European Journal of Sustainable Development (2022), **11**, 1, 101-112 ISSN: 2239-5938
Doi: 10.14207/ejsd.2022.v11n1p101

Sustainable Fishery and Renewable Energy in Perspective of Sustainable Development Goals (SDGs): Re-visiting SDG Indicators 7.2.1 and 14.7.1

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Abstract
This article explores sustainable fishery and renewable energy with the perspective of Sustainable Development Goals (SDGs), with a special focus on improving the data collection, computation, reporting and analysis for SDG Indicators 7.2.1 and 14.7.1. This article finds that the estimation of renewable energy consumed in fishing vessels/fleets, which is a part of SDG Indicator 7.2.1, can be used to estimate the costs for preserving and/or processing fishes on board, which is essential to compute the value added of marine fishery. A number of practice-oriented implications, especially in the context of small island developing states (SIDS) and least developed countries (LDCs), are discussed in this article. For example, international organizations may consider taking effective actions in capacity development and awareness raising, especially in SIDS and LDCs. More interdisciplinary studies, which can provide evidence for holistic approaches to support the development renewable energy and its use in fishing vessels/fleets, should also be encouraged. This article, as an early conceptual research in this field, also have limitations which should be addressed by future studies.

Key words: sustainable fishery; renewable energy; SDGs; fishing vessels/fleets; on board application

1. Introduction

The 17 Sustainable Development Goals (SDGs) are the core components of the 2030 Agenda for Sustainable Development (the 2030 Agenda), which was adopted by the United Nations (UN) General Assembly in 2015 as a global blue print to achieve sustainable peace and prosperity (UN, 2020). Since the adoption of the 2030 Agenda and the SDGs, significant scientific and practical efforts have been made with the objective to achieve the SDGs (e.g., Huaccho Huatuco & Ball, 2019). Examples include the continuing efforts from Inter-Agency and Expert Group on SDG Indicators (IAEG-SDGs) in refining the SDG Indicators (IAEG-SDGs, 2019), and also the launch of a new Global SDG Indicators Data Platform by the UN (UN, 2021).

Although there are significant achievements, significant gaps remain to fully achieve the SDGs, especially due to the disruption from COVID-19 (Abidoye et al, 2021). A significant challenge is the relatively limited knowledge of the interactions across SDGs (including SDG indicators), as well as the data unavailability (e.g., Liu, 2021). This context calls for more research in the field of SDG interactions, especially in countries with relatively weaker statistical capacities such as least developed countries (LDCs) and small island developing states (SIDS), where the statistical capacities are relatively weaker (World Bank, 2021).

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Food supply and renewable energy are both important dimensions of sustainable development, especially for LDCs and SIDS. They are both included in the SDGs (especially SDG 2, SDG 7, and SDG 14), and are interacted with other SDGs and SDG indicators (e.g., Liu, 2020a). Food and Agriculture Organization (FAO) of the UN and International Renewable Energy Agency (IRENA) are the custodian agencies of a number of SDG indicators related to food supply and renewable energy, and contribute significantly to the data collection, computation, reporting and analysis of these indicators. As shown by IRENA and FAO (2021), energy and food systems are inter-related to each other, with around 30% of energy in the world are consumed by the agri-food system (IRENA and FAO, 2021, p9). Fishery, which serves as an important source of food supply and provider of essential nutrition such as protein (e.g., Cai et al, 2019), is also one of the major sectors in the agri-food system that consumes energy, especially in the process of cold storage and refrigeration (IRENA and FAO, 2021). Therefore, more research about renewable energy in the fishery sector should be encouraged.

This article aims to explore sustainable fishery and renewable energy with the perspective of SDGs. More specifically, it examines the data collection, computation, and measurement of sustainable marine fishery and its influence in economic development, as well as how renewable energy, especially the off shore renewable energy, can contribute to sustainable marine fishery. The focus on marine fishery corresponds to the status quo of fishery sector, because the vast majority of fishes are harvested (including both capture and aquaculture) from marine sources instead of in-land waters (FAO, 2020, p4). This is also consistent with the context of many SIDS, which have limited in-land water resources. Sustainable marine fishery and renewable energy are reflected and monitored by SDG Indicator 14.7.1 and SDG Indicator 7.2.1 respectively, so that this article will analyze sustainable marine fishery and renewable energy, including their interactions, by exploring these two indicators.

As an initial research of a number of planned follow-up studies by the author, this article pays special attention to a specific issue: off shore renewable energy supply for marine fishery on fishing vessels/fleets. This is important because energy consumption is an essential component of the 'intermediate cost' of marine fishery, thus it is unable to properly compute data for SDG Indicator 14.7.1 without adequate estimation of energy consumption on board. Also, for SDG Indicator 7.2.1, consumption of energy in fishing vessels/fleets is also an important part to measure the share of renewable energy in the final consumption. This is also consistent with the current definition and measurement of marine fishery, as shown by FAO (2021) and UN Department of Economic and Social Affairs (2008).

The remaining parts of the article will be organized as follows. The next section will briefly review the relevant literature, so that the research gaps can be noticed. In Section 3 and Section 4, SDG Indicators 14.7.1 and 7.2.1 will be introduced respectively, with the emphasis on the practice of SIDS. Section 5 discusses the findings with possible practice-oriented recommendations. Section 6 concludes the article, in which the limitations and the way forward are presented.

2. Literature review

There is a substantial amount of literature about sustainable marine fishery and renewable energy. However, the interactions between sustainable marine fishery and renewable energy (particularly off shore renewable energy), especially in the framework SDGs, are relatively less investigated. Furthermore, there are relatively fewer studies about renewable energy in fishing vessels/fleets, and how the consumption of renewable energy in such specific context affects the data collection and measurement of value added of marine fishery. For example, if the search terms 'renewable energy on board', 'renewable energy in fishing vessels', or 'renewable vessels in fishing fleets' were input into the search engine of Google Scholar (in late December 2021), there are few hits of these full terms. Therefore, due to space limitation, this article only briefly reviews some studies which are directly related to the theme of this article, including some studies relevant to SDG Indicators 7.2.1 and 14.7.1.

Marine fishery is believed as an energy-consuming sector (e.g., Guillen et al, 2016). Therefore, scholars pay attention to the energy consumption of fishing vessels/fleets: the energy to operate fishing vessels/fleets so that they can go to the fishing areas and then return (or go to other destinations), and the energy needed to process and/or preserve fishes on board (until they arrive at the destinations and unload the catches). Sanntosa (2019) finds that solar sail fishing vessels can save up to 90% of fuel, even though it still adopts a hybrid technology (fuel is still in use to ensure the vessels can work as normal even in bad weathers). Also it may help to reduce pollution. With comprehensive case studies of selected fishing vessels, Basurko et al (2016) demonstrate that energy consumption of fishing vessels depends on a number of factors, such as the vessel size, engine used, fishing gears, and fishing patterns (e.g., target species and areas). Therefore, the generalization of energy consumption (including energy saving practice) is not easy. Instead, it may require specific knowledge of the fishing vessels and their fishing patterns. This is somewhat supported by a Pacific-based study (Nuttall et al, 2014), which shows that renewable energy can be used to reduce ships' reliance on fossil fuel. However, in addition to technological difficulties, socioeconomic factors may also restrict the wide-adoption of renewable energy for vessels.

Energy for preserving and/or processing fishes on board also attracts scientific attention. Wang & Wang (2005) explore several options for fishing vessels to use waste energy for refrigeration, such as vapor-compression refrigeration systems and adsorption icemaker systems. Lu & Wang (2016) introduce on board sorption refrigerator technologies. It is demonstrated that although fishing vessels' shaking may affect the on board energy performance, small-channel heat transfers can be used to address this problem (Lu & Wang, 2016). Palomba et al (2017) find that on board waste-driven refrigeration technology can reduce both fuel consumption and pollution. The two core technologies of on board waste-driven refrigeration: absorption and adsorption, are examined via a case study of a number of Italian fishing vessels (Palomba et al, 2017). Empirical results show that if the traditional systems were replaced by either absorption or adsorption technology, the electricity energy savings can be higher than 50% (Palomba et al, 2017, p562). Palomba et al (2019) further evaluate the integration of hybrid sorption–compression systems in vessels with various fishing routes/areas and engine powers, and observe that with hybrid sorption-compression systems, significant reduction in energy consumption and CO_2 emission can be achieved. Wang et al (2018) propose the adoption of ammonia-based double-effect vapor absorption refrigeration cycle, which may contribute to use diesel engines' high-temperature waste heat for fishing vessels on board refrigerators. Monte Carlo simulations are applied which reveal that expected cooling capacities can be reached with less energy consumption and CO_2 emission (Wang et al, 2018).

Marine renewable energy and marine fisheries may not be always consistent with each other. Sometimes conflict of interest may exist between them. For example, Alexander et al (2013) show that off shore renewable energy may have negative impact on marine fishery, such as affecting fishing areas and species. This finding is supported by Reilly et al (2016). Both studies find that fishers have some uncertainties about marine renewable energy (including both advantages and disadvantages), which is a possible reason of their reluctance about marine renewable energy. Nevertheless, Alexander et al (2013) demonstrate via a survey that in general, fishers still express neutral or even supportive attitudes towards the development of marine renewable energy. Reilly et al (2016) suggest to establish suitable financial mechanisms to compensate some costs of the fishery sector in case they are affected by the development of marine renewable energy. This is consistent with a recent study (Said & Chuenpagdee, 2019), which supports holistic approaches to develop small-scale fisheries with the perspective of SDGs. Cai & Leung (2020) introduce an input-output model with the aim to calculate fishery's contribution to economy, as reflected by SDG Indicator 14.7.1. However, this model does not fully incorporate the on board consumption of energy (including renewable energy), which is a shortcoming to the measurement of SDG Indicator 14.7.1

Although previous studies contribute significantly to the academic literature and practical knowledge about marine fishery and renewable energy, there are insufficient details of distributing the cost of adopting renewable energy on fishing vessels. This is a significant challenge for promoting more use of renewable energy on board, especially fishing vessels/fleets are usually decentralized and scattered in different parts of the ocean. Therefore, the economy of scale of using renewable energy on board cannot be easily achieved, even some modern technologies can assist to collect some data for the operation of fishing vessels, which can be used for objectives such as the planning of marine renewable energy deployment (e.g., Campbell et al, 2014). Existing literature still do not fully address the problem of the data collection, computation, reporting and analysis for SDG Indicators 14.7.1 and 7.2.1, which is also a challenge of applying renewable energy into fishing vessels. Studies on the interactions between renewable energy and marine fishery with SDG perspectives are also limited. Such limitations provide spaces for this article to explore marine fishery development and off shore renewable energy by re-visiting SDG Indicators 7.2.1 and 14.7.1.

3. Sustainable Development Goal Indicator 14.7.1

According to FAO (2021, p1), SDG Indicator 14.7.1 has the full name 'Sustainable fisheries as a percentage of GDP in small island developing States, least developed countries and all countries'. It is the only indicator to measure the contribution of sustainable fishery to national economy under SDG 14 'Conserve and sustainably use the oceans, seas and marine resources for sustainable development'. SDG Indicator 14.7.1 pays special attention on SIDS and LDCs.

To operationalize this indicator, FAO (2021) introduces that 'fisheries' in this context only refers marine fisheries (fish harvested from marine stocks) and does not include fisheries from in-land waters. This indicator can be defined and expressed by '…the value added of sustainable marine capture fisheries as a proportion of Gross Domestic Product (GDP)' (FAO, 2021, p1). The value added of marine capture fisheries is defined as the difference of '…the value of fish harvested from marine stocks, minus the value of goods and services that are used in the production process (such as raw materials and utilities)' (FAO, 2021, p2). The costs of such goods and services used in the fishery process, or can be called 'intermediate costs', should occur at sea, such as on board processing and preserving fish catches. Energy consumed by fishing vessels/fleets such as energy for operating fishing vessels/fleets and on board refrigeration for fish preservation is included in the intermediate costs. In mathematical terms, the value added of marine capture fishery can be expressed by Equation (1) below:

Value added of marine capture fishery= value of marine harvest fishes – intermediate costs (1)

The definition of sustainable marine fishery, although a bit abstruse[1], is measured by 'Sustainability Multiplier', which is compiled and computed by FAO mainly according to the biological information of fishing areas (such as the fish stock status) in which countries perform fishing activities[2]. The 'Sustainability Multiplier' is a figure between 0 and 1. It is compiled and computed by FAO every two years although the data is not available to public. The exact methodology to compute the 'Sustainability Multiplier' is not published either.

SDG Indicator 14.7.1 can therefore also be expressed by Equation (2) below:

Sustainable marine fisheries' contribution to economy=
(Value added of marine capture fishery/GDP) × Sustainability Multiplier (2)

[1] In fact, FAO (2021) does not provide clear definition of what is 'sustainable' marine fishery (and what is not). However, according to the descriptions of sustainable marine fisheries' contribution to economy (FAO, 2021), the 'formula' defining sustainable marine fishery can be written as:

capture from sustainable marine fishery= marine harvested fishes × Sustainability Multiplier

[2] According to FAO (2021), if national data for SDG Indicator 14.4.1 is available, then it is used as the Sustainability Multiplier. However, the availability of data for SDG Indicator 14.4.1 is rather low (only around 10 valid data), so in practice this is seldom implemented. Due to limited spaces the article does not introduce these data and related methods in more detail. FAO's efforts in improving data collection are widely perceived, and this article also appreciates FAO's contribution to the SDG indicators under its custodianship.

According to Equation (2), although SDG Indicator 14.7.1 aims to measure and monitor sustainable fisheries' contribution to national economy, it is actually not very straightforward to interpret the data for this indicator. This is because, as shown by Equation (2), SDG Indicator 14.7.1 has two components: the economic dimension (Value added of marine capture fishery/GDP) and the environmental dimension (Sustainability Multiplier). Thus it is not simple to evaluate which component contributes to the result. For example, data shows that in 2015, the share of value added of sustainable fishery in the GDP of Marshall Islands was 12.50 (UN, 2021). However, does this relatively high value mean in Marshall Island, fishery's contribution to economy is substantial, or the sustainability of fishery sector in Marshall Island is high, or perhaps both? It is unable to make simple interpretations and evaluations because we do not know exactly of the two components, especially the data and methodology of 'Sustainability Multiplier' is not available to the public. Similarly, it is difficult to estimate the economic dimension, for example we do not have reliable information on the use of energy including renewable energy on board of fishing vessels/fleets, which is an important part of the intermediate cost for calculating the value added of marine capture fishery. Therefore, the next section moves to explore a bit more about SDG Indicator 7.2.1, which measures the share of renewable energy in all energy used.

4. Sustainable Development Goal Indicator 7.2.1

International Energy Agency (IEA), UN Statistics Division and IRENA jointly take the responsibility to monitor SDG Indicator 7.2.1, which has the full name 'renewable energy share in the total final energy consumption' (IEA, UN Statistics Division & IRENA, 2021, p1). SDG Indicator 7.2.1 is defined as the '…percentage of final consumption of energy that is derived from renewable resources' (IEA, UN Statistics Division & IRENA, 2021, p1). It can also be expressed by the following Equation (3):

Renewable energy share in total final energy consumption =
(final consumption of energy from renewable resources/ total final consumption of energy) × 100% (3)

An advantage of SDG Indicator 7.2.1 is that it focuses on the final consumption instead of the production of energy, which minimizes the possible disruptions caused by energy losses. The data is obtained from national energy balances, and specialized surveys as household and/or industrial levels are also used to collect data to supplement national level data. The emphasis on the end-use of renewable energy also provides more conveniences to support data collection and aggregation/disaggregation at industrial level or even sub-industrial level (e.g., for marine fishing fleets).

Fishing fleets is an important end-user of energy including renewable energy. This is particularly the situation for some SIDS and LDCs, in which a substantial share of GDP is contributed from marine fishery (Gillett, 2016). Currently, specific data of on board energy consumption, including the use of renewable energy in fishing vessels/fleets, is not publically available. However, since SDG Indicator 7.2.1 focuses on the final consumption and end-use, it is more convenient to conduct industrial or sub-industrial level surveys to collect such information for marine fishing fleets. Energy intensity should also be considered in these surveys. This would be supportive to compute the 'intermediate costs' of preserving and processing fishes on board, which is an essential component to compute data for SDG Indicator 14.7.1. This is another example reflecting the interactions across SDG indicators, especially the interactions between the economic and environmental dimensions of SDGs (e.g., Liu, 2020b).

5. Discussion and implications

The above exploration on the existing literature about renewable energy in marine fishery vessels/fleets, especially the re-visiting of the SDG Indicators 7.2.1 and 14.7.1, could generate a number of dialogues with previous studies in this field, and also some practice-oriented implications to support the use of renewable energy and the sustainable development of marine fishery. This would be particularly useful for LDCs and SIDS.

The current deficiencies of SDG Indicators 7.2.1 and 14.7.1, as discussed above, require further improvement in data and information collection, computation, and reporting. This is consistent with existing studies (e.g., IRENA and FAO, 2021). For example, since the estimation of intermediate costs on board for processing and/or preserving fishes becomes a difficulty to compile and report the data for SDG Indicator 14.7.1, data for SDG Indicator 7.2.1 can be somewhat useful to estimate the on board energy cost for fishing vessels/fleets. This could contribute to the estimation of the full intermediate costs on board because energy cost is part of them. Modern technologies such as vessel monitoring system could be applied into the process of data and information collection, computation, and analysis (e.g., Campbell et al, 2014). The exact methodologies and measurement of the 'Sustainability Multiplier', if can become available for public access, would also enhance the computation and reporting of data for SDG Indicator 14.7.1, and provide more opportunities to incorporate socioeconomic factors into the consideration of sustainable fishery. In addition, it would be useful to collect data for SDG Indicators 7.2.1 and 14.7.1 according to the dichotomy of ocean fishery and coastal fishery, as these two types of fisheries may user different vessels/fleets and apply different energy on board. For example, coastal fishery vessels are usually smaller in size and consume less energy to go to and return from fishing areas, as well as process and/or preserve fishes on board due to their relatively shorter fishing routes. Such dichotomy also corresponds to the practice of fishery statistics in SIDS (e.g., Gillett, 2016).

Holistic approaches which incorporate the interactions across SDGs are essential to expand the application of renewable energy and support the sustainable development of marine fishery, especially in the context of SIDS and LDCs. This is because of energy (including renewable energy) flows in almost the whole agri-food systems (IRENA and FAO, 2021). In addition, renewable energy applied for the food systems, including marine fishery, can contribute to achieving other SDGs such as generating positive health outcomes (SDG 3) and alleviating poverty (SDG 1). The positive outcomes of holistic approaches can be demonstrated by existing studies on the Water-Energy-Food Nexus (e.g., Bhaduri et al, 2015). Interdisciplinary studies and cross-sector perspectives would be useful to provide evidence and generate insights to support such holistic approaches (e.g., Biggs et al, 2015).

In particular, the holistic approaches to promote renewable energy and sustainable marine fishery, especially supporting the on board use of renewable energy in fishing vessels/fleets, call for better access to essential financing. This is because, as widely known, the initial cost of applying renewable energy solutions (such as installing solar photovoltaics) can be rather high while the operation cost is relatively lower. This is especially the situation for fishing vessels/fleets, which are with various sizes and types and conduct fishing activities in different parts of the sea (Barsuko et al, 2013). For example, it would be more difficult and expensive to apply renewable energy in smaller fishing vessels, because they usually have limited spaces to install essential technical appliances on board. Also, due to their relatively smaller amount of harvest and shorter journeys for fishing, it would be less economical for smaller fishing vessels to apply renewable energy which may incur high initial cost. Therefore, without accessing to essential financial resources, it would be difficult for fishing vessels, especially smaller fishing vessels, to widely use renewable energy for fishing activities including the on board processing and/preserving of fishes. This article supports previous studies which identify the existence and importance of decentralized renewable energy the agri-food system (IRENA and FAO, 2021), as fishing vessels are examples of decentralized agri-food production and processing. This is especially the case for SIDS due to the prevalence of small-scale marine fishery in these countries (e.g., Gillett, 2016).

Research and development (R&D) in renewable energy and its application in fishing vessels/fleets should be encouraged, such as the use of solar ice-making machines (e.g., IRENA and FAO, 2021). Since marine fishery is a larger consumer of fossil fuel, R&D in renewable energy and its application on board would reduce the cost of fuel and the risk caused by possible sharp fluctuations of oil prices. It can also enhance the sustainability of fish value chain, for example, renewable energy can better support on board refrigeration of fishes, which may improve the storage and transport of fishes so that they can be sold at proper price levels in the market with minimized losses from rotting. R&D in increasing energy intensity of on board renewable energy could be a priority. Nevertheless, for most LDCs and SIDS, the R&D capacity is relatively weak, as measured by the percentage of R&D expenditure in GDP (World Bank, 2021). This calls for further improvements in R&D in this field, as well as international cooperation to support R&D development, as reflected by SDG 9 and SDG 17 (especially SDG Targets 9.5 and 17.8).

Without adequate capacity and awareness of renewable energy and its application in fishing vessels/fleets, it is unable to support the sustainable development of marine fishery and the expansion of renewable energy. Therefore, suitable capacity development and awareness raising efforts should be taken, especially in the field of data collection and analysis, as well as renewable energy technologies and its application on board. This is particularly important for SIDS and LDCs due to their relatively lower statistical capacities (World Bank, 2021). Capacity development including essential awareness raising not only corresponds to the core functions and expertise of international organizations such as the UN (Vallejo & Wehn, 2016), but is also an important dimension of the SDGs, especially SDGs 4, 9, and 17. Adequate capacity development and awareness raising actions, which are consistent with the national and regional context, should be properly considered and adopted to support the on board consumption of renewable energy and sustainable development of marine fishery.

6. Conclusion and the way forward

This article is an initial exploration of renewable energy and marine fishery with the perspective of SDGs by re-visiting the SDG Indicators 7.2.1 and 14.7.1. It examines the application of renewable energy in a very specific context, the marine fishing fleets/vessels (on board). Based on the review of existing literature, the article identifies that a gap exists in the collection, computation, reporting and analysis of relevant data for SDG Indicators 7.2.1 and 14.7.1, especially the data to measure the intermediate costs so that difficulties are observed in estimating the contribution of sustainable marine fishery to national economy. This article provides some thoughts to reduce the gap and a number of practice-oriented implications to support the expansion of renewable energy and the sustainable development of marine fishery, especially in the context of SIDS and LDCs. The article pays speciation attention to the application of renewable energy in fishing vessels/fleets (on board). The interactions across SDGs are also discussed in this article.

It is suggested that estimating the use of renewable energy in fishing vessels/fleets, which is part of SDG Indicator 7.2.1, can also be used for the estimation of the costs for on board processing and/or preservation of fishes, which is a core component to estimate the value added of marine fishery, as shown by SDG Indicator 14.7.1. To enhance the collection, computation, reporting and analysis of data for SDG Indicators 7.2.1 and 14.7.1, it is recommended to take actions in capacity development and awareness raising. International organizations such as FAO and IRENA can play an important part in consideration of their experience and skills in capacity development and awareness, as well as their expertise in statistics at national, regional, and global levels. Also, as widely known, both FAO and IRENA's work have strong emphasis on LDCs and SIDS. Adequate capacity development and awareness raising actions would generate positive impact to support the expansion of renewable energy and the sustainable development of marine fishery in LDCs and SIDS.

This article, as a very initial attempt to explore sustainable marine fishery and off shore renewable energy with the perspective of SDGs, is of course not without limitations. This study is more conceptual and explorative without analysis of empirical data. Although it provokes thoughts and generates practice-oriented implications, this article does not provide specific policy recommendations at country level. This also reflects the difficulty in reducing the gap of collecting, computing, reporting and analysing relevant data, especially for SDG Indicators 7.2.1 and 14.7.1. LDCs and SIDS may suffer more difficulties due to their relatively weak statistical capacities. In addition, due to the cross-disciplinary nature of renewable energy and marine fishery, as well as applying renewable energy into agri-food systems (including marine fishery), this article cannot address all relevant issues. Instead, as a conceptual and explorative research note, this article aims to introduce the relevant SDG indicators and explores the interactions across SDGs. This demonstrates the difficulty and also the necessity of using holistic approaches to support the marine fishery and renewable energy, especially the application of renewable energy in fishing vessels/fleets. Furthermore, due to space limitation, it is unable for this article to have an in-depth discussion on good practices and lessons of sustainable marine fishery and the use of renewable energy on board.

The limitations of this article provide spaces for further studies including the author's planned more in-depth research in this field. In future, more empirical evidence can be examined in order to provide more specific policy recommendations for using renewable energy in fishing vessels/fleets, especially in LDCs and SIDS. More in-depth analysis of good practices and lessons of sustainable marine fishery and renewable energy should also be encouraged in future. This will not only enrich scientific knowledge in this field, but can also provide good empirical information to support country level policy making and international cooperation in this field. Of course, when applying such good experience, it is essential to properly examine the difference in country context.

Also, more interdisciplinary research should be encouraged, corresponding to the cross-disciplinary nature of renewable energy and marine fishery, as well as the interactions across SDGs. This may require strong collaboration between researchers with different expertise, as well as joint effective efforts to reduce science-policy gaps in relevant fields. Such collaborations may significantly benefit from international organizations such as FAO and IRENA, which have strong experience and expertise in boosting cross-country and cross-disciplinary collaborations. This article, together with other studies on the interactions across SDGs, can function as a call for future interdisciplinary research in renewable energy and marine fishery development with the perspective of SDGs.

Acknowledgement

The author is grateful to the insights from current and former colleagues at various United Nations (UN) organizations and/or agencies. The views expressed in this article is the author's unless otherwise specified. The views in this article, unless otherwise mentioned, do not reflect any official stance and policy of the UN and its departments, organizations, agencies, and/or observers, including FAO and IRENA. The author appreciates the valuable comments from the editorial and peer review teams.

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