refined coastal spatial planning and governance.

4.3 Spatial optimization of coastal zone

4.3.1 Land suitability evaluation methods

Land suitability evaluation integrates economic, social and environmental needs, providing a scientific basis for spatial optimization. Evaluation methods are developing from qualitative to quantitative. Early methods are mathematical planning model and superposition analysis. AI reduces the uncertainty of previous methods, with advantages of both structural optimization and spatial pattern optimization. This method has been commonly used in many suitability assessment studies, such as genetic heuristic algorithms (Cao et al., 2012; Porta et al., 2013; Kaim et al., 2018; Ma et al., 2018; Schwaab et al., 2018): simulated annealing (Kirkpatrick et al., 1983; Aerts and Heuvelink, 2002; Santé-Riveira et al., 2008; Santé et al., 2016), ant-colony (Huang et al., 2006; Liu et al., 2012; Ai et al., 2015; Su et al., 2020), and rule-based particle-swarm optimization (Dorigo et al., 2006; Li et al., 2018; Fletcher and Winton, 2021).

Linear programming can only set an optimization goal, with other benefits converted to constraints to solve the optimal allocation of land use. However, a series of coefficients need to be fixed which can lead to unrealistic. Gray linear programming offers more flexibility by allowing fixed values to vary across 'gray' interval values, which has great advantages in processing discrete data and small sample data (Darvishi et al., 2020). However, computational complexity is their common problem, limiting further application in the GIS environment.

According to the weighted overlay method and Analytic Hierarchy Process (AHP), all objective functions are combined into a scalar objective function, weights are assigned to each objective and an optimal solution is obtained (Rahman and Szabó, 2021). Both are similar to overlay mapping in GIS so they are more suited for raster data. However, the determination of evaluation indicators and weights rely on prior information and may introduce subjectivity and uncertainty. Moreover, such methods tend to ignore some suitability influences which are difficult to express in GIS (He et al., 2009).

Simulated annealing is a general probabilistic algorithm proposed by Kirkpatrick et al. (1983). This algorithm not only avoids being trapped in a local optimal solution, but also ensures that the solution is simple and global. Santé-Riveira et al., (2008) carried out optimal allocation of land use in Galicia by combining compactness and simulated annealing to avoid the deviation of secondary objectives due to weight allocation under multiple objectives. Santé et al., (2016) set suitability and compactness optimization goals and conducted land use optimization based on simulated annealing algorithms. Simulated annealing simulations usually consumes a lot of time and cannot guide subsequent searches based on currently detected regions.

Particle swarm optimization was first proposed by Italian scholar Marco Dorigo (2006). Optimization is based on diverse fitness values across 'particles' each with their own fitness characteristics related to the desired outcomes from objectives. The concept of this algorithm is relatively simple, easy to implement, and results are of relatively high quality and robust. In addition, it is based primarily upon rules or pre-defined behaviors related to situations, and widely used in optimal scheduling, function optimization, and fuzzy system control. Su et al. (2020) established a framework coupling ant colony algorithm and gray linear programming for solving the coastal landscape pattern configuration problem under multi-objective constrains. However, fast convergence of particle swarm optimization algorithms, may lead to a local optimal solution. To address this issue, many relevant experts and scholars have proposed improved methods, such as adaptive particle swarm optimization algorithms, particle swarm optimization algorithms with selection mechanisms, particle swarm optimization algorithms with mutation operators, and particle swarm optimization algorithms with spatial neighbors.

Genetic algorithms, first proposed by Bagley (1967), attempt to mimic natural evolutionary processes using mechanisms such as crossover, inheritance, mutation, selection, and elimination. Organisms and groups equivalent to chromosomes are iteratively and genetically modified, and then chosen based on their survival suitability in current conditions (Kaim et al., 2018; Schwaab et al., 2018). The algorithms are suited for parallel and efficient computing, but cannot guarantee optimal solutions of a polynomial complex uncertain problem within a certain period of time.

However, currently, linear optimization is most widely used method in coastal zone spatial optimization. Coastal zone optimization in future needs to be combined with heuristic algorithms for better results. Additionally, existing spatial optimization of coastal zones is mostly based on optimization of land areas, and only a few based on land-sea integration. Few studies have incorporated stakeholders' views into the quantitative optimization process of the mathematical models, and further researches are needed on the coupling of public participation and land use planning, such as giving more consideration to the economic benefits of planning scenarios, determining the weights of indicators through public consultation, and analyzing impacts of land-use change on the public under different scenarios.

4.3.2 Land-sea integrated optimization

In the coastal areas, the integrity and interaction between marine space and land space have received more and more attention from researchers and planners. Land-sea interaction is recognized as one of the minimum requirements for Marine Spatial Planning by the EU Directive 2014/89 (art. 6) (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2014.257.01.0135.01.ENG%20). Bocci et al. (2024) proposed a set of guidelines for analyzing land-sea interaction in planning, including identifying hotspots and conflicts, promoting positive impacts, and some recommended measures. Many scholars are also exploring how to carry out planning, developing, and protecting efforts with land-sea coordination characteristic. For example, Li et al. (2021) proposed coordination of space utilization activities by using system theory to integrate territorial spatial planning in coastal areas with aspects such as ecology, environment, economy, resources, transportation, and disasters. Lin et al. (2018) discussed spatial control of Xiamen's coastal zone of China by combining flexibility and rigidity, from four aspects: key elements of land space, utilization of sea space, control of land-based pollution of the marine environment, and shoreline conservation of marine resources. Li et al. (2019) proposed improvements for Shenzhen of China included: enhancing ecological objectives, implanting marine culture, and planning across land-sea. Zhang (2016) integrated spaces across production, living, and ecological, evaluated with respect to utilization to resolve conflict, planning, and optimization. Current crude coastal zone classifications lack of consideration of sea carrying capacity for land-pollution emissions, and management must also consider detailed monitoring and land-sea integrated optimizations.

Advanced scenario-modelling was explored across alternative futures for Australia's North-West Shelf using an advanced integrated agent model, In-Vitro, developed by Randall Gray (Gray et al., 2013). Outcomes were explored across land-sea, fisheries, oil-and-gas exploration, tourism, conservation, maritime traffic, land-use, Aboriginal cultural values, climate change and land-sea environmental pollution (Fletcher and Winton, 2021). However, this system requires advanced computing clusters, high-level technical expertise, funds to maintain integrated databases, computational skills, and software/hardware maintenance. However, policy makers and managers can experiment with digital-twin simulations, as if they were real world. Here, optimal or compromise, decisions are left to policy makers, with technical help provided by scientists to activate policy levers, such as industrial investments, ports, rail, roads, land-use planning schemes, environmental pollution controls, effectiveness of different enforcements, and value of different monitoring strategies.

Although many plannings studies are based on scientific evaluation results, current classifications of coastal zones are relatively crude and optimizations often neglect impact of land pollution emissions to sea which restricts the aim of 'land determined by sea'. The lack of consideration of the sea carrying capacity prevents 'promoting land by the sea'. The management must consider sea and land carrying capacity, detailed monitoring and land-sea integrated optimization.

5 Challenges in Coastal Zone Planning

5.1 Integration in coastal zone planning

Coastal zone planning seriously depends on the cooperation of government, nongovernmental organizations, and individuals in a multi-level institutional environment, so the integration involving the needs and interests from all parties is a key principle of coastal zone planning. Many studies have summarized and evaluated the methods, extent and effectiveness of integration in different countries (Enemark, 2005; Runhaar et al., 2014; Soma et al., 2015; Smythe and McCann, 2019). The previous studies paid more attention on vertical integration between government and stakeholders, ignoring the importance of intra-governmental coordination. However, a lot of experience suggests that both are equally important in promoting corporate governance in coastal zone (Kidd, 2013; Olsen et al., 2014; Smythe, 2017; Glass et al., 2023). Smythe and McCann (2019) analyzed three cases in Washington, Rhode Island, and San Francisco in the United States. The results showed that horizontal integration between government agency and equivalent jurisdiction occurs throughout the entire process. Driven by shared concerns and pressing problems, horizontal integration with informal mechanisms (e.g., informal dialogues, voluntary cooperation) was found to be more effective than formal mechanisms (e.g., agreements, new leadership agency), especially in solving multi-objective problems. It has also been argued that unified and independent leadership agency can increase cohesion and administrative efficiency (Albotoush and Tan Shau-Hwai, 2021).

In addition, land-sea conflicts are commonly presented in threats, protection objectives, and planning areas, so 'integration' also includes land-sea functions and scopes. Álvarez-Romero et al. (2011) summarized 12 common threats in the planning, including urban sprawl, nutrient loss from agriculture, and aquaculture. These cross-system threats can affect both terrestrial and marine systems, but many studies have focused on threats from land-based sources, ignoring those caused by activities in the coastal marine realm (Álvarez-Romero et al., 2011; Lucrezi, 2021). Decision makers need to prioritize conservation objectives, add governance requirements in registry forms, and use analytical tools like interest-impact matrix to coordinate every conservation objective and spatial function.

Overall, how to promote the breadth, depth, and effectiveness of integration is one of the challenges. There is no unified set of collaborative governance paradigm, instead, differentiated governance approaches are more recommended. Experiences from China (Bao et al., 2019), Chile (Vázquez Pinillos et al., 2023), and Belize (Alves, 2021) have shown that appropriate decentralization and step-by-step planning strategies are more conducive to improving the adaptability and implementation of coastal management. Compared to terrestrial spatial planning systems, the management and mapping of marine parts have not received sufficient attention, a situation that is quite common (Hassanali, 2015; Liao et al., 2023). With regard to the problem of inconsistencies in the spatial scope of planning and sea-related regulations, it is suggested to establish the conversion standard of multi-regulation indicators and find means to better co-ordinate use of physical space in the marine environment itself (Hassanali, 2015). For example, based on the coastal ecosystem services valuation, a region-specific and multi-level control mechanism for coastlines can be established. Higher-level government adopt rigid control strategies to determine the categories and directions of shoreline use, while lower-level government adopt flexible regulation strategies to formulate specific supervision and restoration regulations for each category.

5.2 Public participation in coastal zone planning

The involvement of non-governmental interests is specially emphasized in almost all studies related to coastal zone planning. The active participation of stakeholders at all phases of planning has been recognized as a key to success. A number of studies have discussed the advantages of public participation in coastal zone governance, such as facilitating understanding of specific issues (Erkkilä-Välimäki et al., 2022), enhancing social cohesion (Tafon et al., 2023) and improving the rationality and adaptation of spatial planning (Gannon et al., 2021). Key elements and quality assessment processes for public engagement have been discussed in these studies. Sanò and Medina (2012) proposed a system approach to identify stakeholders, issues, variables, and ultimately select a simplified set as management indicators. Many studies have discussed how best to engage stakeholders (Garriga and Losada, 2010; Areizaga et al., 2012a; 2012b; Zaucha and Kreiner, 2021). Pomeroy and Douvere (2008) noted that participation can range from one-directional communication, where there is no actual participation, to full-fledged negotiation, where stakeholders share in decision-making. Other examples include techniques like joint fact-finding (Gleason et al., 2010) and citizen science (Jarvis et al., 2015), advisory councils and nested institutional arrangements (Sievanen et al., 2011), and both formal and informal participatory opportunities (Moodie et al., 2019).

Nevertheless, stakeholders' misconceptions about coastal spatial planning remains a major challenge for stakeholder engagements. Piwowarczyk et al. (2019) investigated fishers' opinions of planning projects. The results showed that fishers' limited trust towards planning groups led to their limited willing to share sensitive information related to fishing grounds with planners. Capacity building of stakeholders should be designed in the 'pre-planning' phase, which can help to increase stakeholders' participation capacities and build social learning initiatives. Specific approaches of public participation need to be adapted to the planning objectives and project characteristics, and they should complement each other, rather than being applicable only at specific phases (Zaucha and Kreiner, 2021). Education, consultation and two-way communication can go hand in hand. Stakeholder involvement at an earlier phase is preferable, allowing them to focus on geographic areas of interest, which can make participation more efficient and effective.

Researchers are also an important part of stakeholders. Multi-disciplinary knowledge integration contributes to more reliable and more appropriate spatial decision-making. The dynamics and diversity of knowledge brings challenges for integration between knowledge and policy. Although the need for 'knowledge integration' is becoming more pressing, there is still no coherent framework for how to do it (de Vries et al., 2024). In political science, knowledge integration models developed from basic linear models to relatively simple functional and later more complex co-production models (de Vries et al., 2024). Non-linear relations of joint knowledge productions, power-relations, and contextual factors have been taken into account. In organizational studies, frameworks have developed which consider interactions (Spaapen and Van Drooge, 2011), interfaces (Tromp, 2019) and pathways for impacting society (Muhonen et al., 2019). For the knowledge integration in the coastal spatial planning, de Vries et al. (2024) proposed a workable framework that considers the knowledge needs and processes of the entire knowledge system by involving interviews, observations, focus groups, and document researches into decision-making system. Based on the case of Netherlands, they argued that clear agreements, structured overviews and monitoring mechanisms were key to knowledge integration.

It is generally believed that clarifying the public participation system through legal forms is an effective way to safeguard the public's right to know and to supervise. Specifically, optional measures include holding hearings, questionnaire surveys visits, timely disclosure of project details, improving the mechanism for monitoring public opinion, and defining the procedures for permits related to public interests. The literature overwhelmingly points to the importance of stakeholder participation. However, it has also been shown that scenarios designed solely with stakeholder input rarely approach optimal solutions. For a complex multi-criteria problem, it is recommended that modelling can be used to highlight unexpected benefits or conflicts to inform stakeholders in subsequent iterations of the scenarios

(Arkema et al., 2015).

5.3 Socio-economic factors in coastal zone planning

There is a mutual influence between coastal spatial planning and coastal economic development (Weig and Schultz-Zehden, 2019). Specifically, coastal spatial planning can create new economic potential by providing new functional space and promoting synergies. At the same time, project funding, economic context, and expected benefits can determine whether the planning process is sustainable. Challenges to integrating socio-economics into the planning have been reported in many studies, mainly the lack of detailed data about economic impacts (Weig and Schultz-Zehden, 2019; Schwartz-Belkin and Portman, 2024). Several studies used scenario modelling and economic input-output tables to describe the impacts of marine spatial use on coastal economy (Morrissey and O'Donoghue, 2013; Jacobsen et al., 2014; Carvalho and Inácio De Moraes, 2021). The socio-economic data available are mainly on monetary benefits related to sectoral values, number of firms and employment, lacking data which can reflect the geographical distribution of economic benefits. In order to fill this gap, the Spatial Economic Benefits Analysis (SEBA) tool was developed in the framework of the BONUS BaltSpace project and has been tested on the German Baltic coast (Weig, 2017). The geographic map of beneficiaries related to offshore activities, offshore wind and shipping can be obtained by this tool, but limited time and data availability restrict its further application. In addition, affected by resource type, time phase and geographical location, it is difficult to accurately estimate the non-market value assessment of coastal resources. Therefore, it is necessary to improve the system of economic statistics, accounting, monitoring and assessment of the coastal zone; and to carry out dynamic and long-term monitoring of the economic benefits and environmental impacts of projects. Optimizing the industrial layout of near-shore waters and expanding the development space for the fisheries and offshore wind farms in deep-water and far-shore areas can also help to achieve the greening and sustainable development of the coastal economy.

5.4 Long-term challenges under climate change

Coastal areas are more vulnerable to climate change-related impacts, such as sea-level rise and storm surges. Climate change from a human-caused rise is increasing the frequency and intensity of extreme weather events in coastal areas. The integration of climate adaptation policies into existing policy frameworks meets the requirements of sustainable development strategies (Ross and Dovers, 2008; Adelle and Russel, 2013), which makes serious challenges that planners have to face. There is still a lack of effective practical experience. Moreover, the formulation of climate change policies is embedded across a number of sectors (e.g., energy, transport, industry, housing and agriculture), so the challenges for decision-makers is in fact to promote 'policy integration' while prioritizing climate objectives. Specifically, these challenges include: the lack of a normative trend towards integration, a vague understanding of the 'climate adaptation integration' concept, and a lack of synergies between sectors.

In a broader field, there is a number of literature describing the characteristics and means of Environmental Policy Integration (EPI) and analyzing experiences with combinations of various mechanisms (Jordan and Lenschow, 2010; Runhaar et al., 2014). The European Environment Agency (EEA) (2005) has produced a checklist of essential EPI elements, including the following: trends in drivers and pressures, political commitments; administrative cultures and practices, assessment and consultation, use of policy instruments, and monitoring and learning. This system has been used to evaluate progress towards EPI. However, there is relatively little written on how to undertake Climate Policy Integration (CPI), and even less from the perspective of the public policy and administration literature, with more attention paid to outputs and outcomes (Adelle and Russel, 2013). For example, Nilsson and Nilsson (2005) analyzed the integration of the climate considerations into the EU's energy, transport and agriculture sectors, while other studies have focused on the integration of climate objectives in energy sector (Wu et al., 2022) and land use planning (Di Gregorio et al., 2017). Subsequent studies have attempted to fill this gap. Serrao-Neumann et al. (2014) described the process of integration and evaluation of cross-sectoral adaptation policies under the consolidated adaptation themes, based on a study of the South East Queensland Climate Adaptation Research Initiative. They argued that the climate adaptation themes can be approached through five phases, namely foundation phase, substantiation phase, mainstreaming phase, review phase and consolidation phase. Long-term close monitoring, the adaptive management cycle, a complete policy evaluation mechanism, and broad stakeholder participation are essential to facilitate cross-sectoral integration of climate adaptation. In addition, there are concerns that complete 'integration' between coastal climate adaptation and other legislation can undermine the coastal management process (Warnken and Mosadeghi, 2018). Planners need scientific and legal tools (e.g., risk assessment, cumulative impact assessment and discretionary powers) to fight the challenges of integrating coastal management into regulatory planning, pollution control, natural resource management and biodiversity conservation frameworks.

Climate change aggravates exposure and vulnerability of the land-sea space. Therefore, it is necessary to enhance the resilience of coastal cities in planning, particularly to strengthen climate adaptation, such as by promoting disaster risk assessment, improving coastal infrastructure for disaster prevention and mitigation, and incorporating long-term sea level rise scenarios.

6 Future Progress Directions

Planners are thinking how to promote conservation across regions and scales, and 'integration' is always a primary objective of resource planning. In face of increasing climate change risks, sustainable development will be the way forward for future ICZM, reflected in the sustainability of long-term stakeholder engagement, effective communication among participants, sustainable use of ecological resources, sustainable coastal economic development, and sustainable coastal governance (Gallagher, 2010; Glass et al., 2023). Currently, several studies and projects are trying to use a 'land-sea conservation' approach based on the integration within multidomain ecosystem-based frameworks (Li et al., 2021; Yue et al., 2023). This approach emphasizes the promotion of systematic conservation of land and sea by identifying connectivity across economics and ecosystems, and optimizing the cost-benefits of actions across scales, and ecosystem responses (Pittman and Armitage, 2016; Yuan and Chang, 2021). For example, for Daly River in Australia, researchers maximized regional benefits, within a limited budget, using action-response curves (Adams et al., 2014). Requirements for refined management in the future will promote the widespread application of new digital technologies, such as spatial ecological modelling, online spatial databases, and ecosystem service value calculation tools, covering the entire process of spatial data collection, management, analysis and decision-making.

In addition, in recent years, the 'land and sea integration' is always emphasized in many studies, which will also be one of the development directions of ICZM in the future. In terms of planning methodology, the discipline system of territorial spatial planning should involve a special chapter related to the sea. In terms of resource evaluation approaches, coordination, suitability evaluation and determination of the main functions should focus on both sides of the coastal zone. According to planning requirements and regional characteristics, ecological landscape corridors which involve important wetlands can be built, so as to enhance the connectivity of the coastal zone. In terms of social development and utilization activities, the environmental carrying capacity of marine resources and ecological sensitivity should be emphasized.

7 Conclusions

Land-sea interactions in the coastal zone pose increasingly serious challenges under the dual pressure of climate change and human activities. Countries around the world are compelled to take immediate actions to cope with the impacts. In this study, we review the development and recent advances in the field of coastal zone planning worldwide during the period 2000–2023, and suggest possible solutions to existing problems. After decades of non-sustainable development, coastal zone planning has shifted from decentralized, fuzzy, and reactive organization activities to integrated actions with clear objectives. More and more developing countries are involved. With the use of administrative and social approaches to ensure the effective implementation of planning. GIS tools have enabled integration of several data layers of environmental, social, and economic values, progressed functional zoning. Through the summary of historical studies, we find that planners could reconcile planning scopes, administrative hierarchy, and conservation objectives. Open discussions, clear monitoring mechanisms and structural frameworks facilitate deep public and researcher engagement. The absence of social datasets hampers the further dissemination of digital tools. Coastal resilience building needs to cover all phases of planning, as well as sectoral collaboration and policy development. Marine parts are not sufficiently considered, such as pollution from the sea, modelling of marine environment, and the impacts of planning on the sea. Therefore, there is a need to explore the integration of disciplines, to focus on the holistic nature of land-sea systems, and to develop more flexible and accurate spatial tools to better respond to climate change and to build more resilient coastal zones.

Conflict of Interest

The authors have no relevant financial or non-financial interests to disclose.

Author Contributions

All authors reviewed and commented on the manuscript. WANG Xinyi contributed to perform the literature search and drafted the manuscript. SU Fenzhen, WANG Xuege, PAN Tingting and CUI Yikun provided strategic advice on the manuscript. LYNE Vincent and Yan Fengqin contributed to guiding and revising the manuscript.

References

Adams VM, Álvarez-Romero JG, Carwardine J et al., 2014. Planning across freshwater and terrestrial realms: cobenefits and tradeoffs between conservation actions: cross-realm systematic planning. *Conservation Letters*, 7(5): 425–440. doi: 10.1111/conl.12080

Adelle C, Russel D, 2013. Climate policy integration: a case of Déjà Vu? *Environmental Policy and Governance*, 23(1): 1–12. doi: 10.1002/eet.1601

Aerts J C J H, Heuvelink G B M, 2002. Using simulated annealing for resource allocation. *International Journal of Geographical Information Science*, 16(6): 571–587. doi: 10.1080/13658810210138751

Ai B, Ma S F, Wang S, 2015. Land-use zoning in fast developing coastal area with ACO model for scenario decision-making. *Geo-spatial Information Science*, 18(1): 43–55. doi: 10.1080/10095020.2015.1017910

Akpoti K, Kabo-bah A T, Dossou-Yovo E R et al., 2020. Mapping suitability for rice production in inland valley landscapes in Benin and Togo using environmental niche modeling. *Science of The Total Environment*, 709: 136165. doi: 10.1016/j.scitotenv.2019.136165

Albotoush R, Tan Shau-Hwai A, 2021. An authority for Marine Spatial Planning (MSP): a systemic review. *Ocean & Coastal Management*, 205: 105551. doi: 10.1016/j.ocecoaman.2021.105551

Álvarez-Romero J G, Pressey R L, Ban N C et al. , 2011. Integrated land-sea conservation planning: the missing links. *Annual Review of Ecology, Evolution, and Systematics*, 42: 381–409. doi: 10.1146/annurev-ecolsys-102209-144702

Alves C, 2021. Marine resource management and fisheries governance in Belize exhibit a polycentric, decentralized, and nested institutional structure. *Ocean & Coastal Management*, 211: 105742. doi: 10.1016/j.ocecoaman.2021.105742

Anugerah A R, Muttaqin P S, Trinarningsih W, 2022. Social network analysis in business and management research: a bibliometric analysis of the research trend and performance from 2001 to 2020. *Heliyon*, 8(4): e09270. doi: 10.1016/j.heliyon.2022.e09270

Areizaga J, Sanò M, Medina R et al., 2012a. A methodological approach to evaluate progress and public participation in ICZM: the case of the Cantabria Region, Spain. *Ocean & Coastal Management*, 59: 63–76. doi: 10.1016/j.ocecoaman.2011.12.007

Areizaga J, Sanò M, Medina R et al., 2012b. Improving public engagement in ICZM: a practical approach. *Journal of Environmental Management*, 109: 123–135. doi: 10.1016/j.jenvman.2012.05.006

Arkema K K, Verutes G M, Wood S A et al. , 2015. Embedding ecosystem services in coastal planning leads to better outcomes for people and nature. *Proceedings of the National Academy of Sciences of the United States of America*. 112: 7390–7395. doi: 10.1073/pnas.1406483112

Aswani S, Christie P, Muthiga N A et al., 2012. The way forward with ecosystem-based management in tropical contexts: reconciling with existing management systems. *Marine Policy*, 36(1): 1–10. doi: 10.1016/j.marpol.2011.02.014

Bagley J D, 1967. *The Behavior of Adaptive Systems Which Employ Genetic and Correlational Algorithms*. Ann Arbor: University of Michigan.

Ball I, Possingham H, 2000. *MARXAN (v1.8. 2) Marine Reserve Design Using Spatially Explicit Annealing: A Manual Prepared for the Great Barrier Reef Marine Park Authority*. Available at: http://www.ecology.uq.edu.au/index.html?page=27710&pid=0

Bao J L, Gao S, Ge J X, 2019. Centralization and decentralization: coastal management pattern changes since the late 19th century, Jiangsu Province, China. *Marine Policy*, 109: 103705. doi: 10.1016/j.marpol.2019.103705

Bocci M, Markovic M, Mlakar A et al., 2024. Land-sea-interactions in MSP and ICZM: a regional perspective from the Mediterranean and the Black Sea. *Marine Policy*, 159: 105924. doi: 10.1016/j.marpol.2023.105924

Botero C M, Milanes C B, Robledo S, 2023. 50 years of the coastal zone management Act: the bibliometric influence of the first coastal management law on the world. *Marine Policy*, 150: 105548. doi: 10.1016/j.marpol.2023.105548

Ballinger R C, 1999. The evolving organisational framework for integrated coastal management in England and Wales. *Marine Policy*, 23(23-25): 501–523 doi: 10.1016/S0308-597X(98)00054-2u

Cao K, Huang B, Wang S W et al., 2012. Sustainable land use optimization using boundary-based fast genetic algorithm. *Computers, Environment and Urban Systems*, 36(3): 257–269. doi: 10.1016/j.compenvurbsys.2011.08.001

Carvalho A B, Inácio De Moraes G, 2021. The Brazilian coastal and marine economies: quantifying and measuring marine economic flow by input-output matrix analysis. *Ocean & Coastal Management*, 213: 105885. doi: 10.1016/j.ocecoaman.2021.105885

Caviedes V, Arenas-Granados P, Barragán-Muñoz J M, 2020. Regional public policy for Integrated Coastal Zone Management in Central America. *Ocean & Coastal Management*, 186: 105114. doi: 10.1016/j.ocecoaman.2020.105114

Caviedes V, Arenas-Granados P, Barragán-Muñoz J M, 2022. Integrated Coastal Zone Management on a transnational area: the Gulf of Honduras. *Marine Policy*, 136: 104931. doi: 10.1016/j.marpol.2021.104931

Chang Y, Lin B H, 2016. Improving marine spatial planning by using an incremental amendment strategy: the case of Anping, Taiwan of China. *Marine Policy*, 68: 30–38. doi: 10.1016/j.marpol.2016.02.004

Chen Yue, Chen Chaomei, Liu Zeyuan et al., 2015. The methodology function of CiteSpace mapping knowledge domains. *Studies in Science of Science*, 33(2): 242–253. (in Chinese)

Chen Z, Zhang H F, Xu M et al., 2022. A study on the ecological zoning of the Nantong coastal zone based on the Marxan model. *Ocean & Coastal Management*, 229: 106328. doi: 10.1016/j.ocecoaman.2022.106328

Christensen V, Pauly D, 1992. ECOPATH II—a software for balancing steady-state ecosystem models and calculating network characteristics. *Ecological Modelling*, 61(3–4): 169–185. doi: 10.1016/0304-3800(92)90016-8

Christie P, Fluharty D L, White A T et al., 2007. Assessing the feasibility of ecosystem-based fisheries management in tropical contexts. *Marine Policy*, 31(3): 239–250. doi: 10.1016/j.marpol.2006.08.001

Chua T E, 2010. *The Dynamics of Integrated Coastal Management*. Zhou Qiulin et al. (trans.). Beijing: China Ocean Press. (in Chinese)

Dai M H, Su J Z, Zhao Y Y et al., 2022. Carbon fluxes in the coastal ocean: synthesis, boundary processes, and future trends. *Annual Review of Earth and Planetary Sciences*, 50: 593–626. doi: 10.1146/annurev-earth-032320-090746

Darvishi D, Liu S F, Yi-Lin Forrest J, 2020. Grey linear programming: a survey on solving approaches and applications. *Grey Systems: Theory and Application*, 11(1): 110–135. doi: 10.1108/GS-04-2020-0043

de Vries J W, Spijkerboer R C, Zuidema C, 2024. Making knowledge matter: understanding and improving knowledge-integration in Dutch marine spatial planning policy. *Ocean & Coastal Management*, 248: 106928. doi: 10.1016/j.ocecoaman.2023.106928

Dhiman R, Kalbar P, Inamdar A B, 2022. Integrated geospatial approach for environment-sensitive planning of coastal urban regions: a case study from the megacity of Mumbai, India. *Ocean & Coastal Management*, 220: 106092. doi: 10.1016/j.ocecoaman.2022.106092

Di Gregorio M, Nurrochmat D R, Paavola J et al., 2017. Climate policy integration in the land use sector: mitigation, adaptation and sustainable development linkages. *Environmental Science & Policy*, 67: 35–43. doi: 10.1016/j.envsci.2016.11.004

Dorigo M, Birattari M, Stutzle T, 2006. Ant colony optimization. *IEEE Computational Intelligence Magazine*, 1(4): 28–39. doi: 10.1109/MCI.2006.329691

Douvere F, 2008. The importance of marine spatial planning in advancing ecosystem-based sea use management. *Marine Policy*, 32(5): 762–771. doi: 10.1016/j.marpol.2008.03.021

Duffy G A, Chown S L, 2017. Explicitly integrating a third dimension in marine species distribution modelling. *Marine Ecology Progress Series*, 564: 1–8. doi: 10.3354/meps12011

Dunning K H, 2020. Building resilience to natural hazards through coastal governance: a case study of Hurricane Harvey recovery in Gulf of Mexico communities. *Ecological Economics*, 176: 106759. doi: 10.1016/j.ecolecon.2020.106759

Eisma-Osorio R-L, Amolo RC, Maypa AP et al., 2009. Scaling up local government initiatives toward ecosystem-based fisheries management in Southeast Cebu Island, Philippines. *Coastal Management*, 37(3–4): 291–307. doi: 10.1080/08920750902851237

Elango N, Arul C, 2022. Ecosystem-based disaster management planning for the Eastern Coast of India. *Journal of Coastal Research*, 39(1): 83–89. doi: 10.2112/JCOASTRES-D-22-00031.1

Enemark J, 2005. The Wadden Sea protection and management scheme—towards an integrated coastal management approach? *Ocean & Coastal Management*, 48(11–12): 996–1015. doi: 10.1016/j.ocecoaman.2005.03.009

Erkkilä-Välimäki A, Pohja-Mykrä M, Katila J et al., 2022. Coastal fishery stakeholders' perceptions, motivation, and trust regarding maritime spatial planning and regional development: the case in the Bothnian Sea of the northern Baltic Sea. *Marine Policy*, 144: 105205. doi: 10.1016/j.marpol.2022.105205

European Commission, 1999. *Towards a European Integrated Coastal Zone Management (ICZM) Strategy: General Principles and Policy Options*. Luxembourg: Office for Official Publications of the European Communities.

European Environment Agency, 2005. *Environmental Policy Integration in Europe: State of Play and an Evaluation Framework*. Luxembourg: Office for Official Publications of the European Communities.

Fernandes L, Day J, Lewis A et al., 2005. Establishing representative no-take areas in the great barrier reef: large-scale implementation of theory on marine protected areas. *Conservation Biology*, 19(6): 1733–1744. doi: 10.1111/j.1523-1739.2005.00302.x

Ferretti V, Pomarico S, 2013. Ecological land suitability analysis through spatial indicators: an application of the Analytic Network Process technique and Ordered Weighted Average approach. *Ecological Indicators*, 34: 507–519. doi: 10.1016/j.ecolind.2013.06.005

Flannery W, Ó Cinnéide M, 2012. A roadmap for marine spatial planning: a critical examination of the European Commission's guiding principles based on their application in the Clyde MSP Pilot Project. *Marine Policy*, 36(1): 265–271. doi: 10.1016/j.marpol.2011.06.003

Fletcher S, Lu Y L, Alvarez P et al., 2021. *Governing Coastal Resources: Implications for a Sustainable Blue Economy*. Nairobi: United Nations Environment Programme.

Gallagher A, 2010. The coastal sustainability standard: a management systems approach to ICZM. *Ocean & Coastal Management*, 53(7): 336–349. doi: 10.1016/j.ocecoaman.2010.04.017

Gangnery A, Bacher C, Boyd A et al., 2021. Web-based public decision support tool for integrated planning and management in aquaculture. *Ocean & Coastal Management*, 203: 105447. doi: 10.1016/j.ocecoaman.2020.105447

Gannon K E, Crick F, Atela J et al., 2021. What role for multi-stakeholder partnerships in adaptation to climate change? experiences from private sector adaptation in Kenya. *Climate Risk Management*, 32: 100319. doi: 10.1016/j.crm.2021.100319

Gao Y, Jiang P H, Li M C, 2021. Spatial planning zoning based on land-type mapping: a case study in Changzhou City, Eastern China. *Journal of Land Use Science*, 16(5-6): 498–521. doi: 10.1080/1747423X.2021.2011968

Garriga M, Losada I J, 2010. Education and training for integrated coastal zone management in Europe. *Ocean & Coastal Management*, 53(3): 89–98. doi: 10.1016/j.ocecoaman.2010.01.004

Gilliland P M, Laffoley D, 2008. Key elements and steps in the process of developing ecosystem-based marine spatial planning. *Marine Policy*, 32(5): 787–796. doi: 10.1016/j.marpol.2008.03.022

Glass L-M, Newig J, Ruf S, 2023. MSPs for the SDGs: assessing the collaborative governance architecture of multi-stakeholder partnerships for implementing the Sustainable Development Goals. *Earth System Governance*, 17: 100182. doi: 10.1016/j.esg.2023.100182

Gleason M, McCreary S, Miller-Henson M et al., 2010. Science-based and stakeholder-driven marine protected area network planning: a successful case study from north central California. *Ocean & Coastal Management*, 53(2): 52–68. doi: 10.1016/j.ocecoaman.2009.12.001

Gracia A, Rangel-Buitrago N, Oakley J A et al., 2018. Use of ecosystems in coastal erosion management. *Ocean & Coastal Management*, 156: 277–289. doi: 10.1016/j.ocecoaman.2017.07.009

Gray R, Fulton E A, Little R, 2014. Human-ecosystem interaction in large ensemble-models. In: Smajgl A and Barreteau O (eds.). *Empirical Agent-based Modelling and Challenges and Solutions*. New York: Springer, 53–83. doi: 10.1007/978-1-4614-6134-0_4

Guo Zhenren, 2013. *Coastal Spatial Planning and Integrated Management: Innovative Approaches to Potential Problems*. Beijing: Science Press. (in Chinese)

Hassanali K, 2015. Improving ocean and coastal governance in Trinidad and Tobago: moving towards ICZM. *Ocean & Coastal Management*, 106: 1–9. doi: 10.1016/j.ocecoaman.2015.01.002

He Yingbin, Chen Youqi, Yang Peng et al., 2009. An overview and perspective of alien land suitability Evaluation study based on GIS technology. *Progress in Geography*, 28(6): 898–904. (in Chinese)

Huang B, Liu N, Chandramouli M, 2006. A GIS supported ant algorithm for the linear feature covering problem with distance constraints. *Decision Support Systems*, 42(2): 1063–1075. doi: 10.1016/j.dss.2005.09.002

IPCC, 2022. *The Ocean and Cryosphere in a Changing Climate: Special Report of the Intergovernmental Panel on Climate Change*. London: Cambridge University Press. doi: 10.1017/9781009157964

Jacobsen K I, Lester S E, Halpern B S, 2014. A global synthesis of the economic multiplier effects of marine sectors. *Marine Policy*, 44: 273–278. doi: 10.1016/j.marpol.2013.09.019

Jarvis R M, Bollard Breen B, Krägeloh C U et al., 2015. Citizen science and the power of public participation in marine spatial planning. *Marine Policy*, 57: 21–26. doi: 10.1016/j.marpol.2015.03.011

Jordan A, Lenschow A, 2010. Environmental policy integration: a state of the art review. *Environmental Policy and Governance*, 20(3): 147–158. doi: 10.1002/eet.539

Kaim A, Cord A F, Volk M, 2018. A review of multi-criteria optimization techniques for agricultural land use allocation. *Environmental Modelling & Software*, 105: 79–93. doi: 10.1016/j.envsoft.2018.03.031

Karimi F, Khalilpour R, 2015. Evolution of carbon capture and storage research: trends of international collaborations and knowledge maps. *International Journal of Greenhouse Gas Control*, 37: 362–376. doi: 10.1016/j.ijggc.2015.04.002

Kay R, Alder J, 1999. *Coastal Planning and Management. 2nd ed*. London: CRC Press. doi: 10.1201/9781315272634

Kidd S, 2013. Rising to the integration ambitions of marine spatial planning: reflections from the Irish Sea. *Marine Policy*, 39: 273–282. doi: 10.1016/j.marpol.2012.11.004

Kirkpatrick S, 1984. Optimization by simulated annealing: quantitative studies. *Journal of Statistical Physics*, 34(5-6): 975–986. doi: 10.1007/BF01009452

Kirkpatrick S, Gelatt C D, Vecchi M P, 1983. Optimization by simulated annealing. *Science*, 220(4598): 671–680. doi: 10.1126/science.220.4598.671

Last P R, Lyne V D, Williams A et al., 2010. A hierarchical framework for classifying seabed biodiversity with application to planning and managing Australia's marine biological resources. *Biological Conservation*, 143(7): 1675–1686. doi: 10.1016/j.biocon.2010.04.008

Li X, Huang J L, Tu Z S et al., 2021. Bringing multi-criteria decision making into cell identification for shoreline management planning in a coastal city of southeast China. *Ocean & Coastal Management*, 207: 104483. doi: 10.1016/j.ocecoaman.2018.04.009

Liao J J, Zhang D, Su S K et al., 2023. Coastal habitat quality assessment and mapping in the terrestrial-marine continuum: simulating effects of coastal management decisions. *Ecological Indicators*, 156: 111158. doi: 10.1016/j.ecolind.2023.111158

Li Baiqi, 2011. *Coastal Zone Management Study*. Beijing: China Ocean Press. (in Chinese)

Li F X, Gong Y, Cai L Y et al., 2018. Sustainable land-use allocation: a multiobjective particle swarm optimization model and application in Changzhou, China. *Journal of Urban Planning and Development*, 144(2): 04018010. doi: 10.1061/(ASCE)UP.1943-5444.0000425

Li Jingguang, Zhang Zhantao, 2014. *Foreign Marine Management and Law Enforcement System*. Beijing: China Ocean Press. (in Chinese)

Li Xiaojuan, Fu Wenchen, Miao Diyou et al., 2019. Shenzhen coastal zone planning under land-sea lntegration guidance. *Planners*, 35(7): 18–24. (in Chinese)

Li Yanping, Liu Dahai, Luo Tian, 2021. The internal logic and developing direction of land-sea coordination in land space planning: from the perspective of complex system theory. *Geographical Research*, 40(7): 1902–1916. (in Chinese)

Lin Xiaoru, Wang Liyun, Wen Chaoxiang, 2018. Coastal spatial control under land-sea coordination: the case of coastal zone planning of Xiamen. *Urban Planning Forum*, (4): 75–80. (in Chinese)

Liu C L, Li W L, Xu J et al., 2022. Global trends and characteristics of ecological security research in the early 21st century: a literature review and bibliometric analysis. *Ecological Indicators*, 137: 108734. doi: 10.1016/j.ecolind.2022.108734

Liu X P, Li X, Shi X et al., 2012. A Multi-type Ant Colony Optimization (MACO) method for optimal land use allocation in large areas. *International Journal of Geographical Information Science*, 26(7): 1325–1343. doi: 10.1080/13658816.2011.635594

Liu Y, Han L M, Pei Z B et al., 2023. Evolution of the coupling coordination between the marine economy and urban resilience of major coastal cities in China. *Marine Policy*, 148: 105456. doi: 10.1016/j.marpol.2022.105456

Lu Shouben, Ai Wanzhu, 2001. *Integrated Coastal Zone Management: Research on Institutional Arrangements and Operating Mechanisms*. Beijing: China Ocean Press. (in Chinese)

Lu W H, Liu J, Xiang X Q et al., 2015. A comparison of marine spatial planning approaches in China: marine functional zoning and the marine ecological red line. *Marine Policy*, 62: 94–101. doi: 10.1016/j.marpol.2015.09.004

Lucrezi S, 2021. Stakeholders' perceptions of coastal development in relation to marine protected areas. *Journal of Coastal Conservation*, 25(4): 46. doi: 10.1007/s11852-021-00834-3

Lyne V, Hayes D, Condie SA, 2007. *A Framework for Identifying Key Ecological Features in the Marine Environment*. Canberra: CSIRO. doi: 10.13140/RG.2.1.2844.3042

Ma X L, Chen X, Li X P et al., 2018. Sustainable station-level planning: an integrated transport and land use design model for transit-oriented development. *Journal of Cleaner Production*, 170: 1052–1063. doi: 10.1016/j.jclepro.2017.09.182

Melbourne-Thomas J, Johnson C R, Aliño P M et al., 2011a. A multi-scale biophysical model to inform regional management of coral reefs in the western Philippines and South China Sea. *Environmental Modelling & Software*, 26(1): 66–82. doi: 10.1016/j.envsoft.2010.03.033

Melbourne-Thomas J, Johnson C R, Fung T et al., 2011b. Regional-scale scenario modeling for coral reefs: a decision support tool to inform management of a complex system. *Ecological Applications*, 21(4): 1380–1398. doi: 10.1890/09-1564.1

Moodie J R, Kull M, Morf A et al., 2019. Challenges and enablers for transboundary integration in MSP: practical experiences from the Baltic Scope project. *Ocean & Coastal Management*, 177: 1–21. doi: 10.1016/j.ocecoaman.2019.04.002

Morrissey K, O'Donoghue C, 2013. The role of the marine sector in the Irish national economy: an input-output analysis. *Marine Policy*, 37: 230–238. doi: 10.1016/j.marpol.2012.05.004

Moser S C, Jeffress Williams S, Boesch D F, 2012. Wicked challenges at land's end: managing coastal vulnerability under climate change. *Annual Review of Environment and Resources*, 37(1): 51–78. doi: 10.1146/annurev-environ-021611-135158

Muhonen R, Benneworth P, Olmos-Peñuela J, 2019. From productive interactions to impact pathways: understanding the key dimensions in developing SSH research societal impact. *Research Evaluation*, 29(1): 34–47. doi: 10.1093/reseval/rvz003

Neumann B, Vafeidis A T, Zimmermann J et al., 2015. Future coastal population growth and exposure to sea-level rise and coastal flooding: a Global Assessment. *PLoS One*, 10(3): e0118571. doi: 10.1371/journal.pone.0118571

Nilsson M, Nilsson L J, 2005. Towards climate policy integration in the EU: evolving dilemmas and opportunities. *Climate Policy*, 5(3): 363–376. doi: 10.1080/14693062.2005.9685563

Olsen E, Fluharty D, Hoel A H et al., 2014. Integration at the round table: marine spatial planning in multi-stakeholder settings. *PLoS One*, 9(10): e109964. doi: 10.1371/journal.pone.0109964

Ounanian K, Van Tatenhove J P M, Hansen C J et al., 2021. Conceptualizing coastal and maritime cultural heritage through communities of meaning and participation. *Ocean & Coastal Management*, 212: 105806. doi: 10.1016/j.ocecoaman.2021.105806

Pafi M, Flannery W, Murtagh B, 2020. Coastal tourism, market segmentation and contested landscapes. *Marine Policy*, 121: 104189. doi: 10.1016/j.marpol.2020.104189

Pattison D, dosReis D, Smillie H, 2004. *An Inventory of GIS-Based Decision-Support Tools for MPAs*. Maryland: National Marine Protected Areas Center, Coastal Services Center.

Pineda F, Padilla J, Granobles-Torres J C et al. , 2023. Community preferences for participating in ecotourism: a case study in a coastal lagoon in Colombia. *Environmental Challenges*. doi: 11: 100713. 10.1016/j.envc.2023.100713

Piquard M, 1973. *Le Littoral Français: Perspectives Pour l' Aménagement*. Paris: La Documentation Française. (in French)

Pittman J, Armitage D, 2016. Governance across the land-sea interface: a systematic review. *Environmental Science & Policy*, 64: 9–17. doi: 10.1016/j.envsci.2016.05.022

Piwowarczyk J, Matczak M, Rakowski M et al. , 2019. Challenges for integration of the Polish fishing sector into Marine Spatial Planning (MSP): do fishers and planners tell the same story? *Ocean & Coastal Management*, 181: 104917. doi: 10.1016/j.ocecoaman.2019.104917

Polovina J J, 1984. Model of a coral reef ecosystem. *Coral Reefs*, 3: 1–11. doi: 10.1007/BF00306135

Pomeroy R, Douvere F, 2008. The engagement of stakeholders in the marine spatial planning process. *Marine Policy*, 32(5): 816–822. doi: 10.1016/j.marpol.2008.03.017

Popova E, Vousden D, Sauer W H H et al., 2019. Ecological connectivity between the areas beyond national jurisdiction and coastal waters: safeguarding interests of coastal communities in developing countries. *Marine Policy*, 104: 9–102. doi: 10.1016/j.marpol.2019.02.050

Porta J, Parapar J, Doallo R et al. , 2013. High performance genetic algorithm for land use planning. *Computers, Environment and Urban Systems*, 37: 45–58. doi: 10.1016/j.compenvurbsys.2012.05.003

Qiao W F, Hu Y, Jia K Y et al., 2020. Dynamic modes and ecological effects of salt field utilization in the Weifang coastal area, China: implications for territorial spatial planning. *Land Use Policy*, 99: 104952. doi: 10.1016/j.landusepol.2020.104952

Rahman MdM, Szabó G, 2021. Multi-objective urban land use optimization using spatial data: a systematic review. *Sustainable Cities and Society*, 74: 103214. doi: 10.1016/j.scs.2021.103214

Ross A, Dovers S, 2008. Making the harder yards: environmental policy integration in Australia. *Australian Journal of Public Administration*, 67(3): 245–260. doi: 10.1111/j.1467-8500.2008.00585.x

Runhaar H, Driessen P, Uittenbroek C, 2014. Towards a systematic framework for the analysis of environmental policy integration. *Environmental Policy and Governance*, 24(4): 233–246. doi: 10.1002/eet.1647

Sadeghi S H R, Jalili Kh, Nikkami D, 2009. Land use optimization in watershed scale. *Land Use Policy*, 26(2): 186–193. doi: 10.1016/j.landusepol.2008.02.007

Sanò M, Medina R, 2012. A systems approach to identify sets of indicators: applications to coastal management. *Ecological Indicators*, 23: 588–596. doi: 10.1016/j.ecolind.2012.04.016

Santé I, Rivera F F, Crecente R et al. , 2016. A simulated annealing algorithm for zoning in planning using parallel computing. *Computers, Environment and Urban Systems*, 59: 95–106. doi: 10.1016/j.compenvurbsys.2016.05.005

Santé-Riveira I, Boullón-Magán M, Crecente-Maseda R et al., 2008. Algorithm based on simulated annealing for land-use allocation. *Computers & Geosciences*, 34(3): 259–268. doi: 10.1016/j.cageo.2007.03.014

Schwaab J, Deb K, Goodman E et al., 2018. Improving the performance of genetic algorithms for land-use allocation problems. *International Journal of Geographical Information Science*, 32(5): 907–930. doi: 10.1080/13658816.2017.1419249

Schwartz-Belkin I, Portman M E, 2024. Exploring barriers to the implementation of geospatial technologies in marine spatial planning: reports from practitioners. *Marine Policy*, 159: 105891. doi: 10.1016/j.marpol.2023.105891

Serrao-Neumann S, Crick F, Harman B et al., 2014. Improving cross-sectoral climate change adaptation for coastal settlements: insights from South East Queensland, Australia. *Regional Environmental Change*, 14(2): 489–500. doi: 10.1007/s10113-013-0442-6

Sharp R, Tallis H T, Ricketts T et al. , 2015. *InVEST 3.2. 0 User' s Guide*. Stanford: The Natural Capital Project, Stanford University, University of Minnesota, The Nature Conservancy, and World Wildlife Fund

Shipman B, Stojanovic T, 2007. Facts, fictions, and failures of integrated coastal zone management in Europe. *Coastal Management*, 35(2-3): 375–398. doi: 10.1080/08920750601169659

Sierra-Correa P C, Cantera Kintz J R, 2015. Ecosystem-based adaptation for improving coastal planning for sea-level rise: a systematic review for mangrove coasts. *Marine Policy*, 51: 385–393. doi: 10.1016/j.marpol.2014.09.013

Sievanen L, Leslie H M, Wondolleck J M et al., 2011. Linking top-down and bottom-up processes through the new U.S. National Ocean Policy: implementing the U.S. National Ocean Policy. *Conservation Letters*, 4(4): 298–303. doi: 10.1111/j.1755-263X.2011.00178.x

Sitzia T, Rizzi A, Cattaneo D, Semenzato P, 2014. Designing recreational trails in a forest dune habitat using least-cost path analysis at the resolution of visitor sight distance. *Urban Forestry & Urban Greening*, 13(4): 861–868. doi: 10.1016/j.ufug.2014.09.011

Smythe TC, 2017. Marine spatial planning as a tool for regional ocean governance? An analysis of the New England ocean planning network. *Ocean & Coastal Management*, 135: 11–24. doi: 10.1016/j.ocecoaman.2016.10.015

Smythe T C, McCann J, 2018. Lessons learned in marine governance: case studies of marine spatial planning practice in the U.S. *Marine Policy*, 94: 227–237. doi: 10.1016/j.marpol.2018.04.019

Smythe T C, McCann J, 2019. Achieving integration in marine governance through marine spatial planning: findings from practice in the United States. *Ocean & Coastal Management*, 167: 197–207. doi: 10.1016/j.ocecoaman.2018.10.006

Soma K, Van Tatenhove J, Van Leeuwen J, 2015. Marine governance in a European context: regionalization, integration and cooperation for ecosystem-based management. *Ocean & Coastal Management*, 117: 4–13. doi: 10.1016/j.ocecoaman.2015.03.010

Spaapen J, Van Drooge L, 2011. Introducing 'productive interactions' in social impact assessment. *Research Evaluation*, 20(3):

211–218. doi: 10.3152/095820211X12941371876742

Stamoulis K A, Delevaux J M S, 2015. Data requirements and tools to operationalize marine spatial planning in the United States. *Ocean & Coastal Management*, 116: 214–223. doi: 10.1016/j.ocecoaman.2015.07.011

Su L, Fan J J, Fu L H, 2020. Exploration of smart city construction under new urbanization: a case study of Jinzhou-Huludao Coastal Area. *Sustainable Computing: Informatics and Systems*, 27: 100403. doi: 10.1016/j.suscom.2020.100403

Tafon R, Armoskaite A, Gee K et al., 2023. Mainstreaming coastally just and equitable marine spatial planning: planner and stakeholder experiences and perspectives on participation in Latvia. *Ocean & Coastal Management*, 242: 106681. doi: 10.1016/j.ocecoaman.2023.106681

Taljaard S, Van Niekerk L, 2013. How supportive are existing national legal regimes for multi-use marine spatial planning? The South African case. *Marine Policy*, 38: 72–79. doi: 10.1016/j.marpol.2012.05.021

Thom B, 2022. Coastal management and the Australian government: a personal perspective. *Ocean & Coastal Management*, 223: 106098. doi: 10.1016/j.ocecoaman.2022.106098

Tromp E, 2019. *Enhancing Knowledge Transfer and Uptake in Design Processes of Flood Defences*. Delft: Delft University of Technology.

United Nations Environment Programme, 1995. *Guidelines for Integrated Management of Coastal and Marine Areas: with Special Reference to the Mediterranean Basin*. Nairobi, Kenya: United Nations Environment Programme.

Vázquez Pinillos F J, Barragán Muñoz J M, Ther Ríos F et al., 2023. Diagnosis of the coastal management model in Chile: the island and the sea of Chiloé governance. *Regional Studies in Marine Science*, 68: 103242. doi: 10.1016/j.rsma.2023.103242

Virtanen E A, Lappalainen J, Nurmi M et al., 2022. Balancing profitability of energy production, societal impacts and biodiversity in offshore wind farm design. *Renewable and Sustainable Energy Reviews*, 158: 112087 doi: 10.1016/j. rser.2022.112087

Wang Dongyu, Ma Qiwei, Cui Baoyi et al. , 2014. *Coastal Zone Planning*. Beijing: China Architecture & Building Press. (in Chinese)

Wang P J, Zhang J H, Ma J X et al., 2023. What impacts ecosystem services in tropical coastal tourism cities? A comparative case study of Haikou and Sanya, China. *Journal of Environmental Management*, 342: 118227. doi: 10.1016/j.jenvman.2023.118227

Warnken J, Mosadeghi R, 2018. Challenges of implementing integrated coastal zone management in into local planning policies, a case study of Queensland, Australia. *Marine Policy*, 91: 75–84. doi: 10.1016/j.marpol.2018.01.031

Wei B Q, Li Y, Suo A N et al., 2021. Spatial suitability evaluation of coastal zone, and zoning optimisation in Ningbo, China. *Ocean & Coastal Management*, 204: 105507. doi: 10.1016/j.ocecoaman.2020.105507

Weig B, 2017. *Spatial Economic Benefit Analysis*. Kiel: Bonus Baltspace Project Report.

Weig B, Schultz-Zehden A, 2019. Spatial economic benefit analysis: facing integration challenges in maritime spatial planning. *Ocean & Coastal Management*, 173: 65–76. doi: 10.1016/j.ocecoaman.2019.02.012

Wongthong P, Harvey N, 2014. Integrated coastal management and sustainable tourism: a case study of the reef-based SCUBA dive industry from Thailand. *Ocean & Coastal Management*, 95: 138–146. doi: 10.1016/j.ocecoaman.2014.04.004

Wu J, Zuidema C, De Roo G, 2022. Climate policy integration on energy transition: an analysis on Chinese cases at the local scale. *Cities*, 120: 103469. doi: 10.1016/j.cities.2021.103469

Wu X Q, Gao M, Wang D et al., 2012. Framework and practice of integrated coastal zone management in Shandong Province, China. *Ocean & Coastal Management*, 69: 58–67. doi: 10.1016/j.ocecoaman.2012.07.030

Yuan W, Chang Y C, 2021. Land and sea coordination: revisiting integrated coastal management in the context of community interests. *Sustainability*, 13(15): 8183. doi: 10.3390/su13158183

Yue W Z, Hou B, Ye G Q et al., 2023. China's land-sea coordination practice in territorial spatial planning. *Ocean & Coastal Management*, 237: 106545. doi: 10.1016/j.ocecoaman.2023.106545

Zaucha J, Kreiner A, 2021. Engagement of stakeholders in the marine/maritime spatial planning process. *Marine Policy*, 132: 103394. doi: 10.1016/j.marpol.2018.12.013

Zhang Chunhua, 2016. *Study on Conflict Measure and Optimization of Coastal Zone Based on the Ecological-Production-Living Spaces: A Case Study of ZhuangHe in Dalian*. Dalian: Liaoning Normal University. (in Chinese)

Zhang N, Yang C, Wang S Y, 2024a. Research progress and prospect of environmental, social and governance: a systematic literature review and bibliometric analysis. *Journal of Cleaner Production*, 447: 141489. doi: 10.1016/j.jclepro.2024.141489

Zhang T, Xin X, He F et al., 2023. How to promote sustainable land use in Hangzhou Bay, China? A decision framework based on fuzzy multiobjective optimization and spatial simulation. *Journal of Cleaner Production*, 414: 137576. doi: 10.1016/j.jclepro.2023.137576

Zhang Y, Ouyang Z Y, Xu C et al., 2024b. A multi-hazard framework for coastal vulnerability assessment and climate-change adaptation planning. *Environmental and Sustainability Indicators*, 21: 100327. doi: 10.1016/j.indic.2023.100327