


Review

Review on the Conflicts between Offshore Wind Power and Fishery Rights: Marine Spatial Planning in Taiwan

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Abstract: In recent years, Taiwan has firmly committed itself to pursue the green energy transition and a nuclear-free homeland by 2025, with an increase in renewable energy from 5% in 2016 to 20% in 2025. Offshore wind power (OWP) has become a sustainable and scalable renewable energy source in Taiwan. Maritime Spatial Planning (MSP) is a fundamental tool to organize the use of the ocean space by different and often conflicting multi-users within ecologically sustainable boundaries in the marine environment. MSP is capable of definitively driving the use of offshore renewable energy. Lessons from Germany and the UK revealed that MSP was crucial to the development of OWP. This paper aims to evaluate how MSP is able to accommodate the exploitation of OWP in Taiwan and contribute to the achievement of marine policy by proposing a set of recommendations. It concludes that MSP is emerging as a solution to be considered by government institutions to optimize the multiple use of the ocean space, reduce conflicts and make use of the environmental and economic synergies generated by the joint deployment of OWP facilities and fishing or aquaculture activities for the conservation and protection of marine environments.

Keywords: maritime spatial planning; offshore wind power; renewable energy; fishery rights; sustainable development



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1. Introduction

Climate change has emerged as one of the major environmental challenges facing the world. The promotion of renewable energy has gradually become a mainstream trend, and countries are also promoting the construction of large-scale renewable energy generation facilities with various supporting regulations or policies. Since the world's first-ever electricity from offshore wind (Vindeby Offshore Wind Farm) was officially operated in Denmark in 1991 [1], offshore wind power (OWP) has become an emergent source of offshore green energy. OWP occupies minimal land area with the characteristics of renewable energy. Large-scale development of OWP farms implies an increase in marine space use conflicts with traditional uses such as fishing and navigation [2]. Managing potential impacts on marine ecosystems and on resource access for traditional and prospective users is crucial [3]. The areas used for OWP farms can in principle no longer be used by other users. Fisheries experience direct impacts if OWP farms are located on their fishing grounds [4,5].

Since Taiwan has great wind energy resources on its seas, it has advantages in the development of OWP [6,7]. Developing OWP is one of the best choices for developing green energy, especially on the Taiwan Strait, with its excellent wind field. However, the planning and construction of OWP will inevitably affect the existing marine space use. When developing OWP in Taiwan, such issues as the changes in fishing grounds, fishermen's losses, navigation safety and marine ecology should be considered. Among

them, the impact of OWP farms on fishermen is the most obvious. In Taiwan's Miaoli, Changhua, Yunlin and other places, fishermen have protested against OWP developments concerning the exclusion of fishing rights, the ineffective subsidies of fishery compensation standards and the protection of sustainable fishing, which has caused disputes over the conflict of competition and cooperation between the development of OWP and fishery rights. Marine Spatial Planning (MSP) seems to be a practical scheme to better organize the use of the ocean space by different and often conflicting multi-users within ecologically sustainable boundaries in the marine environment [8].

The energy sector in Taiwan is in a period of transformation. The current government's green energy policy is set to increase the proportion of renewable energy to 20% and achieve the goal of non-nuclear homes by 2025 [9]. Among them, wind power is the main source of power generation, and OWP under planning is an important basis for achieving the green energy policy. Furthermore, sustainable development goal seven (SDG 7) in the "UN Sustainable Development Goals" (SDGs) announced in 2015, relates to sustainable energy [10]. It sets up clear objectives for the next energy transition for global society. The goals of energy services in the future should be affordable, reliable and energy-sustainable [11]. By comparing the OWP regulation models of European countries (such as Germany and the UK) with Taiwan's practice, this paper explores Taiwan's future development of OWP farm regulations and policies.

MSP is generally considered an appropriate tool for encountering the transition from a traditional model of sector-by-sector administration to an ecosystem management approach to marine space [12], especially the emerging use of OWP energy [13]. This paper studies the conspectus of MSP in Taiwan from a holistic approach and analyzes the repercussions of future MSP in the OWP with a twofold objective: to identify the regulatory factors related to MSP that affect the use of OWP energy in Taiwan; and to propose a set of recommendations aimed at overcoming the conflict between the development of OWP and fishery rights in future uses of Taiwanese waters.

2. Reconciling OWP Development and Fisheries: Experiences from Europe

Large-scale development of OWP implies an increase in marine resource use conflicts. Managing potential impacts on marine ecosystems and on resource access for traditional and prospective users is important. The European Union (EU) has become a global leader, being responsible for about 90% of global newly finished OWP projects [14]. Since the European Commission (EC) announced a communication to promote its blue energy development, offshore renewable energy production has been on its political agenda since 2008 [15]. It has now become an integral part of the EU Renewable Energy Strategy. The policies for the promotion of marine renewable energy are among the elements that have driven the progress of MSP approaches in Europe with the greatest force [16], such as the multi-use of marine spaces for OWP development and the protection of sustainable fisheries.

2.1. Policy Development on the Use of Marine Areas for OWP: Experiences from Germany

With the approval of the Strategy on the Use of Offshore Wind Energy, the German government's commitment to marine renewable energies became clear in 2002 [17]. The document includes provisions with spatial planning, and identifying potentially suitable marine areas for OWP farms. In 2009, Germany enacted Maritime Spatial Plans (MSP) for the exclusive economic zone of the North Sea and the Baltic Sea for the first time, which established rules on how to use and develop the exclusive economic zone with legally binding goals and guiding principles [18]. The legal basis for the MSP is the Federal Spatial Planning Act (ROG), which was last amended in 2017 to transform the European Union (EU) MSP Directive 2014/89/EU [19]. The ROG identifies the central Government as taking responsibility for the planning of the German Economic Exclusive Zone (EEZ), whereas the three coastal federal states take responsibility for the management of territorial waters.

The competent authority for maritime spatial planning in Germany is the Federal Ministry of the Interior, Building and Community (BMI). The BMI then appointed the

Federal Maritime and Hydrographic Agency (BSH) to develop the management plan of the MSP, which intends to reinforce maritime traffic, making it safer, protecting marine environment and reconciling the exploitation of OWP farms [20]. In June 2019, the BMI and the BSH jointly promoted the update and revision of the MSP. The BMI informed specific groups and alerted public sectors that the revision of the MSP would be carried out in accordance with Article 9(1) of the ROG, and specifically invited the public sector to provide its scheduled or ongoing plans for MSP considerations. The revision of the MSP had to be accompanied by a Strategic Environmental Assessment (SEA) (Article 8 of the ROG) to assess the significant impacts of the implementation of the MSP on the marine environment. After extensive participation of the public, industry associations and the public sector in the draft MSP and the draft Project Environmental Impact Assessment (EIA) report, the BMI and the BSH made corresponding revisions and coordinated with the relevant federal ministries (ROG Article 9(1)). Eventually, the newly enacted MSP came into effect on 1 September 2021 (referred to as the MSP 2021). It coordinates the various uses of the aforementioned sea space and reserves required areas or spaces for individual uses to reduce possible conflicts and it also reconciles sea space use and marine ecological protection to promote the sustainable development of Germany's exclusive economic zone [21].

MSP 2021 provides the basis for the expansion of OWP in Germany's exclusive economic zone. On this basis, the "Site Development Plan" (SDP) dedicated to OWP must be revised, and the new OWP site must be delineated in the plan. In addition to the MSP, the Offshore Wind Energy Act (WindSeeG) is also the legal basis for the SDP. The WindSeeG, implemented in 2017, launched the so-called central development model, in which the governmental authorities are responsible for investigating and preselecting appropriate areas for the installation of OWP plants [22]. In 2019, the BSH introduced the SDP for the first time in accordance with Article 4 of the WindSeeG (i.e., SDP 2019 for short). In SDP 2019, development sites for offshore wind and submarine cables from 2026 were delineated, as well as site allocation capacity, and the sequence for site tenders and wind farm start-up operations was determined. The BSH conducts a preliminary survey of the delineated sites and assesses the suitability of the sites for the installation and operation of offshore wind turbines (Clause 12 of the WindSeeG); when conducting this suitability assessment, a strategic environmental assessment is required. Sites that have passed the suitability assessment will be auctioned by the Federal Network Agency (BNetzA) through a bidding process, and the results of the BSH preliminary survey will be provided to the bidders. The update and revision of the SDP 2019 are necessary due to the 2020 amendment to the WindSeeG, which stipulated that the expansion path for OWP will be increased to 20 GW by 2030 (Article 1(2) of the WindSeeG). In addition, since the MSP 2021 became effective, the BSH has now started the procedure for amending the SDP [22].

Developers will vie for the development rights of the preselected sites at a public auction. Winning bidders of wind power farms must apply to the BSH for a license before they can develop offshore wind farms, and a plan must be determined before the license is issued (Article 45 of the WindSeeG below). The EIA process (Article 47 of the WindSeeG) must in principle be carried out in the project determination process, which means that public participation must be involved and careful consideration must be given to whether the environmental impact of the project is justifiable. When making a decision on the plan, there will be a number of additional provisions to ensure that the construction and operation of the wind farm will not have any negative impact on shipping and flight safety or the marine ecological environment, all of which must be supervised by the BSH [23]. The case-by-case EIA under the plan determination process is carried out by the developers and a detailed EIA report must be prepared in accordance with the Investigation of the Impacts of Offshore Wind Turbines on the Marine Environment (StUK 4) [24] and be submitted to the BSH for review along with the planning documents. The StUK 4 sets out the scope of investigation and requirements for monitoring the possible impact of offshore wind

turbines and, therefore, the findings according to StUK 4 are important for assessing the impact of offshore wind turbines on the marine environment [25].

For the construction of an OWP farm, the project promoter needs a permit. The BSH acts as the competent authority in the process of licensing and planning the offshore wind farms (and energy grid connection). To coordinate marine environmental protection and OWP development, the BSH has long monitored the noise generated by piling during the construction of the development. Since 2017, the BSH has been running a professional information system, “MarinEARS”. MarinEARS is currently the world’s largest database of piling noise events monitored during the construction of offshore developments and also assists in monitoring various noise mitigation measures. As a result, the BSH can further process events for EIA reports with the noise data included [26].

2.2. Reconciliation of the Use of Marine Areas by OWP and Fishing Rights: Experiences from the UK

The UK electricity market reform programme launched by the Energy Act of 2013 promotes investment in safe, decarbonized and accessible electricity generation for consumers [27,28]. In terms of energy, the aim is to solve the problems of energy dependence arising from the depletion of the country’s fossil energy resources [29]. The British Climate Change Act [30] includes a commitment to reduce greenhouse gas emissions by 34% by 2020 and 80% by 2050, taking 1990 as the reference year. In 2009, the Marine and Coastal Access Act (MCAA) provided the legal basis for planning maritime activities at the national level [31] and required the British authorities to develop management plans for the marine space [32]. The Marine Management Organization (MMO) is created by the MCAA with competencies for planning the marine environment of English territorial waters and offshore marine areas (beyond 12 nautical miles). The MMO exists to make a significant contribution to sustainable development in the marine area, and to promote the UK government’s vision for clean, healthy, safe, productive and biologically diverse oceans and seas [33].

In terms of marine policy, the National Policy Statement for Renewable Energy Infrastructure [34] states: First, consultation with fishery representatives should be conducted in advance; and second, in the assessment of the wind farm applicants, a detailed impact investigation should be conducted on the impact of fish stocks with commercial value, as well as possible reductions in fish stocks and restrictions on fishing activities. The Planning Inspectorate (PINS) should also consider whether the proposed development case occupies fishing grounds and whether it affects the protection of sustainable fisheries and fully consults with fisheries representatives to minimize their losses. In addition, mitigation schemes should be established to avoid affecting the interests and sources of fisheries as much as possible.

To alleviate the problem of communication and coordination between the OWP industry and fisheries or local groups, the UK established the “Fishing Liaison with Offshore Wind and Wet Renewables Group (FLOWW)” in 2002, and its members include the Crown Estate, relevant government agencies, fishermen groups, offshore renewable developers and other stakeholders. The main function of the FLOWW is to establish and maintain the communication channel between the offshore renewable energy industry and the fishing industry, formulate communication guidelines, deal with national general issues, provide fishermen with the relevant information on offshore renewable energy development and ensure offshore renewable energy developers’ “co-existence” with the fishery industry. The Best Practice Guidance for Offshore Renewables Developments: Recommendations for Fisheries Liaison [35] was introduced by FLOWW to assist developers and fishery communities in reaching a consensus. Meanwhile, it also regulates the implementation of relevant measures by developers to meet the needs of fisherman groups, including the proposal by developers of a “fishing liaison plan”, which the fishermen must review and agree to. Additionally, the developers must hire a full-time Company Fishing Liaison Officer (CFLO) who specializes in fishery issues through a maritime consulting company

and try to find trusted Fishing Industry Representatives (FIR) in the fishing community to establish a communication channel between the two parties. Since the CFLO's role is similar to that of an independent contractor and the developers will keep the CFLO at a distance from the development, the CFLO should rely on his own expertise to assist in the investigation during the construction and operation of the wind farm and provide fishermen with collecting evidence as well as compensation. This will help make the negotiation process more transparent, thereby increasing the fishermen's trust in the development. In addition, the FLOWW has also issued the FLOWW Best Practice Guidance for Offshore Renewables Developments: Recommendations for Fisheries Disruption Settlements and Community Funds for reference for related compensation operations.

2.3. Summary of the Experiences from Germany and the UK

Lessons learned from Germany and the UK indicated that MSP was crucial to the development of OWP. Consequently, MSP allows for the integration of different sectors that constitute the regime of maritime energy administration. It defines a fundamental framework in MSP for the development of multiple marine activities, which requires the authorities taking control and balancing the interests of economic development with protecting the natural environment [19]. Multiple use of marine space is emerging as an option to be considered by government institutions to optimize the use of marine space, reduce conflicts and make use of the environmental and economic synergies created by the joint deployment of OWP facilities and fishing or aquaculture activities for the conservation of marine areas [36]. Following Germany, the government announced an energy transition to phase out nuclear power by 2025 under a nuclear-free homeland policy, which aims to replace nuclear power with renewable energy which promote OWP in Taiwan [37]. They announced a schedule to increase renewables from approximately 5% in 2016 to 20% by 2025 [38].

3. Marine Policy toward OWP in Taiwan

This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation as well as the experimental conclusions that can be drawn. As of 2021, Taiwan's top five energy sources are natural gas (42.5%), coal (35.5%), nuclear energy (10.5%), petroleum (1.6%) and renewable energy (10.8%) [39]. According to the Electricity Act, the Ministry of Economic Affairs is responsible for the analysis, development and promotion of energy policy. Green energy's contribution to Taiwan's energy mix is incidental. Despite this, OWP is a key point in the development of renewable energy. To implement Taiwan's energy transformation and achieve the goal of reaching 20% of renewable energy power generation by 2025, the government plans to set a cumulative OWP capacity of 5.5 GW in 2025 and announced the 10-year 15 GW Phase III block development policy from 2026 to 2035 [40]. Currently, Taiwan has built a 128 MW demonstration wind farm off the coast of Miaoli and completed two wind farms including "OWF YUNLIN" and "TPC Offshore Wind Farm Project—Phase I" in 2021 [41].

The government has developed a series of measures to promote the development of the wind power generation industry. The development of OWP, however, has to solve the problems that offshore wind farms are overlapping with some traditional fishing grounds and are unable to reach consensus with relevant stakeholders.

3.1. Review of MSP in Taiwan's Marine Areas

From the marine policy perspective, there are relevant national regulations or instruments with clear implications for ocean governance. Pursuant to Article 4(2) of Ocean Basic Law, the government should promulgate regulations on MSP [20,40,42], coordinate the use and competition of sea areas and implement integrated management of the ocean in response to the needs of marine multiple users. In order to promote integrated coastal management, the Coastal Zone Management Act was promulgated in 2015 as the basis for Taiwan's coastal management plan, approval of the protection plans and legal sources. In

accordance with Article 2(1) of this Act, the “Offshore area” is the area from the average high tide line to the 30 m isobaths or three nautical miles towards the sea, whichever is longer in distance, but not exceeding the territorial sea and its seabed and subsoil”. However, the Bureau of Energy, Ministry of Economic Affairs, has planned 36 zones in the central sea areas of Taiwan for the promotion of OWP farms [7], most of which have exceeded the scope of the “offshore area”. Faced with incomplete regulations, the review of coastal management can only be conducted on the north and south cable corridors within the scope of coastal management and for most wind farms outside the scope of the offshore area that cannot be regulated. In accordance with Article 3 of the Renewable Energy Development Act enacted in May 2019: “Offshore wind power system refers to energy generated from wind power is converted into electricity with the offshore wind farm installed in waters outside the subtidal line and not exceeding the bounds of the territorial sea”. It can infer that the construction of OWP projects in Taiwan should be limited by “not exceeding the territorial waters”. Recently, there has been a constant call by the Taiwanese market to expand the installation of OWP generation facilities, so the removal of this restriction has been suggested.

Furthermore, Article 7 of the “Law on the Exclusive Economic Zone and the Continental Shelf of the R.O.C.” states that for utilizing energy from the water, currents winds or other activities in the exclusive economic zone (EEZ) of the R.O.C., permission from the Government shall be required. When the Government decides to extend OWP farms in the EEZ beyond the territorial sea, will OWP facilities fall under the definition of “installations or structures” specified in Article 5(1)(b) in this Law? Since Taiwan’s EEZ overlaps with the areas of adjacent or opposite countries, in the absence of an appropriate coordination mechanism, there is still controversy over how could the government can protect the interests of OWP developers. In Germany, the central government is responsible for the planning of the EEZ, which it exercises through the BSH [20]. The EEZ management plans define priority areas for OWP. The location of OWP facilities in the rest of the EEZ is also permitted, except for the Natura 2000 network areas [43]. From experiences in Germany, MSP has emerged as an appropriate concept and is capable of definitively driving the use of offshore renewable facilities in the EEZ.

3.2. Marine Space Use and Sustainable Development for OWP

The absence of a rule of law and reliance on numerous administrative internal rules could create large investment uncertainty for OWP developers [7]. On 23 July 2021, the Ministry of Economic Affairs introduced the “Offshore Wind Farm Directions of Zone Application for Planning” and its Article 5 regulates the site planning of OWP generation applications. The site scope of the application submitted by the developers shall not overlap with the environmentally sensitive area. After compiling the maps and materials provided by the Authorities, the “Sensitive Areas of Marine Areas in Site Planning” was announced. The “Map of Sensitive Areas in the Marine Area” and the “Table of Highly Sensitive Areas” shall disclose the regulations as well as corresponding competent authorities of them, and the specific areas for reference. For example, the Fisheries Agency, Council of Agriculture, recommends excluding the fishing grounds of the three islands in the north (i.e., the Pengjia, Mianhua, Huaping Islets), and in accordance with the Fisheries Act, the zone of set net fishing rights, aquatic organisms’ propagation and conservation zone, fishing prohibition zone of artificial reef and zone of protected reef, are all designated as highly sensitive areas; the Maritime Port Bureau, Ministry of Transportation and Communications, proposes to exclude the north–south marine passage; the State-Owned Enterprise Commission, Ministry of Economic Affairs, recommends the exclusion of natural gas pipelines; after all, the Ministry of Economic Affairs may revise the “Offshore Wind Farm Directions of Zone Application for Planning” at any time depending on the latest scope announced by each competent authority. However, generally, there is consensus regarding its positive implications on development of OWP projects; delimiting specific areas of the sea for OWP

brings legal security, predictability and certainty to developers, and minimizing conflicts with other activities and environmental risks to marine ecosystems is also important [44].

Taiwan's Environmental Impact Assessment Act [45] mandates that environmental impact assessments (EIAs) should be conducted prior to commencing development activities that may have an adverse environmental impact. Subsequently, EIAs have become the thresholds to assess the conflicts of environmental protection and economic development prior to starting new construction projects [40]. Engaging interested parties early and effectively is not only a regulatory requirement, but is also an important factor for achieving consensus and resolving conflicts among users of marine space [46]. Indeed, all stakeholders for participation processes can also be an efficient way to address the issues of public opinion and acceptance of the OWP projects [47].

Institutional and regulatory complication of the natural environment make it difficult to execute an integrated MSP for OWP projects. For successful MSP, the planning should be integrated into existing national spatial planning systems, with due decision-making processes creating opportunities for all stakeholders to participate, with the appropriate reconciliation of conflicts to promote green energy policies and support marine sustainable development. The vertical integration between the different levels of government through MSP to accelerate the deployment of OWP is also suggested. Table 1 shows the main governmental institutions involved in OWP generation and MSP in Taiwan.

Table 1. Summary of the governmental institutions related in OWP management and MSP in Taiwan.

Governmental Institutions	Rules/Regulations	Description
Ocean Affairs Council	Ocean Basic Act	To reply to the needs of marine multiple users, the government should promulgate regulations on MSP [20,40,46], coordinate the use and competition of sea areas and implement integrated management of the ocean.
Ministry of the Interior	Coastal Zone Management Act	OWP farms within 30 m isobaths or three nautical miles measured from the coasts are administered by this Act [7]; however, the application scope for offshore areas is limited by territorial seas. The government shall enjoy and exercise jurisdiction over the
Ministry of the Interior	Law on the Exclusive Economic Zone and the Continental Shelf of the R.O.C.	construction, use, modification or dismantlement of "installations or structures" in the EEZ [19,20]. However, the application of OWP facilities is unclear.
Bureau of Energy, Ministry of Economic Affairs	Renewable Energy Development Act	OWP means the renewable energy produced from offshore wind farms installed in waters outside the subtidal line but not exceeding the bounds of territorial sea [7,40].
Environmental Protection Administration	Environmental Impact Assessment Act	When applying for a project permission, the developer shall submit an EIA statement to the authority with due decision-making processes giving opportunities to all stakeholders for participation [40,46,47].

Source: Authors' own.

4. Conflict of Fishery Rights and Compensation for Marine Environmental Pollution Liability

Currently, the main obstacle to the development of OWP in Taiwan is the disputes caused by the conflict between OWP development and fishery rights in marine areas. Article 6 of the Fisheries Act refers to the marine areas where fisheries operate as “public waters”. The definition of public waters is the area of waters that the Fisheries Act intends to regulate, but this concept does not exclude or prohibit other uses that exist in the seas. However, Article 20 of the Fisheries Act stipulates that fishing rights shall be considered as a right in rem, and the provisions of the rights in rem of real property in the Civil Code shall, *mutatis mutandis*, apply. Over the years, it has caused fishermen to think that their perception of the sea is similar to that of land-based real estate. From this perspective, such a fishery rights system causes fishermen to not only regard public sea space as their private property, but also request compensation, reimbursement or the exclusion of other uses by those who infringe upon their fishery rights or of other users who want to use the marine area for other purposes. Unfortunately, in the process of developing OWP, Taiwan is facing the problems involving the fishermen’s association and fishermen constantly making claims based on fishery rights [48].

4.1. Compensation and Subsidization for Fishing Rights

The Fisheries Act defines fishing rights as a right in rem, so if wind farm planning overlaps with existing fishing grounds, compensation for lost catches or other increased costs could be inevitable. Compensation is an economic incentive system used to solve the problem of setting up NIMBY (not in my backyard) facilities to improve residents’ tolerance for NIMBY facilities. If the compensation is greater than the loss of the local residents, the residents will agree to the installation of the facility. On 30 November 2016, the Fisheries Agency announced the “Fisheries Compensation Standards for Offshore Wind Power Plants” [49] in Figure 1. Through a transparent and institutionalized compensation formula, wind power developers can calculate the amount to be compensated to fishermen. Nevertheless, it remains debatable whether equality can be achieved by providing financial compensation to fishermen [40].

In 2021, the Fisheries Agency proposed a draft amendment to the “Fisheries Compensation Standards for Offshore Wind Power Plants” to increase the funds for fishery transformation and ecological restoration; meanwhile, a mutual fund was also established to improve the fishing community [50]. During the negotiation of compensation process, the fishermen’s association often advocated for funding for fishery transformation and ecological restoration to achieve the goal of sustainable fishery. The details are shown in Figure 2.

Moreover, the Bureau of Energy and the Ministry of Economic Affairs introduced amendments to the “Regulations Governing the Use of Funds to Facilitate the Development of Electric Power” [51] in 2021, requiring OWP developers to establish a Power Development Foundation which is allocated to local development. The management of the Power Development Foundation has been supervised by the government, so as to make more effective use of funds. Giving back to the fishery, the Power Development Foundation should be used to promote the coexistence of OWP and local fisheries. Additionally, more than half of the funds from the Power Development Foundation shall be used to subsidize the livelihood of fishermen who are actually engaged in fishing, to manage the restoration of coastal and reef fishery resources or to promote the economic development of fishing villages, so that fair and reasonable distribution of the catching/harvesting or cultivation of aquatic organisms can be facilitated. In this respect, it is suggested that an operational subsidization policy should establish a long-term development perspective for the fishery sector so that there is a principle of agreement to ensure the coexistence between fisheries and wind power operators.

The above-mentioned Fisheries Compensation Standards for Offshore Wind Power Plants and the Power Development Foundation are intended to compensate for fishery

losses or subsidize the livelihood of fishermen. However, the fishermen remain distrustful of the calculation of the compensation and claim that the distribution is unfair, and therefore refuse to accept the compensation amount. More than half of the funds of the Power Development Foundation goes to the fishermen's association, which cannot completely solve the livelihood problem of the fishermen as it ignores the expectations of the fishermen who want to manage their fisheries sustainably. Furthermore, there is lack of a fishery coordination organization between fisheries and OWP developers in Taiwan (such as FLOWW and CFLO in UK), and a complete fishery communication mechanism has not yet been established. The inability of OWP developers to understand the needs of fishermen groups or fishermen has led to disputes over fishing rights negotiations and conflicts at sea.

The calculation formula of fishery compensation is as follows:

I. Wind farms (applicable to areas of fishery rights)

$$OC = C1 \times n \times rA + C2 + C3 \times rA$$
OC: Wind farms compensation amount
C1: Losses for the management of fishery rights
C2: Increased costs of fishing vessels bypassing wind farms
C3: Losses of net gain from fishing catches

$$C3 = V \times D \times ((1 + r)^n - 1) / (r(1 + r)^n)$$
n: construction period plus operation period (year)
rA: Affected area ratio
V: Average net income
D: Productivity abundance ratio
r: One-year fixed deposit average annual interest rate for Taiwan Bank Corporation, Cooperative Bank Commercial Bank Corporation, First Bank Corporation, South China Bank Corporation and Land Bank Corporation

II. Cables
(1) $CC = (C1 + V \times D) \times rB \times rt$
CC: Compensation amount of submarine cables laying sea area (applicable to areas of fishery rights)
C1: Losses for the management of fishery rights
V: Average net income
D: Productivity abundance ratio
rB: Affected area ratio
rt: Affected time ratio
(2) IC: If the submarine cable passes through the intertidal zone of the exclusive fishery rights, the catch losses of the aquaculture or fishing industry within the construction period.

III. Total amount of fishery compensation = $(OC + CC + IC) \times (1 + 10\%)$

Figure 1. The calculation formula of fishery compensation amounts. Source: Authors' own based on [49].

4.2. Marine Environmental Pollution and Liability for Compensation

Marine environmental pollution has adverse impacts on underwater life, which is the main theme of the UN SDG 14 (Conserve and Sustainably Use the Oceans, Seas and Marine Resources for Sustainable Development) [52]. While for competing spatial claims, OWP could play a role in nature conservation, providing artificial reef structures for benthic invertebrates and shelter for fish if they are well located and based on further research [53,54], and therefore are increasingly promoted as ideal locations for habitat development [5]. Public policies of various countries regard sustainable development as the core goal or development direction of policy planning.

Energy is one of the policy areas related to sustainable development and marine environmental pollution caused by OWP has attracted great attention from the public. The greater availability of environmental information on the oceans also makes it possible to

identify areas of special environmental sensitivity or ecological importance. This allows for planning by selecting the appropriate protection measures to reduce the risk in advance of possible environmental impacts caused by the construction and operation of OWP farms and ensures their loss prevention in the project phase [55].

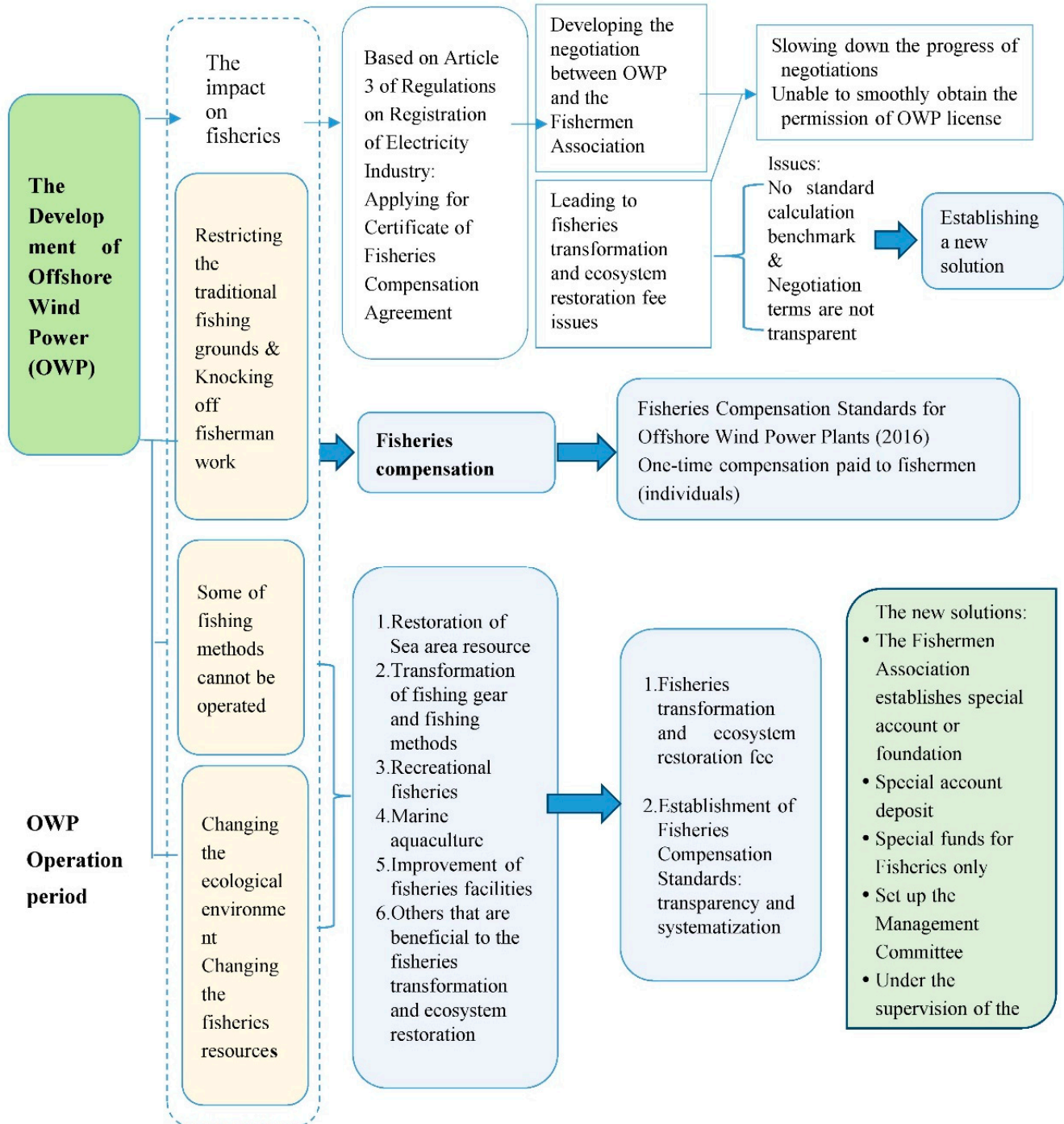


Figure 2. The draft amendment to the Fisheries Compensation Standards for Offshore Wind Power Plants. Source: Authors’ own based on WindTAIWAN (2021) [50].

Part XII of the United Nations Convention on the Law of the Sea (UNCLOS) [56], Article 192 to 196, concerns the State’s obligations to protect marine environment and maintain the marine ecology. Article 192 indicates that “States have the obligation to protect and preserve the marine environment”. In accordance with UNCLOS, the contracting parties have the obligation to follow the Polluting act, which defines an act as the direct

or indirect introduction of substances or energy into the marine environment. Through measures such as “Pollution Cleanup”, “Financial Guarantee and Liability Insurance” and “Ship Contingency Plan”, the risks of the main offshore wind turbine facility, its ancillary facilities and the ships involved in the operation can be minimized during the three stages of construction, operation and decommissioning.

In line with the “polluter pays” principle, in June 2020, the Ocean Affairs Council designated the “Directions for Allocating Installed Capacity of Offshore Wind Potential Zones” [57], which specified that those who have obtained the consent letter for the installation of the OWP system from the Ministry of Economic Affairs fall into the scope of public or private premises designated by the competent authority, according to Article 13(1) of the Marine Pollution Control Act. Public or private premises engaged in OWP projects shall first submit an emergency response plan that can sufficiently prevent and deal with marine pollution and then a letter of financial guarantee or liability insurance policy for the compensation of pollution damage caused by the offshore wind turbine itself or operating ships [58]. The minimum amount of financial guarantee or the limit of liability insurance policy for each and every pollution accident is 24 million Special Drawing Rights (SDR) of the International Monetary Fund (IMF) (approximately NT USD 956,251,494) per occurrence. Furthermore, for those who use operating ships to carry out OWP projects, they must submit a financial guarantee or liability insurance policy for the ships as well. The owner of a ship with gross tonnage over 400 tons or an oil tanker or chemical tanker with gross tonnage over 150 tons shall arrange liability insurance or provide a guarantee based on the gross tonnage of the ship and may neither suspend nor terminate the insurance or guarantee. In terms of responsibility, the developers and their insurers are usually the ones held accountable for pollution damages. Whenever OWP projects cause marine pollution damages to the ecological environment, all stakeholders can rely on the above regulations as the basis for lawsuits or settlement negotiations for damages and ecological restoration. Thus, compensation to parties that incurred damages may be a better deterrent tool against avoidable marine pollution. This civil liability and compensation regime law suite lessens the government’s burden in terms of cost and enables all stakeholders to claim for compensation.

4.3. Marine Noise Pollution Caused by OWP Farms

Many studies show the negative impacts of underwater noise on fish, invertebrates [59] and marine mammals [60] and on their abilities in the split ecosystem and changing population both biologically and ecologically [61]. The high possibility of pollution caused by the construction of OWPs in Taiwan that can affect other countries is the ecological impact of the noise generated by wind farms on migratory fish populations. Fish are quite sensitive to sound waves, so the construction of wind farms may change the migration path of fish.

In July 2012, the Ministry of Economic Affairs announced the “Offshore Wind Power System Demonstration Incentive Regulations”, which stipulated that licensed developers should set up a marine meteorological observation tower in the demonstration wind farm. In response to the requirements of the EIA of the Environmental Protection Administration, it requires long-term monitoring of underwater noise from OWP farms and observation of the number of cetacean activities. An additional set of underwater microphones for the underwater measurement system was installed in the observation tower [62]. The Environmental Protection Administration issued Announcement No. 1020065536 of the Environmental Protection Administration in 2013, adding “wind power generation units” to the noise control area where the sound shall not exceed the provisions of Article 8(1)(b) of the Noise Control Standards [63]. Wind power generation units were then incorporated into the noise control area regulated by these Standards. Although the “Operation of Underwater Noise Assessment for Offshore Wind Generation Units” was drafted at the time, there has been little progress on this regulation. The prevention measure toward marine noise pollution depends on the implementation of domestic laws and regulations, such as

the standard operating procedures and guidelines for the marine ecological monitoring of OWP farms (StUK 4) [24] promulgated in Germany. This guideline is recognized as a relatively complete operating standard and has also been referenced by the government, OWP developers and all marine stakeholders in Taiwan. Issues advanced so far concern noise pollution from OWP farms as a threat to the maritime environment. Underwater noise pollution could, however, also be considered for its potential to endanger marine living resources and therefore affect their exploitation. In this respect, it is required that the administrative frameworks of noise pollution should be designed, developed, implemented and maintained. By the above discussion, Table 2 contains recommendations to achieve the objectives of coexistence between fisheries and green energy generation in Taiwan.

Table 2. Recommendations to achieve the objectives of coexistence between fisheries and green energy generation in Taiwan.

Maritime Policy	Governmental Institutions	Recommendations
Fisheries Compensation Standards for offshore wind farms	Fisheries Agency	Introduce compensation funds for fishery transformation and ecological restoration to achieve sustainable fishery. To establish a complete fishery communication mechanism (such as the FLOWW and CFLO in UK) [35] to resolve the conflict of marine space usage between fisheries and OWP effectively.
Power Development Foundation	Bureau of Energy, Ministry of Economic Affairs	Agree on a subsidization policy for fisheries that establish a long-term development foundation [51]. There shall be a principle of agreement to ensure coexistence between local fisheries and OWP developers.
Marine pollution protection	Ocean Affairs Council	Ensure the emergency response plan, and provide liability insurance policy or financial guarantee for the compensation of pollution damages [58].
Underwater noise prevention and control	Environmental Protection Administration	The management frameworks (such as StUK 4 in Germany) [24] of noise pollution shall be designed, developed, implemented and maintained.

Source: Authors' own.

5. Conclusions

This paper aims to evaluate how MSP is allowed to accommodate the expansion of renewable offshore energy in Taiwan and contribute to the government's commitment for the production of green energy in the oceans. According to Taiwan's OWP planning, the delimited areas may actually reach the marine space beyond the territorial sea, but this seems to contradict the current "Renewable Energy Development Act" that OWP shall not exceed the territorial sea. Furthermore, if the devices of OWP are "installations or structures" under the "Law on the Exclusive Economic Zone and the Continental Shelf of the R.O.C.", the Government shall vindicate and exercise the jurisdiction over the construction, use, modification or dismantlement of OWP facilities in the EEZ.

For a positive relationship between MSP and the development of offshore renewable energy, this paper proposes the enactment of the Marine Spatial Planning and Management Act as soon as possible in accordance with the Article 4(2) of the Ocean Basic Act. MSP is a tool that will undoubtedly contribute to achieving green energy objectives while respecting the principles of marine sustainability that govern regulations for managing the marine

environment [42]. The improvements of coordination should be accompanied by the implementation of coordination schemes for marine renewables, managed by the maritime authority and coherence in the application of marine policies. Additionally, a solid legal basis and regulations to cope with the installation of OWP projects are essential to deliver investment security [7].

By means of providing compensation with fishery catch losses and subsidization for the livelihood of fishermen, this paper proposes a consideration of the FLOWW and CFLO in the UK to establish a complete fishery communication mechanism to resolve the conflict of sea space usage between fisheries and OWP developers effectively. Finally, marine pollution by OWP has emerged as a new environmental issue, which has caused negative environmental and socio-economic impacts that threaten the global sustainable development. OWP developers should submit an emergency response plan for marine pollution, as well as a liability insurance policy or financial guarantee for the compensation of marine pollution damage. The administrative frameworks (such as StUK 4 in Germany) of noise pollution should be designed, developed, implemented and maintained, so that they can be tailored to environmental protection of the oceans, OWP, fisheries and holistic marine policies.

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