The Importance of Establishing Particularly Sensitive Sea Areas in Lombok Strait: Maritime Security Perspective

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Abstract. Shipping activities in the Indonesian Archipelagic Sea Lane II (IASL II) of the Lombok Strait will likely to increase in the future and expose the areas maritime threats like sea damage and pollution. To preserve maritime security from any adverse effects caused by shipping activities, the Indonesian Government has designated these areas as Marine Protective Areas (MPAs). However, such areas still has to recognition as protected areas. The Indonesian Government has issued an internal policy demonstrating intent to establish the Lombok Strait as Particularly Sensitive Sea Areas (PSSA), which has been discussed since 2008 but has not yet officially submitted to the International Maritime Organization (IMO). This research aims to analyze the advantages and disadvantages of PSSA enactment in Lombok Strait. The research employs qualitative methods with Soft System Methodology as the data analysis technique in attempt to analyze PSSA enactment, which is characterized as a complex and ill-defined problem. NVivo 12 Plus software is employed in this research to assist in data processing and triangulation. The research results showed that Lombok Strait’s enactment as PSSA could provide several advantages, especially in preserving maritime safety and protection of the environment.

1. Introduction

As an archipelagic state, the sea territories of Indonesia inherently, possesses several maritime security threats. These threats are not only related to issues of piracy, acts of terrorism, drug smuggling, or other transnational organized crime, but also include damage or pollution to the environment [1], which will be further analyzed and discussed in this research. Report of the Secretary-General on Oceans on the Law of the Sea stated that deliberation over preventing the destruction of the marine environment are included within the issue of maritime security threats. The sea is declared to be safe and controlled when all users of the sea is being free from all forms of threats or disruption to various activities and utilization of marine resources [2].

Prevention and protection of the sea is an obligation for signatories of the 1982 United Nations Convention on the Law of the Sea (UNCLOS). UNCLOS obliges every country that has ratified this convention to protect and preserve the marine environment through preventive measures, reduction, and controlling pollution of the marine environment. Indonesia is a member state that ratified UNCLOS and has since issued a policy related to the protection of the marine environment. Any...
protective measures arising from an approved PSSA will be implemented under international law, as reflected in UNCLOS. One of the strategies to realize this policy is through global cooperation development in the field of marine environmental management. Indonesia has joined the IMO since 1961 and actively contributes to environmental issues, one of which is through the Marine Environmental Protection Committee (MEPC) session. At the 72nd and 73rd MEPC sessions, Indonesia participated in discussing strategic issues related to the environment.

Preventive measures against damage and pollution of the marine environment can be exercised through the determination of MPA, such as PSSA that has been recognized internationally in efforts to protect the marine environment, especially those caused by marine pollution from international shipping activities. A PSSA is an area that needs special protection through action by IMO due to its significance for recognized ecological, socio-economic, or scientific attributes that are vulnerable to damage by shipping activities. Through a 2015 letter from the Indonesian Director-General of Sea Transportation of the Ministry of Transportation to IMO, Indonesia expressed its seriousness in pursuing PSSA establishment.

Indonesia proposed the Lombok Strait, where Nusa Penida has already been designated as an MPA. The Lombok Strait is also the waters with the third-highest shipping traffic density in Indonesia behind the Malacca and Makassar Straits. The average annual unique voyages in Lombok Strait is amounted to 29,841 voyages, which translates to about 82 ships per day. Among this data, the traffic constituted of 34.17% fast boats, 29.28% ferries, 10.31% merchant ships, 9.81% fishing vessels, 5.4% passenger ship, while other vessel types (i.e. tug boats, pleasure vessels, offshore supporting vessels, and military) made up about 13.27% [3]. Following is an overview of Lombok Strait and traffic flows that occur in the Lombok Strait.

![Figure 1. Lombok Strait Chart](image-url)
Figure 2. Ship Traffic Density Chart in the Lombok Strait by density plot of AIS reported positions in 2017.

Given large traffic density and the wide variety of ships that pass through Lombok Strait, including tankers, the strait is vulnerable to ship accidents. This will also have implication on the environment around the Lombok Strait. A Traffic Separation Scheme (TSS) in the Lombok Strait was approved in 2019, which functions as a regulator of shipping traffic. Therefore, the Lombok Strait was chosen because it was considered to meet the three main elements required for establishing a PSSA, namely regional attributes, regional vulnerability to damage by shipping activities, and the availability of Additional Protective Measures (APM) to overcome threats. Currently, there are 17 PSSA approved by IMO throughout the world. Some of them are the Great Barrier Reef in Australia, the Galapagos Islands in Ecuador, and the Canary Islands in Spain.

Figure 3. Map Showing All Areas in the World that are Classified as PSSA [4].

Despite the importance of PSSA enactment in Lombok Strait, the proposal for a PSSA in the Lombok Strait has not officially submitted to the IMO as of 2019. The Coordinator Minister for Indonesian Maritime and Resources at that time Rizal Ramli stated that development in the next 10-20 years would mean that the Malacca Strait would no longer be sufficient to cope with traffic, and the
Government was encouraging more voyages to pass through the Lombok Strait [5]. This would undoubtedly increase shipping activities in the Lombok Strait. Increased shipping activity is positively correlated with increased maritime threats, especially marine pollution. Marine area protection is essential in ensuring maritime environmental security, especially against the vulnerability to damage caused by shipping activities.

Government policies to protect the marine environment in form of Lombok Strait’s enactment as a PSSA are expected to overcome these problems. The Government must demonstrate its seriousness in determining and implementing appropriate policies and comprehensive strategies to prevent damage and pollution to the marine environment. Therefore, the research problems are the policy planning for PSSA determination in the Lombok Strait and whether it will contribute to maritime security improvement in the areas. Against the background, this research aims to analyze the advantages and disadvantages of Indonesia if PSSA is applied in the Lombok Strait in the context of maritime security. This research is expected to contribute in enriching the PSSA concept from maritime security perspective and serve as a maritime security perspective reference for PSSA enactment proposals preparation in the Lombok Strait.

2. Methodology
This study employed a qualitative method with an analytical approach [6]—the research data is collected through interviews and document analysis. Research subjects included the Ministry of Transportation, the Coordinating Ministry of Maritime Affairs, the Ministry of Foreign Affairs, Ministry of Ocean and Fisheries, Ministry of Forestry and Environment, Indonesian Navy Hydrographic and Oceanographic Center, and Researchers from Sepuluh November Institute of Technology. ‘Nvivo 12 Plus’ software is employed to assist in data processing and data triangulation by creating coding categories that assist in reconstructing themes and exploring the relationship between attributes from findings in the field. Coding is derived from the research questions, findings in the field of research subjects, as well as the secondary data. The classification of themes created in Nvivo 12 Plus process refers to the research question as well as the theories and concepts used in this study, while the classification of nodes in Nvivo 12 Plus refers to interview guidelines. By doing so, the main themes and essences of the data that is contained in the coding categories could be identified, discussed further, and traced back to the data sources and reference columns.

Soft System Methodology (SSM) is employed as the data analysis technique in this research [7]. SSM originally consisted of seven stages, which are compressed to four main stages. The SSM process is commenced by exploring the problematic situation through identifying the issues, as well as analyzing the culture and power relations. The problematic situation is the described in form of rich picture that visualize how all involved actors view the problems, as well as interconnections and relationships between actors. The second stage of SSM consists of constructing relevant purposeful activity models, which correspond to a specific worldview. Root Definition (RD) enables the researcher to formulate activities in the system to find a range of comparisons with reality in the field (real world), which is the main finding of the research. RD uses the PQR formula to answer the question of what (P), how (Q), and why (R) that the system requires to address the problematic situation. The RD will then be refined and approved by performing CATWOE analysis that stands for Customer (C), Actor (A), Transformation (T), Worldview (W), Owner (O), and Environment (E).

3. Result
3.1. Problem Situation
Unstructured problem situations are examined through interviews to get an initial understanding of the problems. In the first stage, SSM aims to immerse in the issues and investigate them from all perspective. In the second stage, SSM express the problem situation form of rich picture. The following rich picture (Figure 4) presents the view of each informant related to the research topic, namely the advantages and disadvantages obtained by Indonesia from PSSA establishment in the Lombok Strait from maritime security perspective.
The Lombok Strait is traversed by large vessels and has dense traffic. There are also migration paths of protected species such as whales, sunfish, and manta rays that occur in the areas. This makes Lombok Strait to become eligible for PSSA designation. PSSA are management tools that can be used in efforts to protect ecologically, socio-economically and scientifically sensitive areas from the impact of international shipping activities. Although PSSA is able to protect sensitive areas from the impact of international shipping activities, this instrument cannot stand alone. Additional protection measures to overcome the risks that arise from the negative implications of international shipping activities are necessary to support PSSA.

Support group agreed that the establishment of the Lombok Strats PSSA had many positive impacts, especially that it will increase the carrying capacity of environment protection which also improve the sustainability of the environment and human life. It will also have an impact on the safety of navigation. However, there are challenges for Indonesia if this region is designated as a PSSA, especially related to the rights of the user that cross the IASL (i.e. the right of free navigation). The applied PSSA could disrupt the right. Moreover, other challenges that will arise to implement the policy is that Indonesia must prepare other supporting facilities and infrastructure in the area, pollution and damage control measures, control and surveillance system that requires high cost. Nevertheless, it is something commensurate to make the Lombok Strait safe and protected from threat of pollution and other damage.

Figure 4. Rich picture

3.2. Root Definition, CATWOE analysis and Conceptual Model
This stage presents the root definition, CATWOE analysis and conceptual model relating to the policy of establishing the Lombok Strait as PSSA, as shown in Table 1, Table 2 and Figure 5.
**Table 1. Root definition**

Making the Lombok Strait as a PSSA by assessing its advantages and disadvantages to achieve conditions that are safe for the environment and navigation in the Lombok Strait.

**Table 2. CATWOE analysis**

| Category          | Description                                                                 |
|-------------------|-----------------------------------------------------------------------------|
| Customers         | Who are beneficiaries or victims. (All users that benefit from all shipping and marine resource utilization activities in the Lombok Strait) |
| Actors            | Who is responsible for the activities. (Transportation ministry and Maritime Coordinator Ministry) |
| Transformation process | Convert input to output.(Establish Nusa Penida as PSSA along with other additional protection measures that are considered to be able to increase the protection of the maritime environment) |
| Worldview         | General view that makes T meaningful. (Nusa Penida which is located in the Lombok Straits with sufficiently dense boat traffic is important to pay attention to its safety, especially related to the dangers that can be caused by shipping activities to the marine environment and the safety of the ship itself. Indonesia as a coastal country which has an obligation to maintain the security of its territory) |
| Owners            | Who can prevent or change the activity. (Ministry transportation and maritime coordinating ministry) |
| Environmental constraints | The elements out of the system. (Accident or pollution management tools are not yet available) |

**Figure 5. Conceptual Model**

1. Recognizing the protection of the maritime environment in the Lombok Straits is important to implement.
2. Understanding UNCLOS 1982 as the main guideline in all forms of governance and maritime policies related to maritime environmental protection in the Lombok Straits.
3. Identify threats related to marine environmental protection in the Lombok Straits and the criteria needed for the determination of PSSA.
4. Formulate a strategy to establish Lombok Straits as a PSSA.
5. Conduct a security risk assessment related to the policy.
6. Formulating a further mechanism of the Lombok Strait establishment.
7. Implementing the policy by involving all related ministries/institutions in efforts to protect the marine environment in the Lombok Straits.
8. Evaluate the results of the implemented system.
4. Discussion
4.1. PSSA Designation Policy to Support Maritime Security
A policy is formulated to provide benefits for all of the state's elements and aims to realize the ideals of the nation, namely the welfare of its people. Furthermore, any policies made should be able to enhance security so and generate more significant benefits for the state. In this context, the policies discussed are related to the protection of the marine environment, through the establishment of the Lombok Strait as PSSA, especially in the vicinity of Nusa Penida. Any policy derived from the research herein should be able to enhance maritime security, especially related to environment protection. The state has to ensure that the area is safe for authorized users and free from all forms of threats and disruptions to authorized activities, including controls on the utilization of marine resources. One of the main drivers associated with the policy of establishing the Lombok Strait as a PSSA, is protecting designated areas from damage and sea pollution threats as the result of shipping activities.

Kachel [8] stated that PSSA is the main instrument that can be adopted by the global community to protect an area from the threat posed by international shipping. Sea damage and sea pollution usually originate from normal ship activities such as unintentional pollution, intentional pollution, or negligent pollution. Furthermore, physical damage to habitats can impact marine biota's biodiversity from the destruction of coral reefs due to ship dragging [9] or from accidental carriage of invasive species by a ship. Many cases have spread and multiplied to the point where they damaged the environment, threaten the existence of native plants and animals, or create significant problems for aquaculture. Pollution originating from ships is generally resulted from routine disposals of waste by ships in the form of oil waste, cleaning of tanks, leakage of ships while sailing, ship accidents resulting in oil spills or other pollutants into the sea, and deliberate vessel activities such as dumping.

These activities can cause damage to the environment or habitat for existing marine life. Damage to these habitats can affect the productivity and breeding of marine life because, in general, marine life is vulnerable or sensitive to changes in the physical environment. For example, oil spills can inhibit sunlight penetration on the sea surface, block the exchange of gases from the atmosphere and reduce the solubility of oxygen which will affect reproduction, growth, and behavior of marine life and even cause long terms implications, including death of the marine biota for many years after an incident. Despite of the improvement over the last 50 years, trends have identified that marine oil spills from tankers have been exceptionally positive compared to the increased volume of oil being loaded, which shows marked downward movement over the decades though this threat to maritime security has not disappeared.
Another ship operation that can affect marine life is the noise pollution caused by massive ship traffic. A study conducted by WWF-Indonesia [11] states that increased noise in waters disrupt marine biota’s life such as whales, dolphins, and other marine mammals, including difficulties in finding mates, foraging and potentially alienating these biotas from primary habitats. There is a tendency for an increase in marine pollution due to oil spills, and the percentage of occurrence is evenly distributed across all Indonesian shipping routes, especially waters that are utilized by large vessels (i.e. Malacca Strait 25%, Lombok Strait 20%, Riau Islands 20%, Java Sea 20%, and South Java 15% [12]). The establishment of Lombok Strait as a PSSA is expected to overcome various sea damage and pollution threats. Based on security theory, the related security dimensions in this study include the security dimension in a non-traditional view. More detailed depictions are presented in Table 3.

Table 3. Dimensions of Security in Non-Traditional Perspectives [13]

| Dimensions of Security | Non-Traditional Security |
|------------------------|-------------------------|
| The origin of the threat | Threats come from shipping activities; ship operating, accidental pollution, intentional pollution, physical damage to habitats |
| The nature of the threat | Non-military threats |
| Changing the response | Non-military approach, through legal, economic, social and diplomatic approaches (through the determination of the Lombok Straits as PSSA) |
| Changing responsibility | Indonesia with other IMO member states |
| Core values of security | Respect for the marine environment, maritime security, and maritime safety |

According to Cozens [14], non-traditional maritime security issues include freedom of navigation, safety at sea, piracy and armed robbery, smuggling in various forms, theft of mineral resources, pollution, and waste. In this research context, PSSA policy is an effort to protect the marine environment from the hazards of shipping activities. They are categorized as non-military threats as described in Table 1. According to Bueger [15], maritime security includes dimensions of the marine
environment and can be related to safety at sea, where the sea is ideally free from threats such as pollution, ship accidents, and the effects of climate change. To overcome these threats, a non-military approach was adopted through the recommendation to endorse the enactment of Lombok Strait PSSA. So that the Indonesian PSSA submission is further strengthened by research that supports the PSSA in the interests in ensuring maritime security and safety.

### 4.2. The Advantages and Disadvantages of PSSA in the Lombok Strait

The designation of a PSSA will bring advantages for marine environment protection, including overcoming regional vulnerability to damages from shipping activities, increasing maritime safety, public awareness, and a culture where seafarers care about the region’s sensitivity and risk of damage from navigation in the region. The main advantages of PSSA establishment is that Indonesia will gain additional authority to easily report prevent violations that previously have never been detected [9].

The existence of PSSA in the Lombok Strait is important and duly needed given the Lombok Strait position in the triangle of coral reefs/Coral Triangle (CT) area, which is rich in biodiversity. It is one of the most significant tuna breeding grounds for the world’s largest tuna fisheries industry. It supports the lives of more than 120 million people who reside in the CT region and millions of people throughout the world. Primarily, these benefits for humanity include:

1. Supporting livelihoods, income, and food security, especially for people living along the coastlines of CT countries;
2. Tuna spawning and breeding sites underpin the multibillion-dollar tuna fishing industry and provide tuna for millions of consumers in all corners of the world;
3. Healthy marine resources contribute to the growth of the natural tourism industry in the CT area; and
4. Healthy coral reefs, seagrass and mangrove ecosystems, which will protect coastal communities from storms and some tsunami effects, thereby reducing future reconstruction costs and international aid needs. This also contribute in reducing global warming intensity and preventing global climate change that can further impact the environment and community.

Wardhana [16] states that the establishment of PSSA in the Lombok Strait itself is believed to provide the following benefits:

1. Protect conservation areas in Indonesia from the impacts of shipping activities;
2. Indonesia’s conservation area can be adopted as one of the IMO adopted measures;
3. Increase the awareness of the international maritime community regarding the existence of conservation areas in Indonesia;
4. Increase tourism in protected areas; and
5. The determination of ship routing as part of APM can also directly improve shipping safety.

Roberts et al. [17], states that PSSA must be accompanied by adequate APM to address risks that arise from shipping activities. PSSA is only the legal status of the protected area, but the benefits can only be obtained if the PSSA are implemented well through the accompanied APM. This APM will later be useful in regulating shipping activities so that these activities do not disturb or threaten sensitive areas in the vicinity. Therefore determining the right APM in protecting PSSA equally important as enacting Lombok Strait as a PSSA.

Through PSSA and the accompanying APM, Indonesia will be able to determine areas where ships are allowed to transit, especially in the Lombok Strait. However, this does not merely just happen since it must also be determined and approved internationally due to the region’s status as an IASL. With the establishment of PSSA in the Lombok Strait, ships passing through this route can be notified of the presence of sensitive areas around the Lombok Strait. The intent of greater traffic control in the shipping lane between the two areas of Nusa Penida and Gili Trawangan is to provide assistance to ships, so any risks of collisions and pollution that causes damage and oil spills will be reduced. Through the PSSA and APM Indonesia will be able to regulate the ship's behavior when sailing in areas designated as a PSSA such as the speed or prescribing that the ship must go through a path that has coral reefs.
Enacting a policy is inseparable from the risks that might occur, therefore a full and thorough risk assessment analysis is required to formulate any new policy. Regarding the determination of the Lombok Strait as a PSSA, the Ministry of Transportation as the leading sector of this stipulation plan states that the PSSA formulation already contains elements of risk assessment in accordance to International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Water Risk Assessment Program (IWRAP) risk assessment methods commonly used by IMO member states, and collaboration with Sepuluh November Institute of Technology as a national consultant. The risk assessment is used primarily in analyzing the frequency of ships collisions that pass the Lombok Strait or crossing from Bali to Lombok and vice versa. However, the risk assessment has not yet performed the initial stage of assessing assets, threats, and vulnerabilities in accordance with the security risk assessment model developed by Tony Burns-Howell et al. [18].

The threat assessment that has been carried out in the risk assessment is only limited to one type of threat, namely the occurrence of a ship collision. Meanwhile, there are broader potential threats that might disturb the environment, maritime security and safety. According to the Hamburg headquartered International Union of Marine Underwriters (IUMI), around half of the world's total losses are caused by bad weather, around a third by grounding and under 10% by collision. Since the initial stages in the security risk assessment method have not yet been carried out, the subsequent assessment of the stages of this model has not incorporated the results produced from the supposedly performed initial stages. As long as the PSSA concept is well guided, there is no loss if PSSA is applied in the Lombok Strait.

When implementing a PSSA, the government will increase patrolling and policing requirements and the report any alleged violation associated with protective measures under the PSSA. A ship flying their flag should provide the Government with the details of any appropriate action taken against the committed offense. After the designation of a PSSA and its associated protective measures, IMO should ensure that the effective implementation date is as soon as possible based on the rules of IMO and consistent with international law. All ships are required to carry 'adequate and up-to-date charts' under SOLAS Chapter V (Regulation 27) to assist in navigation; all associated protective measures should be identified on charts following the symbols and methods of the International Hydrographic Organization (IHO) these charts will be promulgated by the Indonesian Navy Hydrographic and Oceanographic Center. Ships will be required to keep clear from these sensitive areas. Even so, it does not rule out that Indonesia will face challenges or consequences when implementing PSSA. Since it implemented in international shipping lanes, Indonesia must prepare a robust argument to counter any protests from many parties that use the route.

Based on the previous explanation, it can be described that the scenario plan includes the best and worst scenario if the Lombok Strait, especially Nusa Penida, is determined as PSSA. The condition of the marine environment in the Lombok Strait is still relatively good since Indonesia has established a conservation area or MPA based on Decree No. 24/KepMen-KP/2014 of the Minister of Maritime Affairs and Fisheries. However, increased shipping activities in the region can worsen the already good condition of the marine environment. PSSA becomes a management tool in overcoming and preventing the impact of shipping activities on the marine environment.

The best scenario is if the Lombok Strait is determined as PSSA. When Indonesia applies, the IMO agrees to designate the Lombok Strait as a PSSA. Following the enactment, there will be regulations and provisions related to the safe navigation of ships that will transit the waters of the Lombok Strait. The regulations and provisions describe the scheme or shipping routes that can be traversed by the ship that apply internationally and are followed by all IASL users. This is intended to ensure maritime safety and reduce the likelihood of marine pollution caused by ship activities and accidents.

Secondly, the Lombok Straits PSSA will be depicted on an internationally recognized and used navigation chart so that users of the IASL line will be notified of sensitive areas and keep away from the area. Eventually, the Lombok Strait shipping lane will be safe from the threat of navigation hazards, particularly around sensitive areas around Nusa Penida and Gili Matra. This diversion of sea traffic will reduce the burden on existing conservation areas; it will also likely increase trade and
supporting industries in other areas so that the benefits will be felt not only for the surrounding coastal communities but also for the international community.

The worst scenario would be that the Lombok Strait is not proposed as PSSA or the IMO rejects Indonesia’s proposal of Lombok Strait designation as PSSA. It is most likely that in the next 10-20 years this IASL will become increasingly congested areas with large shipping activities. Traffic from shipping activities in the Lombok Strait, both ships that sail from the Indian Ocean to the Pacific Ocean and vice versa and from Bali to Lombok and vice versa, will be increasingly out of control and increasing threats to maritime safety. This will lead to the increase of violations from vessel activities which will have an impact on the marine environment’s damage and pollution due to the lack of supervision and control systems. The decline marine environment condition will badly affects marine life, especially the rare and endangered species. Marine environment quality and productivity will also decline and affect coastal and global communities. Subsequently, the decline in the region’s aesthetic value will decrease of income sources from the tourism industry in the Lombok Strait.

Comparative analysis between the conceptual model and the real world situation as shown in Figure 4 found several gaps in form of activities have not been carried out by related instruments. First, there is a requirement to formulate a policy strategy to establish the Lombok Strait as a PSSA. This includes assessing the suitability of the existing APM as the basis of a Lombok Strait PSSA to ensure that it has met all of the requirements of the IMO guidelines for submissions. Secondly, conducting a security risk assessment on the policy as the basis for formulating a strategy to manage risk and unintended outcomes of the policy. Third, formulating a follow-up mechanism resulting from any IMO determination on the Lombok Strait PSSA proposal. Fourth, setting up the policy implementation, which involve various related ministries/institutions in efforts to protect Lombok Strait’s marine environment. Fifth, evaluating the Lombok Straits PSSA enactment, which requires assessment to implement any requirements in the field.

5. Conclusion
Shipping activities in the Lombok Strait will likely increase in the future, which in turn will increase maritime security threats in the areas, especially sea damage and pollution threats in sensitive areas such as Nusa Penida and Gili Trawangan that is designated as an MPA. To preserve maritime security in the area from any adverse effects of shipping activities this research suggest the needs of Lombok Strait to obtain international recognition as a protected area. The Indonesia Government has issued an internal policy demonstrating intent to establish the Lombok Strait as PSSA, which has not yet been officially submitted to the IMO. This research analyzed and discussed the advantages and disadvantages of PSSA designation in Lombok Strait, which concluded that the enactment of Lombok Strait as PSSA could provide several advantages, particularly in preserving maritime safety and protecting the environment.

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