Blue economy policy for sustainable fisheries in Indonesia

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Abstract. Climate change has detrimental impacts on the ocean such as ocean acidification, the occurrence of extreme weather, increasing frequency of storms, and sea level and temperature rise, which will threaten the marine ecosystem existence and threaten the marine economic potential. Indonesia, with 6.4 million km\textsuperscript{2} area of waters, hold enormous fisheries potential wealth and enormous potential economic value. Data from the Marine and Fisheries Ministry notes that the marine economic potential reaches IDR 3000 trillion and there only IDR 291.8 trillion of the total potency that already gained. Sustainable fisheries development must be in accordance with the development principles that benefit the present generation but still pay attention to sustainability for future generations. Blue economy policies and programs become the right and effective approach for marine development to encourage optimal and sustainable utilization and exploitation of fisheries resources. This research is a legal research by using statute approach to relevant legal materials. This study aims to integrate the blue economy principle in to marine and fisheries policies and reconstruct the existing policies. The result of this study is a proposed model of blue economy-based policy to get a sustainable national marine and fisheries management.

1. Introduction

Indonesia, as an archipelago with more than 70\% of its territory is sea, has enormous marine economic potential. According to the national reference data from the Coordinating Ministry for Maritime Affairs, based on the results of mapping and geospatial information conducted by the Geospatial Information Agency (BIG) and the Navy Hydro-Oceanography Center, the total area of Indonesian waters is around 6.4 million km\textsuperscript{2}, of the total 8.3 million km\textsuperscript{2} of Indonesian land and waters area [1]. Indonesia's marine economic potential is estimated at US $ 1.33 trillion per year, 1.3 times the 2017 National Gross Domestic Product (GDP)[2]. In 2017, the marine and fisheries sector contributes for the national fisheries production volume up to 23,186,442 tons with a production value of around 384.48 billion Rupiah [3].

Data from the Marine and Fisheries Ministry shows that the total national fish consumption in 2017 and 2018 are 47.34 kg/capita/ year and 50.69 kg/capita/ year, respectively. The target of national fish consumption in 2019 is 54.49 kg/capita/year. For exports of fisheries production, the Indonesian fishery products export value in 2017 reached 1078.11 thousand tons with a value of 4.52 billion US$ [4].

With these enormous marine economic potential, Indonesia also receives threats from the current global climate change. Threats such as sea level rise, global and ocean temperature rise, extreme weather, and ocean acidification will threaten the marine ecosystem existence and threaten the marine economic potential. A new State of the Climate report confirmed that 2018 was the fourth warmest year
in records dating to the mid-1800s. The globally averaged surface temperature was 0.30°C to 0.40°C above the 1981–2010 average. Sea surface temperature was near-record high. The globally averaged sea surface temperature rose by 0.33°C ± 0.05°C above the 1981–2010 mean during 2018. Global sea level was highest on record. For the seventh consecutive year, global average sea level rose to a new record high in 2018 and was about 3.2 inches (8.1 cm) higher than the 1993 average [5].

The blue economy offers an approach to improving the economy while simultaneously conserving the sea and its ecosystem. In this study, a review of the implementation of marine economic management policies in Indonesia will be carried out, assessing the obstacles to implementing regulations, and providing suggestions for improvements to the integration of blue economic principles into Indonesia's marine economic policies.

2. Study area and methods

2.1. Study setting
This research aims to review current fisheries management policies in Indonesia, identify barriers and deficiency, and provide input and propose models of fisheries management policies that integrate the blue economy principles. The scope of this research includes review of national and international regulations related to marine and fisheries management.

2.2. Study methods
This research is a legal research using a normative juridical approach based on the main legal materials, namely the applicable laws and regulations and other documents relating to this research. This study uses primary legal material sources in the form of legislation and derivative regulations as well as secondary legal materials derived from previous studies relating to the problem under study.

3. Result and discussion

3.1. Review of marine and fisheries policy in Indonesia
Indonesian waters have 27.2% of all flora and fauna species in the world. These flora and fauna species include 12% mammals, 23.8% amphibians, 31.8 reptiles, 44.7% fish, 40% mollusks, and 8.6% seaweed from all species in the world [6]. There are 3,476 species of fish that have been identified in the Indonesian ocean [7]. The wealth of these aquatic resources makes Indonesia the second highest capture fisheries production in the world in marine fisheries, and the seventh highest capture fisheries production in the world in public waters [8].

Currently, fisheries management policies in Indonesia are based on Law Number 31 of 2004 concerning Fisheries, as amended by Law Number 45 of 2009 concerning Amendments to Law Number 31 of 2004 concerning Fisheries [9]. The Government of Indonesia divides the Indonesian sea area into 11 (eleven) State Fisheries Management Areas of the Republic of Indonesia (WPPNRI) through the Marine and Fisheries Ministerial Regulation Number 18/PERMEN-KP/2014 as shown in Figure 1. This WPPNRI is a fisheries management area for fishing, fish cultivation, conservation, research and development of fisheries which include inland waters, archipelagic waters, territorial seas, additional zones, and Indonesia's exclusive economic zone [10].

To be able to conduct fishing and fish transportation activities in WPPNRI, fishermen must complete a series of permits to carry out fishing activities at the sea. The rules regarding fishing requirements are stated in the Marine and Fisheries Ministerial Regulation Number Per.30/Men/2012 concerning Capture Fisheries Business in the Republic of Indonesia's Fisheries Management Area, as has been amended twice with the latest amendment in the Marine and Fisheries Ministerial Regulation Number 57/PERMEN-KP/2014 concerning the Second Amendment to the Marine and Fisheries Ministerial Regulation Number PER.30/MEN/2012 [11]. For large fishing vessels above 30 GT, all permits are issued by the central government through officials at the Director General level. For fishing vessels between 10 GT to 30 GT, permits are issued by the Governor and for vessels under 10 GT, permits are
issued by the Regent or Mayor. For small fishermen, fishing vessels under 5 GT are freed up from permits.

![Figure 1. State fisheries management areas of the Republic of Indonesia (WPPNRI) [10].](image)

For permits related to fishing areas, each fishing vessel can be given a fish catchment area in 1 (one) WPPNRI or 2 (two) side by side WPPNRI by stating the coordinates. Each fishing vessel is also determined by its base port and transit port, and it must land its catch at the pre-determined base port. This fishing area policy does not apply to small fishermen, where they are free to fish throughout WPPNRI and free to land their catch in any port in Indonesia.

**Table 1.** Estimated potential, the amount of catch allowed, and the utilization level of fish resources in some WPPNRI [12].

| WPPNRI                          | Small Pelagic Fish | Big Pelagic Fish* | Demersal Fish | Reef Fish | Penaeid Shrimp | Lobster | Crab | Small Crab | Squid | Total |
|---------------------------------|-------------------|------------------|---------------|----------|---------------|---------|------|------------|-------|-------|
| **WPPNRI 571 Malaka Strait**    |                   |                  |               |          |               |         |      |            |       |       |
| and Andaman Sea                 |                   |                  |               |          |               |         |      |            |       |       |
| Potency (tons)                   | 99,865            | 64,444           | 145,495       | 20,030   | 0             | 59,455  | 673  | 12,829     | 12,61 | 4     | 9,038 | 425,444 |
| Allowed catch (tons)             | 79,892            | 51,556           | 116,396       | 16,024   | 4             | 47,564  | 539  | 10,263     | 10,89 | 1     | 7,230 |
| Utilization Level               | 0.83              | 0.52             | 0.33          | 0.34     | 1.59          | 1.30    | 1.00 | 0.93       | 0.93  | 0.62  |
| **WPPNRI 572 Indian Ocean**     |                   |                  |               |          |               |         |      |            |       |       |
| west of Sumatra and the Sunda   |                   |                  |               |          |               |         |      |            |       |       |
| Strait                           |                   |                  |               |          |               |         |      |            |       |       |
| Potency (tons)                   | 527,029           | 276,755          | 362,005       | 40,570   | 0             | 8,023   | 1,483| 9,543      | 989   | 14,579| 1,240,975 |
| Allowed catch (tons)             | 421,623           | 221,404          | 289,604       | 32,456   | 6             | 6,418   | 1,186| 7,634      | 791   | 11,663|
| Utilization Level               | 0.50              | 0.95             | 0.57          | 0.33     | 1.53          | 0.93    | 0.18 | 0.49       | 0.39  |       |
| **WPPNRI 712 Java Sea**         |                   |                  |               |          |               |         |      |            |       |       |
| Potency (tons)                   | 364,663           | 72,812           | 657,525       | 29,951   | 1             | 57,965  | 989  | 7,664      | 23,30 | 8     | 126,554 | 1,341,632 |
| Allowed catch (tons)             | 291,730           | 58,250           | 526,020       | 23,961   | 1             | 46,372  | 791  | 6,131      | 18,80 | 6     | 101,244 |
| Utilization Level               | 0.38              | 0.63             | 0.83          | 1.22     | 1.11          | 1.36    | 0.70 | 0.65       | 2.02  |       |
| **WPPNRI 718 Aru Sea, Arafuru**  |                   |                  |               |          |               |         |      |            |       |       |
| Sea, and Eastern Timor Sea       |                   |                  |               |          |               |         |      |            |       |       |
| Potency (tons)                   | 836,973           | 818,870          | 876,722       | 29,485   | 5             | 62,842  | 1,187| 1,498      | 775   | 9     | 2,637,565 |
| Allowed catch (tons)             | 669,579           | 655,096          | 701,378       | 23,583   | 8             | 50,274  | 950  | 1,198      | 620   | 7     | 2,370  |
| Utilization Level               | 0.51              | 0.99             | 0.67          | 1.07     | 0.86          | 0.97    | 0.85 | 0.77       | 1.28  |       |

*Big Pelagic Fish non tuna
Utilization Level: E < 0.5 = Moderate; 0.5 ≤ E < 1 = Fully-exploited; E ≥ 1 = Over-exploited
To avoid over fishing, the government also determines the estimated number of potential, the amount of catch allowed, and the utilization level of fish resources in each WPPNRI as shown in Table 1. The most recent estimation of the potential and utilization level set by the government is the Marine and Fisheries Ministerial Decree Number 50/KEPMEN-KP/2017 concerning Estimation of Potential, Number of Catches that are allowed, and the Utilization Level of Fish Resources in the Fisheries Management Area of the Republic of Indonesia. The amount of catch allowed is set at around 80% of the estimated total potential [12]. This policy serves to regulate the fishing activities distribution and balance the exploitation activities of fish resources throughout WPPNRI.

The Government has also regulated the permissible and non-permissible fishing tools. In the Marine and Fisheries Ministerial Regulation Number 71/PERMEN-KP/2016 concerning Fishing Tracks and Placement of Fishing Tools in the Republic of Indonesia’s Fisheries Management Area, fishing tool is prohibited if it could threaten the extinction of marine biota, resulting in habitat destruction, and endanger user safety [13]. The Government has also issued Marine and Fisheries Ministerial Regulation Number 49/PERMEN-KP/2014 concerning aquaculture business. This regulation regulates permits related to fish hatchery and or fish growing, and permits for fishing transport vessels [14].

3.2. Blue economy and technology-based innovation
The Blue Economy concept was introduced with two principles. First, nature’s efficiency, where the blue economy imitates the natural ecosystem and works in accordance with what nature provides efficiently and does not reduce but instead enriches nature. The second principle is zero waste, means that waste from one source is becoming food or energy sources for the other, so that the living systems in the ecosystem become balanced and sustainable [15]. Blue Economy is an economic development model that unites the sea and land development, emphasizing the use of technology optimization, in order to improve utilization level of marine resources [16].

Innovation is the keyword in the application of blue economic principles in the marine and fisheries development in Indonesia. Innovation is required to increase fisheries production while trying to ensure the sustainability of fish resource stocks in the future. The Government through the Research and Development Agency of the Marine and Fisheries Ministry seeks to conduct research on breakthrough innovations and appropriate technologies that can be used in fisheries management. Blue Economy puts technology as an important base of economic development innovation, because it can accelerate the growth and product diversification that produced by the community, utilizing waste as a means of production to produce new products.

Blue economy integration in national fisheries management requires harmonization of many sectors, in supporting the main objective of national fisheries management. Based on the review of national fisheries management policy above, the blue economy integration model in sustainable fisheries management can be made as shown in Figure 2.

![Figure 2. Blue economy integration model in sustainable fisheries management.](image-url)
This integration model involves several aspects, namely:

3.2.1 **Innovation and technology.** Innovation and technology act as enablers that allow techniques to manage fisheries to be more efficient, and produce more than before. This is corresponding with the blue economy principles which requires the use of efficient and innovative methods, while still preserving the ecosystem and the environment. With new innovations utilizing technology for fisheries resources, it is hoped that new fish management techniques can be developed so that nature can enrich itself, engineer better ecosystems for nature or bring up superior varieties of fish resources that are better and can produce more abundant.

3.2.2 **Ecosystem and environment sustainability.** The blue economy requires that economic development does not have a negative impact on the environment. Fishing in ways that may harm the environment must be avoided and replaced with fisheries management that is concerned with the sustainability of fish resources, because these resources are limited and still need to be preserved for the future. The choice of fishing methods that avoid damaging the ecosystem, avoid overfishing, avoid catching small and protected fish, and minimize waste is a necessity for fisheries businesses. High fisheries economic growth will be useless if the ecosystem is damaged and there is no guarantee that economic growth can stand into the future.

3.2.3 **Alignments in fishermen and fish farmers.** Improvement of marine and fisheries economy in macro must be also improve the micro-economy of fisheries businesses, especially fishermen and fish farmers. Economic development in the blue economy must also be able to improve the people prosperity, not only increase economic income for fishers and fish farmers, but also increase the human resource capabilities of fishermen and fish farmers. They must also be equipped with the ability to not only capture, cultivate, and sell the results, but also be taught about efforts to improve the quality and capacity of their businesses, especially using new innovative techniques so that in the end they can improve their fisheries and possible in creating new job employments.

3.2.4 **Government policy.** Summarized from the basis of fisheries management [7], there are three main bases for the formulation of policies related to fisheries management, namely: First, input control, which is input from fisheries activities that can be controlled. This includes policies to regulate fisheries management areas, and the number of fishing vessels allowed for fishing. Second, output control, which is output from fisheries activities that can be controlled. This includes the amount of catch allowed and the level of fish utilization analysis in a fisheries management area. Third, technical measures, that are permitted in fishing activities. This includes the types and methods of fishing that are allowed, and also the time of fishing that is allowed.

The blue economy requires the government's commitment to establish policies related to the three aspects above, and also to supervise the implementation of policies that have been made so that fisheries management activities remain in a sustainable direction.

3.2.5 **Research and development.** Research and development activities are efforts to find new ways to manage fisheries corresponding with the blue economy principles. In 2018, the national research budget is only around 0.3% of national GDP [17]. In addition, research and development efforts will be better if carried out in the open science principles, where research results are published and people have wide-open access to these research results without commercialization which will quickly push fishery businesses to develop innovations and increase their fisheries production.

Integration and alignment of all the aspects above are expected to be able to bring national fisheries management based on blue economy to achieve the main objectives of national fisheries development, that is achievement of food security, economic growth, and environmental sustainability.
3.3. Obstacles and challenges in fisheries management based on the blue economy

Fisheries management activities must always be evaluated continuously and identification of obstacles must be immediately resolved as soon as possible so it doesn’t develop into major obstacles that can interfere with the achievement of objectives.

3.3.1 Climate change issue. Some studies show that changes in air temperature and ocean temperature and the emergence of El-Nino cause many types of fish migration from their natural habitat. For coastal areas, a large amount of intromission of sea water to groundwater will increase the utrophication or water pollution due to excessive increase in nutrient amount, as well as can cause hypoxia and anoxia in fish [18]. When the environment changes, fish will adjust to the new environment so that fishing patterns also need to be changed. Changes in species composition, fish abundance, and fish size will encourage changes in method and time of fishing [19].

The blue economy principle that flowing as the natural ecosystems also means that innovations and engineering of fisheries technology are needed to anticipate changes in ecosystems and changes in fish behavior that occur as a result of climate change, so that fisheries production is maintained and can even be increased despite the global climate changes.

3.3.2 Illegal fishing and overfishing. According to the Minister of Marine and Fisheries Affairs, Susi Pudjiastuti, the Task Force to Combat Illegal Fishing (Task Force 115) has captured at least 633 illegal fishing vessels from January 2017 - October 2018, where 366 are Indonesian-flagged fishing vessels and 267 foreign fishing vessels. In addition, as many as 488 illegal fishing vessels have been sunk based on a court decision [20].

The threat of overfishing is also one of the obstacles in managing national fisheries. Many marine area in the western and central regions of Indonesia have shown symptoms of overfishing, such as the Malacca Strait, the eastern waters of Sumatra, the Java Sea, and the Bali Strait. Meanwhile, in eastern Indonesia waters, the fish resources utilization level is not optimal or is still underfishing [8]. Globally, 90% of the world's fish stocks have been fully exploited or overexploited. In Indonesia, illegal fishing and overfishing caused Indonesian fishing households to decrease by 50% in just 10 years, from 1.6 million in 2003 to only 800 thousand in 2013. Illegal fishing also threatened about 65% of Indonesia's coral reefs, which are natural habitat and place for fish for reproduction [20].

3.3.3 Marine debris issue. In the last few years, the issue of marine debris, especially plastic waste in the ocean has draw attention of environmental activists. Some research remark that there are over 150 million tonnes of plastics in the ocean today. In a business-as-usual scenario, the ocean is expected to contain 1 tonne of plastic for every 3 tonnes of fish by 2025, and by 2050, more plastics than fish (by weight) [21].

Marine debris does not only come from waste that is directly discharged into the sea or on the coast, but rather more from household waste that has a "leakage" to enter the water flow or river flow and finally carried up to the sea. Some of the leakage of garbage that enters the river flow mainly comes from houses on the riverside and canals.[22].

To overcome the marine debris issue, the Government of Indonesia has published the National Action Plan for Marine Debris Handling in 2018–2025 in Presidential Regulation Number 83 of 2018 concerning Marine Debris Handling [23]. This quiete new regulation must be implemented properly so that marine debris does not threaten the marine ecosystem.

4. Conclusion

The government's commitment to implement marine and fisheries management based on the blue economy still faces many challenges and obstacles that must be resolved immediately. Towards the blue economy-based fisheries management, the government must intensify policies related to the following issues, such as revise the Fisheries Act immediately to protect the local and small fishermen; Law enforcement against illegal fishing and implementation of innovation and technology in fisheries
management where the use of innovation and technology should reach the applicative stage in fishermen, including in the forms of assistance and maintenance. If the commitment can be fully implemented, the national marine and fisheries sector will be able to achieve its main objectives that is food security, economic growth and the environmental sustainability including mitigate the climate change effect.

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