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Study on the Marine Spatial Planning and Management of Marine Renewable Energy Development in Taiwan

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Abstract

Promoting renewable energy is crucial to the national net-zero policy goal, and conflicts over space use are easily caused by promoting renewable energy. The siting of renewable energy is mainly based on energy potential and demand. At the same time, the spatial information related to other objectives and resources still needs to be completed, which increases the social and economic costs due to conflicts. For example, the current cases on the siting of offshore wind farms show the importance of spatial planning in the marine area. Therefore, this study aims to clarify the characteristics of marine spatial information and the integration of different scales of spatial information, the differences in the demands of marine spatial information by different users, the conflicts and coordination of multiple objectives of marine spatial use, and to help establish a mechanism for the participation of stakeholders to guide them from conflict to coexistence and then to collaborate in the strategic study of marine spatial resource planning. This study will clarify the current competition between the identified potential areas of marine renewable energy and other uses by understanding the limited marine spatial information and will study the difficulties that may be encountered in the integration and application of the information so that it can consider the multi-targeted use of marine space under the overall renewable energy policy purpose, and propose a framework for overall marine spatial planning as a response to the renewable energy development department tools, regulations, interdepartmental governance, and special geographical issues. The proposal provides a scientific basis and future spatial planning for developing renewable energy sector tools, regulations, interdepartmental governance, and particular areas.

Keywords: Marine spatial planning; Marine renewable energy; Using competitive; Net zero policy; Interdepartmental governance

Introduction

Climate change has made renewable energy sources a top priority on national policy agendas globally. To achieve net-zero emissions and mitigate climate change, fossil fuels must be replaced with cleaner, more sustainable energy. Marine renewable energy sources like offshore wind farms and tidal energy projects are abundant and reliable, making them promising options. However, allocating important maritime area for marine renewable energy typically presents difficult issues. Strategic energy project siting is crucial in maritime renewable energy development. This technique usually evaluates energy potential and area demand. It seeks areas to optimize renewable energy output to fulfill energy demands effectively. However, this standard strategy has criticized for focusing just on energy production and neglecting marine ecosystems and activities' spatial elements. Overlooking other spatial issues may lead to marine area usage conflicts. When parties with different goals compete for marine spaces, these conflicts may arise. Marine locations utilized for fishing, shipping, tourism, or conservation may be suitable for renewable energy infrastructure. Conflicts of interest may cause disagreements, project delays, and lawsuits. Failure to account for diverse goals and resources may have significant social and economic consequences. These costs may include project delays, legal fees, and environmental damage from poor planning. Indeed, ignoring maritime environments' complex spatial dynamics might hinder renewable energy projects' sustainability and environmental protection aims. Addressing these difficulties requires a comprehensive approach to maritime spatial planning that includes several aims and resources. This method should identify renewable energy development sites and coordinate them with maritime operations and environmental protection. This requires a grasp of marine ecosystems' complex linkages and stakeholders' demands and expectations, including coastal communities, industry, environmental groups, and governments. Promoting maritime renewable energy is vital to fighting climate change, but it presents complicated geographical constraints. Siting energy projects exclusively on energy potential and demand ignores the larger geographical context. This may cause disagreements and expensive delays. Comprehensive marine spatial planning is need

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to overcome these constraints and maximize marine renewable energy. To guarantee that maritime renewable energy production supports sustainability, environmental preservation, and climate action, this method must incorporate varied geographical information, recognize conflicting objectives, and encourage stakeholder engagement. The location of offshore wind farms is a powerful example of how marine spatial planning is crucial to the sustainable and efficient development of marine renewable energy projects. The complexity of maritime spatial planning and its relevance in marine renewable energy development are the focus of our study. Marine spatial information differs from terrestrial spatial planning, therefore first, acknowledge. Marine habitats are continually changing due to tides, currents, and weather. Sustainable marine spatial planning requires data on both physical and biological factors, including marine habitats and biodiversity hotspots. Human activities like shipping routes, fishing grounds, and tourist zones must also be included in these fluid ecosystems. Harmonizing spatial data across scales is a major difficulty in maritime spatial planning. Marine ecosystems span national borders and span coastal areas to enormous oceans. Effective planning requires integrating local, regional, and global data to create complete plans that fulfill local needs and conservation and sustainability goals. Marine spatial planning is complicate by diverse stakeholders with different goals. These stakeholders include coastal communities, indigenous groups, commercial fisheries, environmental advocacy groups, energy producers, and government. Each group has different needs, objectives, and concerns, which might cause maritime space disputes. Sustainable and fair results require understanding and resolving these various viewpoints. Competition for limited maritime resources and space causes marine spatial planning disputes. Renewable energy ambitions must coexist with commercial fishing, shipping routes, and conservation efforts. Since hurried or misinformed choices may harm the environment, economy, and society, balancing these interests needs careful study. Participatory maritime spatial planning may help resolve these tensions and promote collaboration. Engaging stakeholders in collaborative discourse may shift the paradigm from conflict resolution to cohabitation and collaboration. This inclusive method allows stakeholders to jointly plan marine space sustainability, taking into consideration varied demands and goals. The complex relationship between maritime spatial planning and renewable energy development is show by offshore wind farm siting. This study explores the intricacies of this confluence, taking into account marine spatial information's unique characteristics, the need to harmonize data across scales, stakeholder variety, and opposing aims. We aim to contribute to a strategic examination of marine spatial resource planning within the context of renewable energy development by championing a participatory approach. Our goal is to achieve coexistence and cooperation in the sustainable use of our valuable marine resources. This study seeks to examine the continuous conflict between specified maritime renewable energy development sites and the many other uses and activities that occupy the same marine regions. Our work focuses on this rivalry and the barriers to marine spatial information integration and implementation. Understanding marine spatial information's intricacies is crucial to our research. Marine ecosystems are fluid, connected, and changeable, unlike terrestrial ones. Marine spatial information includes bathymetric maps, oceanographic data, ecological evaluations, and socio-economic analysis. The integration of disparate information into a cohesive and actionable framework is a major problem that we want to overcome. Our study reveals marine spatial information integration and application difficulties. Data gaps, discrepancies, and the lack of data exchange and analysis processes are examples of these shortcomings. Addressing these restrictions is essential to provide decision-makers with accurate, up-to-date, and relevant information when allocating maritime area for renewable energy projects. We want to improve marine spatial information systems for decision-making by recognizing these constraints. Our research seeks to integrate complex maritime space usage into renewable energy strategy while overcoming these restrictions. This means acknowledging that maritime regions are vital for commercial fishing, shipping, tourism, and biodiversity protection. Choosing between these applications necessitates weighing the potential advantages of renewable energy production against its socio-economic and environmental drawbacks. We want to present a systematic framework for comprehensive marine spatial planning as a key research result. In addition to regulatory measures, this framework will address interdepartmental governance. Effective maritime spatial planning requires cooperation and coordination among government agencies and stakeholders with different jurisdictions and interests. We will present rules and procedures to improve cooperation, decision-making, and stakeholder synergy. Furthermore, maritime environments' geographical qualities might vary greatly, creating distinct difficulties and possibilities in various places. Thus, our framework will provide customized solutions for geographical issues. This requires identifying regional differences in marine ecosystems, socio-economic situations, and cultural sensitivities to tailor marine spatial planning to local demands. Our study aims to establish a scientific basis for renewable energy spatial planning. Policymakers, regulators, and stakeholders need tools and knowledge to navigate marine renewable energy development, so we address marine spatial competition, integrate diverse data sources, and propose a structured framework for holistic planning. We aim to promote a sustainable and harmonious coexistence of renewable energy projects and other marine uses, ensuring that marine resources are responsibly harnesses to meet our energy needs while protecting our oceans and coastal communities. Marine renewable energy promotion is crucial to fighting climate change and transitioning to a sustainable energy future. This effort is complicate by a web of spatial issues that need careful attention. The typical strategy of choosing renewable energy project locations based on energy generating potential and local demand seems rational on paper, but it fails in maritime settings. Thus, this insufficiency may cause complex issues, disputes, and expensive setbacks that hamper renewable energy growth. Marine spatial planning is challenging; therefore, we must rethink how we allocate maritime area for renewable energy projects. This transition involves adopting a holistic marine spatial planning strategy that goes beyond traditional thinking. An integrative approach that combines different and sometimes incongruous spatial information acknowledges the complex fabric of marine ecosystems, human activities, and

environmental processes. Understanding that maritime regions are dynamic and interrelated due to tides, currents, climatic changes, and biological processes is the main problem. A complete marine spatial planning approach must include bathymetry, oceanography, marine ecosystems, biodiversity distribution, and socio-economic considerations. This comprehensive approach lets decision-makers maximize maritime space usage while avoiding risks. Remember that maritime habitats are shared by stakeholders with different goals and interests. Coastal communities, indigenous groups, commercial businesses, environmentalists, and governments compete over marine space. Recognizing and balancing these opposing goals is key to cooperation and conflict reduction. Effective maritime spatial planning requires stakeholder collaboration. To do this, foster teamwork and shared accountability. Participatory procedures that include all participants in planning and execution may provide more fair and sustainable results. Participatory procedures allow stakeholders to collaborate on responsible maritime space usage and identify mutually beneficial solutions. A comprehensive maritime spatial planning methodology ensures that marine renewable energy development supports sustainability goals. This alignment supports environmental preservation, biodiversity conservation, and coastal community well-being as well as greenhouse gas emission reduction. Marine spatial planning can help achieve a sustainable energy future that protects our oceans and coastal ecosystems and addresses climate change by navigating multifaceted challenges with an inclusive and data-driven approach [1-11].

Methodology

The primary objective of the current study is to perform a detailed systematic and meta-analytic policy review associated with Marine Spatial Planning (MSP) and management of marine renewable energy development in Taiwan. The focus of the review is to provide a thorough empirical analysis of the progress of MSP in Taiwan, and an overview of its evolution within diverse national and regional contexts considering the global scope of the topic of interest. To achieve the intended objectives, the paper adopts a qualitative policy analytical approach based on the perspectives of policy analysis and sustainable development. The adopted methodological framework of qualitative policy analysis is beneficial for the ability of improving the practicability of the unmanageable public policy and, therefore, the study is viewed as both a process and a product. As a process, the study applies both policy analysis and sustainable development perspectives to examine associated materials from a wide range of government documents, think-tank statistics, and academic literature to study the topic of interest. As a product, the study presents the appropriate policy recommendations for improving the MSP and management of marine renewable energy development in Taiwan.

As a qualitative policy analytical study, the author adopted the systematic review model by and, in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The three-step review framework by involved planning, conducting and reporting the review. In the first step, the author developed a review protocol that outlined the inclusion and exclusion criteria of the materials to be included in the study. The relevant and applicable articles for the study were collected from multiple bibliographic databases containing journals, government documents, think-tank statistics patents, and the sources of cited references to provide a comprehensive overview of MSP and management of marine renewable energy development in Taiwan. The author then applied the inclusion and exclusion criteria to exclude the materials that were not relevant for achieving the objectives of the systematic policy review. The included materials had to adopt either a policy analysis perspective, sustainable development perspective or both. The policy analysis materials included in the study focused on solving existing policy problems associated with MSP and marine renewable energy while the sustainable development perspective materials focused on the three es; environment, economy and equality [12-15].

The overall search strategy for the materials included in the systematic policy review was guided by a preliminary review of existing literature and knowledge on the topic. The existing policy reviews and literature was crucial in identifying the relevant research terms and phrases for the different materials to be included. The authors searched for associated publication titles, keywords and abstracts for published research between 2016 and 2023 that focused on MSP and marine renewable energy with an emphasis on Taiwan, even though other studies with a regional scope were also incorporated. The databases of interest included government documents, think-tank statistics, journals, legislative proceedings and the sources of cited references. Any additional article that was associated with marine environmental policies and could not be identified through database searches was identified through cross-referencing and hand searches of the reference lists of the included studies and the existing systematic reviews and meta-analyses on the topic. The Boolean operators and the keywords used for the material research included ‘Marine Spatial Planning’, ‘Marine Renewable Energy’, ‘Net Zero Policy’ and ‘Sustainable Development’ [16,17].

After the identification of the materials that passed the inclusion and exclusion criteria, the author did away with the duplicate materials and selected those to be included using a multi-step screening strategy. The first step of the screening process involved the exclusion of the materials with irrelevant titles and those that did not cover the regional scope of the study. Secondly, the author removed the studies with abstracts that did not align with the policy analysis and sustainable development perspectives and those that were considered to be editorials or commentaries. To determine the suitability of the remaining materials, the researcher applied the inclusion and exclusion criteria and created an ultimate list of studies that met the review objectives. After selection of the relevant materials, the researcher extracted specific facets of information associated with on MSP and marine renewable

energy in Taiwan. To achieve the product goal of the study, the author applied the 'planner's triangle' to identify MSP policy dilemmas and the applicable recommendations. The subsequent sections of the review present the material findings and a detailed policy analysis and sustainable development perspectives on the topic (**FIG.1**).

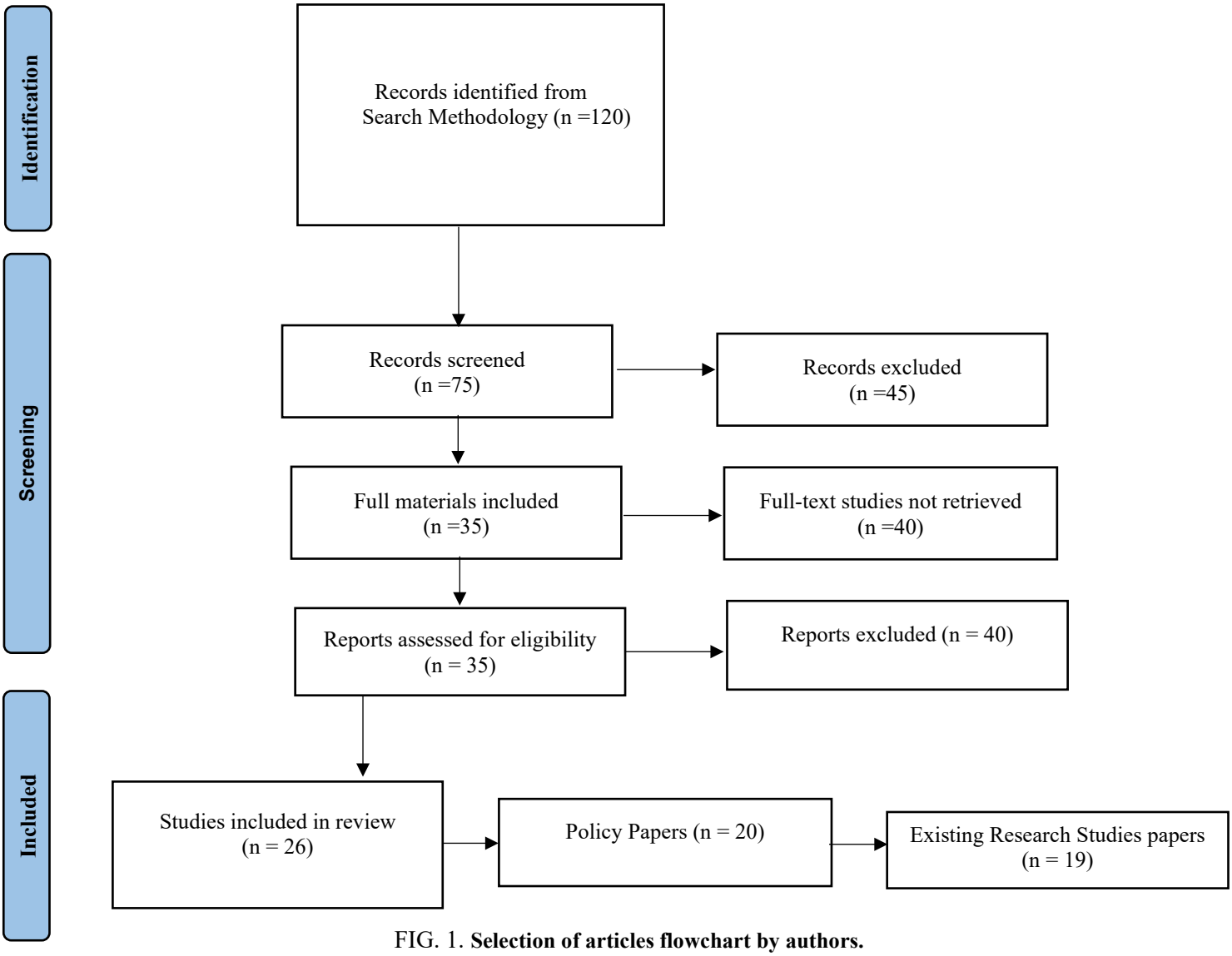

FIG. 1. **Selection of articles flowchart by authors.**

Results

The material search methodology identified a total of 120 materials including policy papers, white papers, government documents and academic literature associated with MSP and management of marine renewable energy development in Taiwan. The different material sources included Ocean Yearbook Online, Marine Policy, Ocean Law and Policy, Energies, Sustainability, and Ocean and Coastal Management. Other materials sources included Marine Policy and Educational Handbook, Journal of Marine Science and Technology, Marine Science and Engineering, and Energy and Environment. After the removal of the duplicated studies, only 75 articles and research materials remained. Out of the remaining studies, 40 did not meet the inclusion criteria and, therefore, only 35 were obtained for detailed eligibility assessment. Further, 6 studies did not meet the eligibility criteria and were excluded from the final list of the resource materials included in the review, and consequently, a total of 29 research materials were eligible for inclusion in the research (**TABLE 1).**

TABLE. 1 **Systematic review table.**

Author	Year of Publication	Type of Material	Focus of Material	Methodology	Publishing Source/ Database
McAteer *et al.*	2020	Policy review	Overview of evolution of Marine Spatial Planning (MSP) within	Empirical analysis	Ocean yearbook online

		article	diverse national and regional contexts including Taiwan		
Chang & Lin	2016	Qualitative policy review article	Improvement of MSP using incremental amendment strategy with a focus on anping, Taiwan	Spatial planning mapping using Geographic Information System (GIS) analysis	Marine policy
Chung	2021	Policy analysis article	Policy recommendations on the design and decision-making processes for Taiwan's Offshore Wind Energy Policy (OWE)	Qualitative policy analysis	Ocean law and policy
Tsai *et al.*	2022	Policy analysis article	Evaluation of MSP and the exploitation of OWP in Taiwan	Qualitative policy analysis	Energies
Huang *et al.*	2022	Case Study Analysis	Evaluation of offshore	Spatial analysis and a Multi-	Sustainability
Lee *et al.*	2014	Policy research study	MSP framework in Southern Taiwan.	Multi-attribute evaluation.	Sustainability
Shiau	2018	Policy research study	Sea use management using a hybrid operational model in Taiwan.	Numerical hybrid operational model	Marine policy educational book
Kao & Ben	2017	Conference policy paper	The sustainable management of marine resource zones in the Taiwan territory spatial planning	Review of existing articles and literature.	International conference of asian-pacific planning societies
Chien *et al.*	2022	Conference Paper	To estimate the priority of deep-water wind farm development in Taiwan	Ocean spatial suitability analysis.	The 32nd international ocean and polar engineering conference
Zhang *et al.*	2017	Systematic Review	Offshore wind farm in MSP and the stakeholder's engagement: Opportunities and challenges for Taiwan	Review of existing literature and articles.	Ocean and Coastal Management.
Tsai *et al.*	2022	Policy analysis article	Review on the conflicts between offshore wind power and fishery rights: marine spatial planning in Taiwan	Qualitative policy analysis	Energies
Lin *et al.*	2019	Research study	Perceptions of offshore wind farms and community development: case study of fangyuan township, chunghua county, Taiwan	Mixed research methodology	Journal of marine science and technology
Winther & Dai	2020	White paper	Integrated ocean management	Policy review	World resources institute
Li *et al.*	2022	Review article	Flexibility and feasibility of emerging offshore and coastal ocean energy technologies in East and Southeast Asia.	Review of existing literature and articles.	Renewable and sustainable energy reviews
Tsai & Lin	2021	Research study	Strategies for navigation safety in the offshore wind farm in taiwan strait	Fault tree analysis	Marine science and engineering
Suris-Regueiro *et al.*	2021	Empirical study	Estimation of the direct economic impact of Marine Spatial Planning (MSP)	Methodological stepwise procedure for estimating economic impacts related to public policies.	Marine policy
United Nations Educational, Scientific and Cultural Organization	2017	White paper	Marine/Maritime Spatial Planning	Review of existing policies.	2nd International conference on marine/maritime spatial planning
Garcia *et al.*	2021	Case study	The role of maritime spatial planning on the advance of blue	Study of MSP processes.	Marine policy

		analysis	energy in the European Union		
Chien *et al.*	2019	Research study	Application of nearshore risk assessment of hazard and vulnerability in	Engineering risk assessment.	In international conference on offshore mechanics and arctic engineering
Cho & Kao	2022	Research study	Marine space planning as a	Review of literature evidence	Sustainability
Colak *et al.*	2021	Case study	GIS-based maritime spatial planning	Spatial planning analysis	International journal of energy
Liao *et al.*	2023	Systematic review and meta-analysis	MSP as solutions for offshore wind	Marine spatial planning analysis	Energy and environment
Smythe & McCann	2018	Case study	Marine governance and practice in the U.S.	Review of literature evidence	Marine policy
Chalastani *et al.*	2021	Bibliomc assessmt	Progress made on MSP	Bibliometric analysis	Marine policy
Frazao *et al.*	2020	Systematic review and meta-analysis	Challenges associated with MSP	Review of existing literature and studies	Marine policy
Flannery *et al.*	2018	Systematic review and meta-analysis	Exclusion and non-participation in Marine Spatial Planning (MSP)	Review of existing literature and studies	Marine policy

Discussion

The current systematic policy review analysed existing research materials and articles that focused on investigating the Marine Spatial Planning (MSP) and management of marine renewable energy development in Taiwan. Based on the available geographical information, Taiwan is categorized as a maritime nation and its marine environment has a wide variety of activities including fisheries, shipping, commerce, and recreational development. Like in most maritime countries, Marine Spatial Planning (MSP) in Taiwan is a place-based integrated maritime governance policy aimed at addressing a wide range of maritime associated sectors and fragmented management issues. The MSP policy has become the widely used and commonly endorsed approach for marine environment sustainable development and is being implemented across different regions globally, especially in maritime nations such as Japan, Taiwan and China. While the policy is widely accepted and embraced by most maritime regions, there are still conceptual and practical challenges that still exist and have a negative impact on the realization of its potential. Some of the existing challenges associated with the policy include institutional shortcomings, stakeholder exclusion and lack of accountability for human and social dimensions. To better understand MSP and marine renewable energy development in Taiwan, it is imperative to understand the global and national evolution of the policy and its associated factors [18-20].

As a globally accepted maritime policy, MSP has significantly contributed to a sustainable economic, environmental and social governance of the maritime environment. Currently, most principles of the MSP are based on spatial planning practices which has instigated a spatial turn in regulation and governance of global marine systems. The basis of the MSP policy is the implementation of marine management plans that involve the use of specific instruments and regulations such as outlining maritime geographical patterns within particular spaces. Also, the policy is based on the principles of neutrality and accessibility to ensure operation within an optimum arrangement of interests while engaging with a wide range of actors and perceptions for conflict prevention between marine environment and human activities. In Taiwan, the MSP is used as an operational framework for conservation of the national marine environment to enable the realization of economic potential and facilitation of integrated sea patterns among the involved stakeholders. The multi-faceted operational approach of the policy is strongly associated with conservation of marine environment and has been academically interpreted as extension of earlier marine protection initiatives.

The evolution of energy policies in Taiwan started in the early 1980s when the country transformed from a democratic to a capitalist society with the subsequent decade experiencing a rapid fossil-fuel-based economic growth and prosperity. Being a maritime territory, the country possesses rich marine environment and resources with a large of the population being interdependent with the ocean and seas. Considering the dependency on the maritime environment, the maintenance of the

sustainability development of the ocean and seas affects all aspects of life of all levels of the Taiwan society. However, since the turn of the new millennium, a lot of concerns have arisen concerning the energy structure largely attributed to internal and external factors. In the first decade of the current millennium, the Taiwanese marine sector accounted for between 4.80% and 5.75% of the Gross National Product (GNP), a statistic which highlights the importance of the marine environment to the country's economy. At the start of the current decade, the top energy sources for Taiwan included natural gas, coal, nuclear energy, petroleum and nuclear energy with natural gas accounting for almost half of the total energy produced. Still, there are a wide variety of measures aimed at promotion of development of other energy sources linked with the maritime environment [21].

The development and implementation of marine energy policies in Taiwan is defined by the Electricity Act and overseen by the Ministry of Economic Affairs and the Ministry of Interior. Apart from the executive branches of the government, other governmental agencies are also responsible for development of a series of measures for development and promotion of the associated energy policies as well as legislative and national regulations for ocean governance. The initial and widely known governmental regulative legislation of marine resources is the National Territorial Planning Act (NTPA) of 2009 that ensured the integration of sea areas into the territorial planning system. According to the Act, marine resources are required to be classified and zoned based on their respective functions such as mineral extraction zones, fishing areas, coastal engineering areas and marine protected areas. The classification of the marine economic activities is undertaken by competent and authorized governmental agencies such as the Fishery Agency, Environmental Protection Agency, Council of Agriculture, and Council for Cultural Affairs, the Bureau of Energy and associated local governments. The framework outlined by the National Territorial Planning Act (NTPA) of 2009 provided the perfect foundation for the development of the Taiwanese MSP and marine energy development policies [22-24].

According to Article 4(2) of the Ocean Basic Law, the Taiwanese government is responsible for the promulgation of the regulations associated with Marine Spatial Planning (MSP) and the marine renewable energy development programs, and coordination of use and competition laws of sea areas. For effective promotion and implementation of the integrated ocean management policies, the government promulgated the Coastal Zone Management Act in 2015 for approval of protection and legal aspects associated with the maritime environment and resources. Article 2(1) of the Act defines different geographical phenomena of the maritime environment including the 'offshore area', and 'marine environment, and outlined the different maritime zones in the sea areas of Taiwan. Within the context of the current discussion, Article 2(1) of the Ocean Basic Law defines the offshore area based on the tide line with an average high tide line to the 30 m isobaths towards the sea. According to the Bureau of Energy, under the Ministry of Economic Affairs, there are over 30 zones that have exceeded the offshore areas that can provide electrical energy that can be installed in the maritime environment outside the sub-tidal line and not exceeding the territorial sea areas. Considering the lack of geographical-based legislative regulations, a large proportion of the MSP covers the north and south cable corridors that lies under the scope of coastal management as well as the areas outside the scope of maritime environment that cannot be regulated [25,26].

In Taiwan, Article 7 of the "Law on the Exclusive Economic Zone and the Continental Shelf of the R.O.C." requires the permission of the government for utilization of any maritime energy sources including water, current and offshore winds, or any activities within the Exclusive Economic Zone (EEZ). The Taiwanese EEZ zone overlaps with the adjacent and opposite countries and, therefore, the R.O.C law can extend beyond the country's territorial boundaries and define the priority energy areas for maritime energy sources. In 2021, the Ministry of Economic Affairs under Article 5 of the 'Offshore Wind Farm Directions of Zone Application for Planning' demarcated and announced the "Sensitive Areas of Marine Areas in Site Planning" and "Table of Highly Sensitive Areas" to define the offshore and maritime areas that are considered as environmentally sensitive areas. The demarcation of the announced geographical areas was done in consultation with different government agencies including the Fisheries Agency and Council of Agriculture which recommended the zone of set net fishing rights, aquatic organisms' propagation and conservation zone and fishing prohibition zone of artificial reef, as well as the State-Owned Enterprise Commission which recommended natural gas pipelines. Also, other authorized and governmental agencies proposed different zones with a general consensus based on the MSP policies being defined by government legislative acts [27].

The geographical and regulatory complications of the Taiwanese natural environment have created significant difficulties in the implementation of MSP policies and associated projects. According to the Environmental Impact Assessment (EIA) under the Environmental Protection Administration, any environmental impact assessment in Taiwan is required to be performed before the commencement of any developmental activities that might have any adverse environmental impact. Based on the background, the EIA forms the background for assessment of conflicts associated with environmental protection and economic developments before the start of any constructional projects. While the early engagement of interested stakeholders in marine construction developments is not a regulatory necessity in Taiwan, it is an important factor for achievement of consensus and resolution of conflicts among the marine space users. As a matter of fact, from a marine policy perspective, the incorporation of stakeholders from in the participation of marine construction projects is an efficient means of addressing the issues of public opinion and acceptance of the MSP policy projects. Therefore, the success of the Taiwanese MSP is based on the integration of

planning into existing national spatial planning systems with the associated due diligence processes creating participatory opportunities for involved stakeholders.

The new Taiwanese government elected in 2016 has focused on the implementation of environmentally friendly policies with the MSP system being considered as a priority. With the primary objective of accommodating the heightened range of pressures associated with the nation's marine environment and establishment of an integrated framework, the government has legislatively introduced and implemented MSP systems across the country as an active approach for marine use management. Prior to 2018, the Ministry of Interior was solely responsible for implementation of coastal administrative and regulatory functions, and management of applications for use of marine areas. In 2018, the government established the Ocean Affairs Council (OAC) which was primarily tasked with governing the developing MSP system and ensuring accountability for implementation and management of the marine environment. The OAC is formulating an Act for strengthening marine area management and establishment of a dynamic MSP system. The Sea Area Management Act, which is not yet legislatively implemented is culmination of a process of consultations between different municipal and county governments, is specifically aimed at strengthening marine monitoring and safeguarding the country's marine rights and interest [28].

As a work in process, the objectives of the Taiwanese Sea Area Management Act are based on underlying matters of national security, development of marine environment, extraction of marine resources and the fair utilization of the ocean and sea areas. Currently, the Act is considered as the hallmark for the implementation of the Taiwanese MSP since it is shaped by the principles and objectives of the policy as well as a wide range of existing legislative provisions for management of the marine environment. While the Sea Area Management Act is still an important legislative piece of the MSP and marine management, it is superseded by the Ocean Basic Act of 2015 which deals with protection of marine resources and ecology as well as their sustainable management. According to Article 13 of the Act, the Taiwanese government is responsible for the protection of all marine areas as well as development of the relevant preservation and protection policies and programs. Article 6 of the Act further provides the Ocean Conservation Administration (OCA) with the mandate of establishment of service units necessary for protection of marine environmental resources and implementation of related conservation laws with Taiwanese territorial waters.

Another legislative pillar of the Taiwanese MSP and marine energy development is the Marine Conservation Act which is designed to protect the country's marine environment and promote the conservation and restoration of its biodiversity. The Act is aimed at promoting the coordinated planning of protection of the marine protected areas and reduction of conflicts among the involved stakeholders for promotion of sustainability of resources and creation of a healthy marine environment. While it has not been legislatively implemented, the Marine Conservation Act is expected to establish a coordinated mechanism and ensure the integration of marine conservation goals and promote future sustainability. The establishment of the Ocean Conservation Administration (OCA) in 2018 has led to the creation of a new milestone in the Taiwanese ocean governance since it led to the development of the associated legislative acts such as the Sea Area Management Act and the Marine Conservation Act which are important pillars of the MSP policies and objectives. Since its establishment, the administrative authority has overseen the management of marine protection and conservation of resources as well as enforcement of laws and regulations to ensure the institutionalization of marine protection and coordination of management of the existing planned marine reserves in the future [29].

While Taiwan is making commendable steps towards the implementation of MSP and marine renewable energy development, there are still challenges associated with management responsibilities and the lack of executive-level coordination mechanisms. An outstanding challenge associated with the implementation of the MSP policies is the lack of a dedicated agency for consolidation of the basic scientific database of marine resources that has led to limitation of the range of available information and knowledge to inform management decision-making. Also, there is lack of a comprehensive analysis of the marine ecological situation even though the monitoring process is conducted through fractional Environmental Impact Assessment (EIA) surveys. Apart from the institutional challenges, the successful implementation of the MSP policies is affected by political factors including contradictions between different legislative documents and domestic policies which can lead to confusion and conflicts as exemplified by disputes and concerns over ministerial communications and coordination of policies. As a result, it is recommended that the associated MSP factors should incorporate the limitations into its development and ensure the implementation of appropriate rectification efforts.

Conclusions

The primary objective of the current policy systematic review was to investigate and analyze the existing knowledge and information on Marine Spatial Planning (MSP) and marine development management in Taiwan. According to the research, Taiwan is categorized as a maritime nation and its MSP is a place-based integrated maritime governance policy aimed at addressing a wide range of maritime associated sectors and fragmented management issues. Within the global context, the MSP policy has become the widely used and commonly endorsed approach for marine environment sustainable development and is being implemented across different regions. The basis of the MSP policy is the implementation of marine management plans that involve the use of specific instruments and regulations such as outlining maritime geographical patterns within particular spaces.

MSP has significantly contributed to a sustainable economic, environmental and social governance of the maritime environment and most of its principles are based on spatial planning practices which has instigated a spatial turn in regulation and governance of global marine systems.

In Taiwan, there are different energy sources with solar generation being popular in the coastal areas while tidal energy is considered as a minority source of energy. The top energy sources for Taiwan included natural gas, coal, nuclear energy, petroleum and nuclear energy with natural gas accounting for almost half of the total energy produced. The success of the Taiwanese MSP is based on the integration of planning into existing national spatial planning systems with the associated due diligence processes creating participatory opportunities for involved stakeholders. The development and implementation of marine energy policies in Taiwan is defined by the Electricity Act and overseen by the Ministry of Economic Affairs and the Ministry of Interior and other governmental agencies are responsible for development of a series of measures for development and promotion of the associated energy policies. While Taiwan is making commendable steps towards the implementation of MSP and marine renewable energy development, there are still challenges associated with management responsibilities and the lack of executive-level coordination mechanisms. It is recommended that the associated MSP factors should incorporate the limitations and challenges into its development and ensure the implementation of appropriate rectification efforts.

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