Chapter

The Role of Marine-Protected Areas as A Life Support for Fishery Communities: Indonesian Perspective

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Abstract

This chapter examines relevant literature on marine-protected areas (MPAs) development and their benefit to support fishery communities in Indonesia. The MPAs concepts experienced since Indonesia's kingdoms eras, continuing the Dutch Colonial period, the next post-independence, and the period from 2000 to the present. One of the functions of MPAs is as a source of livelihood for fishery communities. The size of MPAs in the year 2000 was around 2.6 million hectares (ha) and significantly increased in 2021 up to 23.3 million ha. The size of MPAs is growing along with forming the Ministry of Marine Affairs and Fisheries. The Indonesian government targets MPAs of 32.5 million ha or 10% of the territorial sea of the archipelago. The involvement of stakeholders in the utilization and management of MPAs ensures the area's sustainability and environmental safety. It improves the welfare of fishermen through the availability of fish resources. Therefore, in the purpose of protecting ecological assets, even though the literature sources were limited, our finding suggests that many MPAs involving local communities and traditional management can become the foundation of the fishery community's livelihood.

Keywords: economic, fisheries, livelihood, marine-protected areas

1. Introduction

Indonesia is located between Australia and Asia as well as between the Indian Ocean and the Pacific Ocean, at 6°08′ North (N)–11°05′ South (S) and 94°45′ East (E)–141°01′ E. As a geographical position, where located between two major continents, it causes the climate in Indonesia influenced by the environment of mainland Asia and Australia. Indonesia is situated between two vast oceans, causing sea breezes from the Pacific and Indian Oceans, carrying a lot of water vapor and causing high rainfall. The direction of the wind changes every half year, along with the Sun's position concerning the equator so that it has two seasons. When the Sun's position is south of the equator, most areas in Indonesia experience the rainy season. But, when the Sun's position is north of the equator, most areas in Indonesia experience a dry season. Indonesian waters are located at the equator so that it has a

tropical climate that receives enough sunlight throughout the year. Indonesia is one of 17 mega diversity countries with 4813 fish, 1592 birds, 781 reptiles, 270 amphibians, and 515 mammal species. Besides that, there are 590 hard coral reefs, 202 mangroves, and 15 seagrasses. In addition, aquatic biota consists of 2500 species of mollusks, 2000 crustaceans, and six species of turtles [1].

Indonesia is an archipelagic country with many large and small islands totaling 17,504 islands, of which 7870 islands have been named, and 9634 have not been named. A total of five large islands are owned by Indonesia, including Sumatra (473,481 km^2), Kalimantan (743,330 km^2), Java (128,297 km^2), Sulawesi (180,681 km^2), and West Papua (102,946 km^2). The proportion of the total area of these large islands reaches about 85.8% of the total land area. The coastline is 99,093 km long, and the land area reaches 1,910,931 km^2, so the ratio of the length of the coast to the land area is 51 m/km^2. In addition, the territorial sea reaches 5,800,000 km^2 consisting of 800,000 km^2 territorial sea, 2,300,000 km^2 archipelago seas, and 2,700,000 km^2 Exclusive Economic Zone [2]. Indonesia also has various coastal water habitats, such as estuaries, lagoons, coastal rivers, bays, tides, coastal dunes, mangroves, coastal swamps, wetlands, seagrass beds, raised soils, and coral reefs.

The main ecosystems of coastal areas, including mangroves, seagrasses, and coral reefs, have an essential role in supporting coastal communities' lives, especially for fishermen. These ecosystems can provide food, industrial raw materials, medicines, and ecosystem services. Coastal ecosystems have many functions, such as ecologically, biologically, economically, and sociologically [3]. The ecological process of coastal ecosystems is feeding ground, spawning ground, and nursery grounds of various aquatic organisms. The biological function of coastal ecosystems is to recycle organic matter into nutrients that can be utilized by aquatic biotics, and provide oxygen through photosynthesis and carbohydrates as the primary food source for herbivores. The economic function is food and medicines, industrial raw materials, tourist areas, and environmental services. Sociological function is a place to perform ceremonies or activities related to belief, religion, or worship.

Excellent and healthy coastal ecosystem conditions can provide abundant food, industrial raw materials, and environmental services for the community [4]. Stakeholders can utilize fishery resources in healthy coastal ecosystems to the maximum recommended and sustainable limits. The increasing demand for fulfilling the population's needs causes coastal ecosystems utilization to increase so that the quality of coastal ecosystems decreases. Therefore, it is necessary to establish marine-protected areas (MPAs) to maintain the quality of the coastal ecosystem to remain good. In addition, the establishment of marine-protected areas is expected to provide opportunities for aquatic biotic to grow and reproduce without any disturbance from fishing activities. Aquatic biota breeds in conservation areas are expected to be a source of germplasm and seedlings suppliers in buffer zones and other utilization areas.

Several provinces or regencies in the archipelago have created conservation areas that are passed down from generation to generation and obeyed by the community. Residents in several areas have established regulations for the controlled use of fishery resources. Rules are made in writing or unwritten, which are strictly adhered to by the community. Laws are made by the district representing stakeholders and apply to the general public. People who violate these regulations will be subject to social sanctions and pay fines, determined based on these regulations. Several provinces have developed models for the use and management of fisheries resources that have been in effect since the royal era, for example, "panglima laot" in Province Aceh, "lubuk larangan" in Sumatra, "kelong" in Batam, "mane'e" in North Sulawesi, "sasi" in Maluku and Papua, and "awig-awig" in Lombok [5].

There are many environmentally friendly fisheries resource management models developing among the people in each region. Panglima Laot, which has existed since the twelfth century, is a traditional institution that connects fishermen with the government in Aceh Province. Panglima Laot is an institution that makes provisions for customary sea law that applies to fishermen throughout Aceh Province. The Panglima Laot is tasked with regulating procedures for catching marine fish, resolving fishing disputes, and other tasks related to the sustainability of fishery resources in Aceh Province [6]. Panglima Laot regulates environmentally friendly fishing procedures, prohibits damage to the marine environment, and stipulates abstinence from the sea on certain days. Abstinence from the sea has implications for the sustainability of fishing and the sustainability of fishery resources. The Panglima Laot stipulates a ban on going to see every August 17, Friday, Eid al-Fitr/Adha, December 26, and on the day of khanduri/sea alms.

Another form of local wisdom is the existence of the prohibition pit in West Sumatra. Lubuk Larangan is a part of the river-protected area from fishing activities and is a place for fish to spawn. The prohibition on fishing using all types of fishing gear applies for a certain period to allow fish to grow and reproduce. Communities living along the Subayang River have agreed to maintain and preserve the river area. The agreement is stated in the customary law that applies to the indigenous community of Rantau Kampar Kiri. Lubuk prohibition is opened once a year in the dry season before religious holidays [7]. The public may catch fish using environmentally friendly fishing gear when the pit is open.

The Ministry of Marine Affairs and Fisheries/Kementerian Kelautan dan Perikanan (MMAF/KKP) has determined that the area of marine conservation areas in Indonesia in 2030 is about 10% of the total area of Indonesian waters, which is around 32,500,000 ha. The increase in marine conservation areas was initially prolonged, then experienced a very rapid rise. The size of marine conservation areas in 1945 was less than one million ha, and 50 years later, the area became 2.6 million ha consisting of 24 conservation areas. In 2005, the area of marine conservation areas had increased to 5.5 million ha; then in 2015, the size of marine conservation areas increased drastically to 17.3 million ha consisting of 154 conservation areas. Furthermore, in 2020, marine conservation areas have grown to 23.14 million ha consisting of 196 regions [8]. Indonesian water conservation areas in early 2021 have reached 23.34 million ha or 7.18% of Indonesian waters [2, 9]. The development of marine-protected areas in Indonesia over the last two decades can be seen in **Figure 1**. Studies on the development of marine-protected areas in Indonesia are still scarce. Therefore, this chapter aims to examine relevant literature related to the development of marine-protected areas during the royal period, the period from 1600 to 1945 or the Dutch colonial period, the period from 1945 to 2000, and then the period from 2000 to the present. This chapter is expected to be a reference for stakeholders to manage marine-protected areas.

1.1 The roadmap of fishery resources conservation

The development of natural resource conservation in Indonesia can be grouped into four models or periods according to the conditions developed at that time, each of which has a different character. The four periods of conservation development, namely:

1. The era of the kingdom,

2. The era of Dutch occupation,

3. The era of independence, and

4. The age of Reformation.

During the kingdom, local people have made efforts to preserve natural resources by giving a haunted label to forests or lakes considered haunted and protected. People label the location as a haunted place so as not to get disturbed. The title haunted means that certain areas, such as lakes that are a source of drinking water for the community, have guards, namely ghosts, who can harm anyone who does terrible things to the lake. People believe that a sacred area becomes haunted, causing only handlers or trusted people to guard the area against daring to enter it. The haunted label causes residents not to dare to kill fish, animals, and cut down trees in the area. Someone who dares to violate the prohibition will get harm or disturbance by spirits, demits, or demons who guard the haunted area. An area is made a haunted area because the area has water sources, protected areas, ancient relics, places of pilgrimage, and places of worship. Areas that humans rarely visit cause no disturbance or deforestation so that forest vegetation grows densely, which can store water reserves for residents [10].

Conservation of natural resources that existed during the kingdom began before the sixteenth century. Today, two models are still adhered to by the community: the sacredness of an object and an agreement to preserve common natural resources. The sacredness of certain things does not use written rules but is based on mystical stories circulating in society, oral traditions, or advice from elders. There are mystical stories in certain places where natural resources are a source of livelihood for many people or communities, for example, in Telaga Renjeng, Pandansari Village, Paguyangan Subdistrict, Pekalongan District. In the lake, there is a catfish (*Clarias batrachus*) which is very sacred. The lake is a source of raw water for the surrounding community. The existing aquatic biota becomes a source of germplasm so that people protect it by maintaining its sacredness. The myth that circulates is that the fish is a lake-dwelling creature so that anyone who disturbs the fish or catches it, then he/she and his/her family will experience disaster. The rumor was that if someone fell ill after catching fish in the lake and then became healthy after returning it, so the mystical story was valid. In almost every area, mystical stories are built

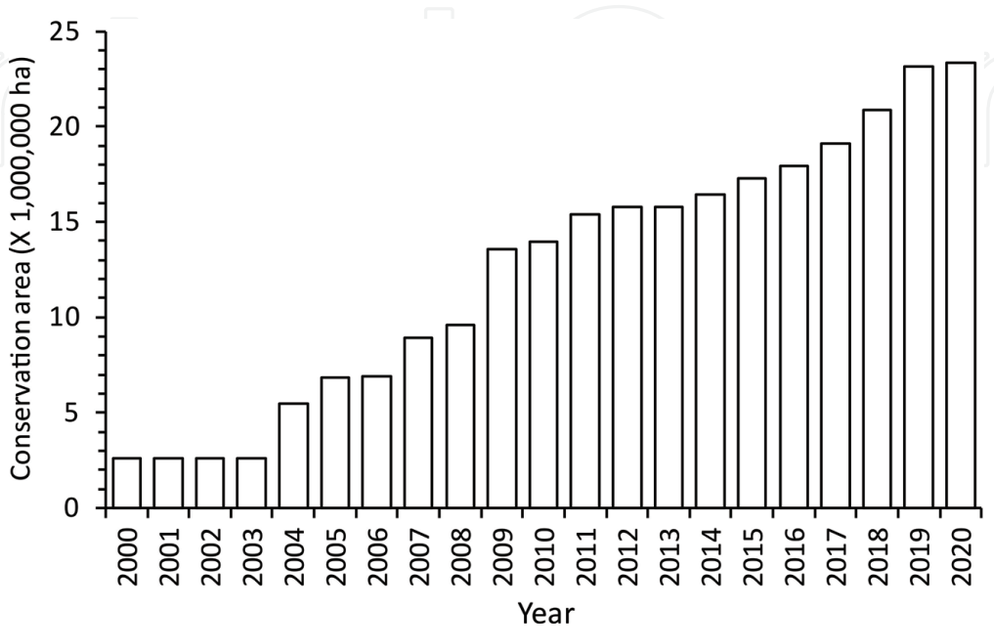

Figure 1.
Development of Indonesian marine and fishery conservation areas in the period 2000–2020.

by the ancestors to protect the community's natural resources so that they remain sustainable for posterity [11].

The next model for conserving natural resources is an agreement between the community and its leaders to regulate the best way to use them. The community entrusts the leadership in managing as well as possible the utilization and preservation of aquatic resources. The leader consists of a group of people who are considered capable and represent various groups. Leaders determine how to use natural resources, harvest amount, harvest time, location, and sanctions for those who do not comply with the rules. Regulations on natural resources have become models of local wisdom, for example, "Panglima Laot" in Aceh and several models of local wisdom in several provinces in the archipelago. The community more embraces conservation by conserving natural resources in specific locations, so this local wisdom model is more successful than other models [6, 7].

During the Dutch occupation, the colonial government cooperated with the indigenous population to exploit the forest. Timber from the forest was used to build office buildings and other infrastructure for Dutch needs, which reached its peak in the early nineteenth century. Uncontrolled forest use causes forest areas to be deforested, which occurs in several locations on the island of Java. For example, the forests on Mount Merbabu, Sumbing, and Sundoro are almost bare. Deforestation causes landslides and flash floods during the rainy season, causing heavy casualties and losses. On the other hand, the water supply is significantly reduced during the dry season, and droughts occur in various places. Deforestation causes farmers to suffer from water and food shortages during the dry season [12].

In the mid-nineteenth century, there were hunting activities that were carried out by the Dutch and and native. Hunting activities were carried out to meet food needs, trade, protect crops, and as a hobby. Uncontrolled hunting of wild animals causes the population to decline very sharply. Wild animals that have high selling value are threatened with extinction in their natural habitat.

Deforestation and wild hunting of animals prompted the Dutch colonial government to find solutions to save animals and plants who are critical populations. In 1909, the colonial government carried out conservation by issuing Staatsblad No. 497 and 594 to protect animals and plants in the Cibodas nature reserve. The law protects and prohibits hunting all animals, except for animals deemed dangerous and disturbing, such as monkeys and orangutans.

Staatsblad No. 497 and 594 exclude orangutans so that populations of orangutans, Javan rhinoceros, and rare birds are threatened with extinction. Furthermore, the colonial government issued Staatsblad No. 134 and 266 of 1931, which prohibits the export of protected animals and their derivatives, and Staatsblad No. 17 of 1932 concerning the establishment of Nature Reserves and Wildlife Sanctuaries. Complete protection of animals and plants is applied to the nature reserve area, while limited use can be carried out in the wildlife reserve area. According to Staatsblad, several wildlife sanctuaries were inaugurated, such as the Baluran conservation forest on the island of Java. Staatsblad remained in effect and was adopted after Indonesia's independence [13].

At the beginning of independence, Indonesia inherited conservation regulations from the Netherlands, valid for approximately 35 years. Conservation of natural resources at that time was in charge of the forestry sector. In 1971, the Ministry of Forestry established the Directorate of Nature Protection and Conservation to manage nature protection activities. In 1973, the Indonesian government ratified the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), then the government ratified CITES with Law no. 43 of 1978. Since independence until the reform era, the government has inaugurated 10 new National Parks, but no single water conservation law has been issued. In 1990,

the government issued Law No. 5/1990 concerning the conservation of natural resources and their ecosystems. With the promulgation of this law, 35 years since independence, the Indonesian government issued regulations on natural resource conservation that focus on terrestrial flora and fauna [14].

During the Reformation period, which began in 1998, the government formed a new ministry to manage marine resources through Presidential Decree No. 355/M of 1999 dated October 26, 1999, in the 1999–2004 Cabinet. The government has refined the name of the Department of Marine Exploration (DEL) several times. The name of the marine exploration department was changed to the Department of Marine Affairs and Fisheries (DKP) based on Presidential Decree no. 165 of 2000, dated November 23, 2000. Coastal and marine resources have received greater attention since the establishment of the Department of Marine and Fisheries Exploration in 1999.

After the Ministry of Marine Affairs and Fisheries was formed, attention to the conservation of marine and fishery resources began to emerge. From 2000 to 2020, the government has issued regulations related to marine and fishery resource conservation. The government has made five laws, two government regulations, and regulations of the minister of marine and fisheries as many as 11 numbers. In addition, the government makes regulations in the form of Decrees of the Minister of Marine Affairs and Fisheries with six numbers, Director-General Regulations with two numbers, and Director General Decrees with two numbers. In the last two decades, the Ministry of Marine Affairs and Fisheries has issued more than 28 types of regulations at the ministerial/Director-General level, directly or indirectly related to the conservation of marine and fishery resources [14, 15]. Some of the regulations related to the conservation of fish and aquatic resources are as follows:

1. Law of The Republic of Indonesia No. 31 of 2004 concerning fisheries, which contains provisions on preserving fishery resources in articles 11 to 14.

2. Law of The Republic of Indonesia No. 27 of 2007 regarding the management of coastal areas and small islands. This Law contains the conservation of coastal areas and small islands in articles 28 to 35.

3. Law of The Republic of Indonesia No. 45 of 2009 concerning Amendments to Law No. 31 of 2004 regarding fishery. In this Law, the provisions on conservation contained in the Law Number 31 have not changed.

4. Law of The Republic of Indonesia No. 1 of 2014 concerning Amendments to the Law Number 27 of 2007 concerning management of coastal areas and small islands. In this regulation, the conservation provisions contained in Article 30 have been refined.

5. Law of The Republic of Indonesia No. 32 of 2014 concerning Marine Affairs. The conservation provisions are contained in Article 11 paragraph (1), which reads, "The Unitary State of the Republic of Indonesia has the right to preserve and manage biological wealth on the high seas."

6. Government Regulation No. 60 of 2007 concerning conservation of fish resources. This government regulation contains the conservation of fish resources, which includes 54 articles of conservation provisions.

7. Regulation of the Minister of Marine Affairs and Fisheries No. 13/PERMEN-KP/2014 concerning Marine-Protected Area Network.

8. Regulation of the Minister of Marine Affairs and Fisheries No. 21/PERMEN-KP/2015 concerning partnership for management of aquatic conservation areas.

9. Decree of the Director General of Coastal and Small Islands Marine Affairs No. Kep. 44/KP3K/2012 concerning technical guidelines for evaluation of the effectiveness of management of marine, coastal, and small islands conservation areas.

10. Regulation of the Director General of Coastal and Small Islands Marines No. 02/PER-DJKP3K/2013 concerning technical guidelines for boundaries of coastal conservation areas and small islands (KKP3K).

The government issued various regulations as the basis for determining marine-protected areas (MPAs). The establishment of marine-protected areas to protect and preserve marine and fishery resources, encourage the economy through natural water tourism programs, and social responsibility for the community's welfare. The existence of marine-protected areas is expected to maintain optimal fish stock populations. The Indonesian government targets the area of conservation areas in 2030 to reach 32.5 million ha. In 2021, the area of marine conservation areas in Indonesia will reach 23.9 million ha with a total area of 201 units. The area of marine-protected areas that are operated and used sustainably reaches 9.9 million ha [16].

1.2 Strategy for the management of fishery resource conservation areas

Indonesia's coastal areas have various types of ecosystems that can be managed and developed into productive areas. These various types of ecosystems, such as mangroves, coral reefs, seagrass beds, river estuaries, sandy beaches, can be developed for capture fisheries, aquaculture, tourism, or other purposes that generate community income. In addition, these ecosystems provide various types of resources that can be used directly and indirectly and environmental services. Various types of ecological services are provided by coastal ecosystems; for example, it can protect the coast from natural disturbances from the sea, provide habitat for various types of organisms on land and water, and provide a fresh environment, unique environment, and other environmental services. Coral reef ecosystems, mangroves, and seagrasses are interconnected and vital ecosystems for aquatic biota. The loss or destruction of one of these ecosystems can result in the disruption of other ecosystems. The subsequent impact disrupts the life cycle of marine life. The following describes the ecosystems of coral reefs, mangroves, seagrass beds, and the distribution of fish communities.

The polyp is an individual coral animal shaped like a tube and has a mouth at the top surrounded by tentacles. Coral animals can produce lime or $CaCO_3$, which becomes a reef. Some polyps form colonies that number in the thousands. The type of coral animal affects the shape of the reef and the direction of growth and color. The types of coral animals in Indonesian waters reach more than 590 species, and as many as 195 species are endemic. Coral animals have a symbiotic relationship with zooxanthellae or algae that are capable of photosynthesis. Therefore, coral reefs can live in warm, shallow, and clear waters in the tropics for the photosynthesis of symbiotic algae [17].

Indonesian waters are part of the world's coral triangle, including six countries, namely Indonesia, Malaysia, Philippines, Papua New Guinea, Timor Leste, and Solomon Islands (**Figure 2**). Coral reef ecosystems in the world's coral triangle are

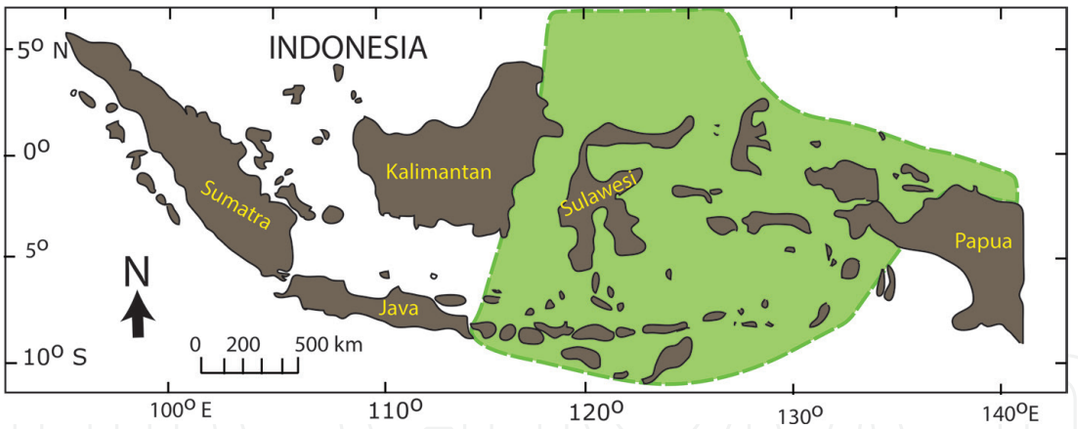

Figure 2.
Map of Indonesia's coral triangle area (green shadow), which is part of the world's coral triangle, has more than 500 coral species and more than 3000 fish species.

the most diverse, with more than 500 species of coral, more than 3000 species of fish, 202 species of mangrove, and 15 species of seagrass. Indonesia's coral reefs reach more than 5 million ha, accounting for 18% of the world's total coral reefs and 65% of the coral reefs in the coral triangle [18]. The coral triangle area becomes a spawning ground, a breeding ground, and a feeding ground for the most economically important fish, such as tuna and skipjack. The position of the coral triangle area is very strategic. It is the center of marine biodiversity, so it is crucial to maintain an excellent ecosystem to produce fish for the welfare of humankind.

Healthy coral reefs are essential so that their functions run well, namely as a habitat for biotic organisms, feeding ground, especially economically important fish, nursery ground, and other uses. Coral reef health is determined based on the percentage of live coral cover. Based on the proportion of coral cover, the category of coral cover is differentiated into four categories, namely excellent (76–100%), good (51–75%), moderate (26–50%), and poor (0–25%). The condition of coral reefs in the excellent category is 6.39%, the good category is 23.4%, the moderate category is 35.06%, and the lousy category is 35.15% [19].

Mangroves are plant communities that tolerate changes in salinity from fresh to very salty and can excrete excess salt due to substrate absorption. Mangroves are found in coastal areas, estuaries, and river estuaries that are connected to the sea. Mangroves can grow in coastal areas that are affected by tides, and the bottom of the water is muddy sandy mud or gravel sand. Mangrove plant communities form a distinctive ecosystem in tidal zones in coastal areas, live in large numbers, have aerial roots or taproots, and bear fruit. The mangrove forest ecosystem benefits directly and indirectly for the surrounding community. Mangrove forest ecosystem can provide many valuable services, such as supporting various ecosystem services, including soil formation, primary production, nutrient cycling. Mangroves as providers of environmental benefits, such as mangroves as a habitat for juvenile fish for consumption or ornamental fish, are spawning grounds and nursery grounds. During photosynthesis, mangroves assimilate CO_2 from the atmosphere to produce carbohydrates as the basis of the food chain. Photosynthetic activity can reduce greenhouse gas emissions so that it can inhibit global warming.

Indonesia's mangrove forest area reaches 3,310,000 ha, which is spread unevenly on the west coast of Sumatra Island, some parts on the north coast of Java Island, along the coast of Kalimantan Island, Sulawesi Island Coast, the southern coast of Papua, and several other small islands. The most extensive mangroves are located on the island of Papua, reaching an area of 1,497,724 ha (45.2%). Then followed by Sumatra Island covering an area of 666,439 ha (20.1%), Kalimantan Island

covering an area of 735,887 ha (22.2%), Maluku Island 221,560 ha (6.7%), Sulawesi 118,891 ha (3.6%), Java Island 35,991 ha (1.1%), Bali and Nusa Tenggara 33,508 ha (1.0%). Mangrove forest area has decreased over time caused by natural and anthropogenic factors. Natural factors causing mangrove damage include natural disasters and abrasion, while anthropogenic factors include overexploitation, such as conversion, reclamation, pollution, and waste disposal from urban areas [20].

Seagrasses are flowering plants, monocots rooted in rhizomes, leaves, flowers, and fruits. Seagrass can grow in a shallow marine environment, have high salinity, be permanently submerged, and get enough light. Seagrass requires a substrate for root attachment in the sandy bottom, muddy sand, soft mud, and coral. Seagrasses consist of 2 families, 12 genera, and 48 species [21]. The type of substrate, water depth, and tidal conditions affect the type of seagrass that can grow. The same species that grow in different habitat conditions will have different growth patterns.

Seagrass bed ecosystems are essential ecologically and economically. Seagrass serves as a spawning ground habitat, nursery ground, feeding ground for various aquatic organisms, especially fish, crustaceans, and shellfish, which are economically significant. Seagrasses can be used as food for herbivores, such as rabbitfish and dugongs. In addition, seagrasses can produce carbohydrates through photosynthesis, which is the basis of the food chain. Seagrasses also play an essential role in supporting the life of coral reef and mangrove organisms through interconnection.

Seagrass cover levels were categorized into three parts based on the percentage of seagrass cover, namely high (60–100%), medium (30–59.9%), and low (0–29.9%). Seagrass ecosystems that have a high percentage of cover indicate a healthy ecosystem. The current health level of seagrass based on the cover portion is around 41.79%, indicating a moderate level of health. The health level of seagrass is influenced by various factors, significantly decreasing environmental quality. The decrease in seagrass areas is caused by natural factors and the impact of human activities on the coastal environment. Natural factors affect seagrass areas, such as waves, strong currents, and storms. Meanwhile, human activities that affect the decrease in seagrass areas are beach reclamation, dredging, and sand mining [21].

Indonesia has various species of freshwater fish that inhabit many types of flowing and flooded ecosystems. Past geological events influence the kinds of fish that inhabit each island. The types of fish that inhabit each island are very different, separated by the Weber, Wallace, and Lydekker lines. The distribution of terrestrial flora and fauna, including fish, is separated by an imaginary line called the Wallace line between western and central Indonesia. In contrast, the diversity of fish species between east and central Indonesia is divided by the Weber line (**Figure 3**). Lydekker's imaginary line separates the variety of flora and fauna between eastern Indonesia and flora and fauna of the Australian type. The Wallace line runs between the islands of Kalimantan and Sulawesi and between Bali and Lombok. The Weber line stretches from the north in the Maluku Islands to the south through the Sahul shelf toward the east side of East Nusa Tenggara. The Lydekker line is an imaginary line that follows the contour of the depth between 180 and 200 m at the edge of the Sahul Shelf [22].

Indonesia has marine waters with potential fish resources reaching 12.5 million tons/year [23]. Excessive use of fish resources causes damage to ecosystems in coastal areas. In the era around 1990, extreme fishing used fishing gear that was not environmentally friendly, which caused fish stocks and catches of fishermen to drop drastically. Furthermore, in 1990, the Republic of Indonesia issued Law Number 5 of 1990 concerning the conservation of biological natural resources and their ecosystems. Law Number 5 of 1990 is an effort to prevent damage to the aquatic environment. It aims to regulate the protection of life support systems, and preserve the diversity of plant and animal species and their ecosystems, and the sustainable use of natural resources.

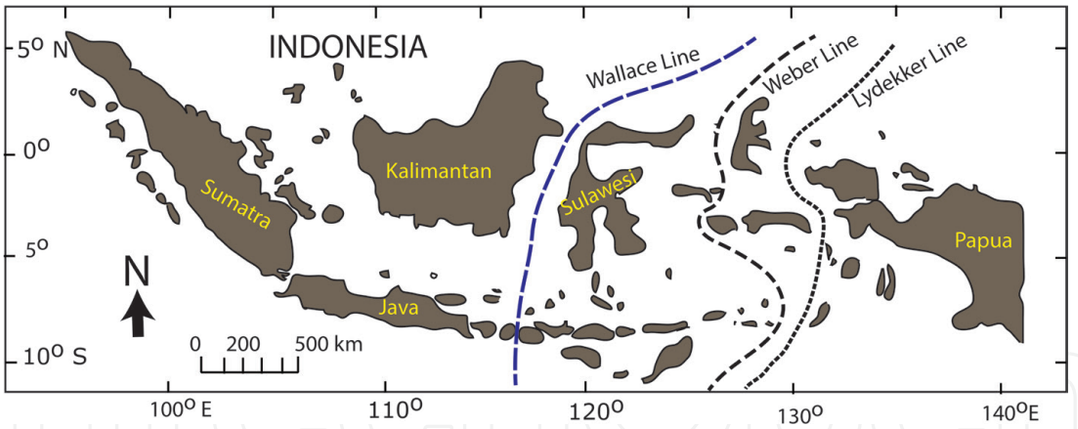

Figure 3.
Weber, Wallace, and Lydekker imaginary lines that separate the flora and fauna that inhabit the islands in western, central, and eastern Indonesia.

As previously explained, Indonesian waters have abundant and diverse fishery resources. Fishery resources can be used to improve the community's welfare and standard of living, provide employment opportunities, and meet domestic protein needs and export needs. However, the exploitation of fish resources must pay attention to sustainability so that the utilization rate of fish biomass must be balanced with the growth rate. Management of fishery resources is an effort to control fisheries business so that it is sustainable. In the last 50 years (1970–2020), the population of Indonesia has doubled, causing fish for consumption and other needs. In the same period, the utilization rate of fish resources has tripled. Overexploitation and unsustainable fishing gear cause most types of fish to be overfished. Capture fisheries production has reached saturation point and tends to decline or fluctuate since the 2000s. In turn, conservation needs to be done to save fishery and marine resources. The Indonesian government has developed a strategy to conserve fishery resources so that marine-protected areas can provide benefits and welfare for the wider community. The established techniques are: (a) strengthening of human resources and fisheries and marine institutions integrated between sectors; (b) maximum and sustainable management of marine and fishery resources; (c) increase the productivity of fishery resources based on research and science; and (d) expanding partnership network, including domestic and international markets as a source of funding.

1.3 Utilization of conservation areas

Marine and freshwater protected areas are protected water areas that are managed with a zoning system as an implementation of sustainable management of fish resources and the environment. The establishment or development of marine-protected areas is one of the efforts to increase aquatic biodiversity and control the sustainable use of fishery resources. Following the provisions of the Government Regulation of the Republic of Indonesia Number 60 of 2007 concerning conservation of fish resources, the determination of marine-protected areas is carried out with the aim of the following: (a) protecting and conserving fish resources and important ecosystem types in the waters to ensure the sustainability of their ecological functions; (b) realizing the use of fish resources and their ecosystems as well as sustainable environmental services; (c) preserving local wisdom in the management of fish resources in and around marine conservation areas; and (d) improve the welfare of the community around the water conservation area.

Protection or conservation areas are intended to protect fishery resources to maximize and sustain their utilization for the community. Therefore, several zones within the conservation area have been defined: (a) core zone, (b) sustainable fishery area, (c) utilization zone, and (d) other zones as needed. Within the core zone of a conservation area, research and education activities can only be carried out on the principle of not disturbing living things in the area. In the sustainable fisheries zone, capture fisheries activities can be carried out that prioritize the protection of habitat conditions for fish resources and the breeding cycle of fish species that prioritize local wisdom. Fish farming is also allowed in this area, considering the carrying capacity and environmental conditions of fish resources for the selection of fish species to be cultivated, feed management, technology, and business scale. In utilizing marine-protected areas, the following activities are carried out (a) fishing; (b) fish farming; (c) marine nature tourism; or (d) research and education [24].

Tourism activities in the utilization zone of marine conservation can be in mangrove ecotourism, marine tourism, or other forms of tourism. In the last few decades, there has been a very significant decrease in the area of mangroves due to anthropogenic activities. Mangroves have many functions for coastal communities, but the total size of mangroves is decreasing. The rate of decline in the area of mangroves reaches around 54,000 ha/year. Stakeholders can make efforts to maintain or increase mangrove areas, including reforestation, restoration, and utilization for ecotourism.

Mangrove ecotourism has been carried out by many people outside the marine conservation area. The Province of the Special Region of Yogyakarta does not have a mangrove area; however, the people of Pasir Mendit Village, Kulonprogo District, independently plant mangrove trees on the side of the Congot Lagoon to make the Congot Beach shady with mangrove plants (**Figure 4A**). The people of the Pasir Mendit Village have turned a sandy beach that was initially arid into an area that is overgrown with lush green mangroves (**Figure 4B** and **C**).

The coastal area of Congot Village eventually became a mangrove tourism spot, which was very crowded with tourists. The Congot mangrove tourism area is exciting to visit because its condition was originally an arid dune. Its condition has now drastically changed to a lush expanse of mangroves. Successful community efforts to plant mangroves on sandy land have encouraged other local communities, such as Baros Village, Bantul District, to carry out similar activities [25].

In marine-protected areas or conservation of fishery resources, tourism activities can be carried out in the utilization zone, while in other zones for transportation, security, and other activities. Managers of marine-protected areas or communities can carry out sustainable tourism activities in other use zones. In the early 2000s, when the economy improved, many people engaged in mass tourism activities, involving large numbers of tourists or groups of people. Mass tourism can have a negative impact in the form of degradation of the natural environment and positively impact the economy of the community visited by tourists. The negative impact caused by mass tourism, for example, is the presence of visitor waste scattered in various places. Furthermore, conservation area managers develop environmentally friendly and sustainable tourism activities that do not harm marine resource conservation areas.

Tourism development in marine-protected areas can provide many positive benefits. The positive benefits of tourism activities include increasing funds for maintaining marine-protected areas and opening new jobs for the surrounding community. Another benefit is to become a place of education and research for students. Marine-protected area managers can obtain development funds by selling visit tickets, area entry permits, and other services. On the other hand, the

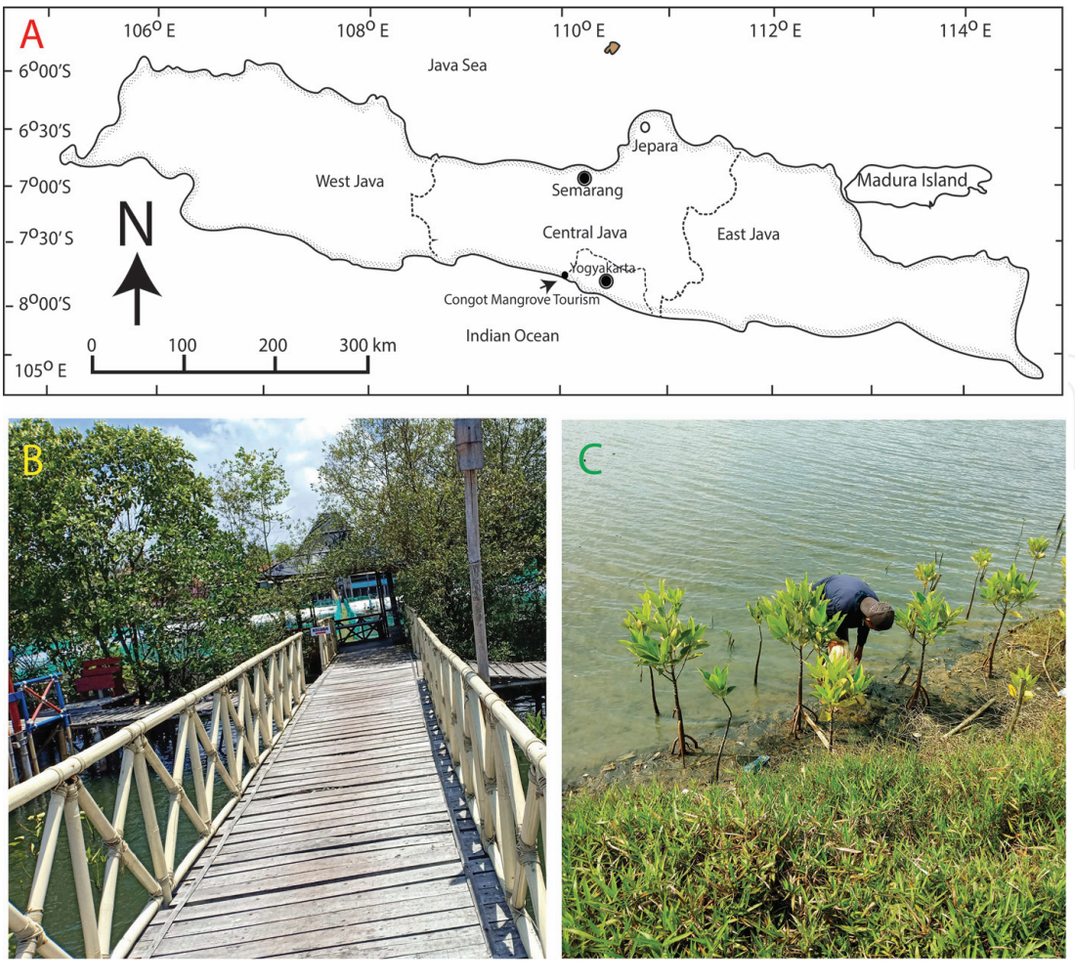

Figure 4.
The map of the Congot coast of the special region of Yogyakarta, as a location for planting people's mangroves of Pasir Mendit Village, has finally become a beautiful tourist area (A). Mangroves planted by the community in early 2000 became a shelter for mangrove tourism areas (B). The community independently planted and cared for mangroves (C).

community earns income by selling services, such as tour guides, renting boats, renting diving facilities, selling food, selling souvenirs, and other services. There are excellent benefits for the community, area managers, and other stakeholders, so they must carry out tourism activities in an integrated, controlled, and sustainable manner. There are 183 tourist sites in marine-protected areas (**Figure 5**) whose core business is mangrove tourism [26].

The management of marine-protected areas has built many mangrove tourism areas, and the most widely built is on the island of Java, with a total of 67 locations. The development of mangrove tourism areas on the coast of Java is very profitable because the development capital will soon return. The creation of a mangrove tourism area along the coast of the island of Java brings many benefits to stakeholders. The main benefits for the manager of marine conservation areas are that the mangrove ecosystem is getting better, the population density of mangrove plants is increasing, the mangrove trees are safe or not disturbed by the community, and the managed funds are raised. Communities involved in mangrove tourism get income that can meet their household needs [27].

2. Utilization of conservation areas

MPAs in Indonesia have some beneficial purposes such as fisheries and marine tourism opportunities. It is covered in the use zone, where various activities include

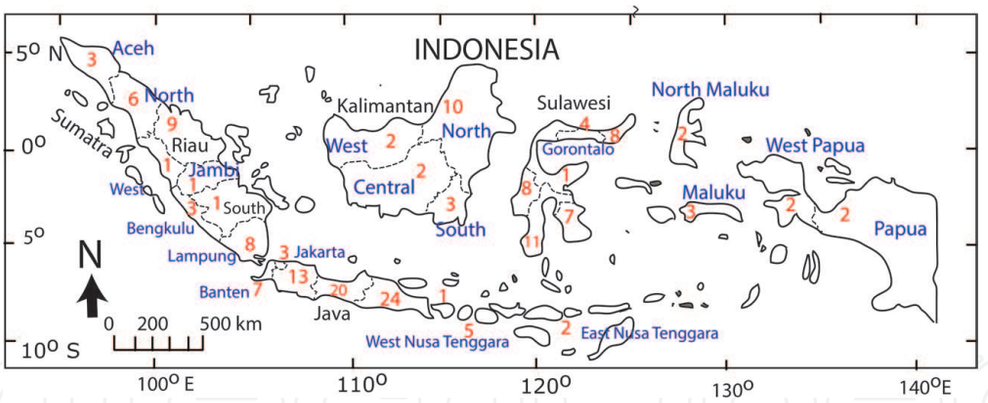

Figure 5.
The number of mangrove tourism areas developed by managers of marine conservation areas in each province (red numbers).

sustainable fisheries and responsible marine tourism. However, the data of fisheries and marine tourism activities within MPAs in Indonesia are limited.

Although the data are limited, unlike FMA, fisheries in specific MPAs are relatively still sustainable. The Ministry of Marine Affairs and Fisheries (MMAF) Republic of Indonesia maintains 35 MPAs priorities as pilot examples for MPAs management effectiveness [28]. The data show that the utilization of potential sustainable fisheries reached 42%. Therefore, 58% of sustainable fisheries commodities can be utilized with eco-friendly fishing gear.

For example, sustainable potency of pelagic fisheries in MPA Laut Sawu (3,355,352.82 ha), a national MPA in East Nusa Tenggara Province, managed under a national government named BKKPN Kupang (Balai Kawasan Konservasi Perairan Nasional/National MPA Office of Kupang) with 3.3 million ha (**Figure 6**). Fisheries stock reaches 156,000 tons/year with utilization of 65,332 tons/year (42%), while demersal fisheries stock reach 84,000 tons/year with utilization 17,779 tons/year

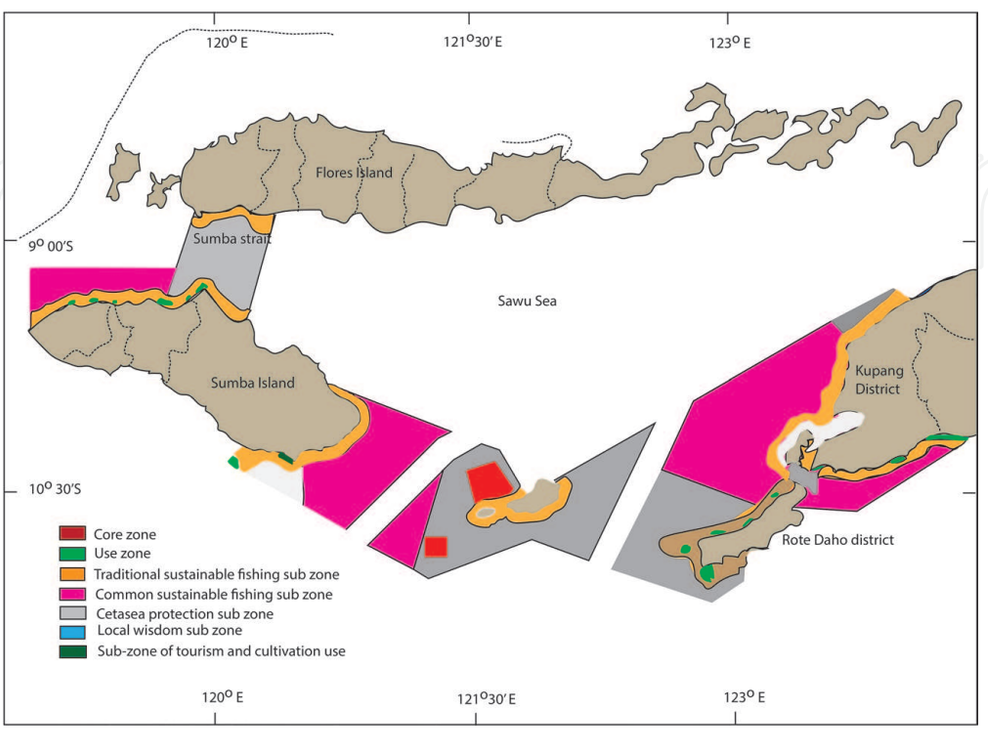

Figure 6.
The map of Laut Sawu national MPA, East Nusa Tenggara Province (Kepmen-KP No. 5/2014).

(21%) [29]. Thus, there is a potential to increase catch per unit effort by strengthening small fisheries groups.

Another example is the Alor District of East Nusa Tenggara Province, where nearly 75% of waters are MPA, named Selat Pantar MPA (276,693.38 ha) (**Figure 7**). It was established in 2015, but the management authority was established in 2019. Fisheries potency in Alor District reaches 45,715 tons/year, where only 18% have been utilized [29].

Although fisheries utilization in many MPAS has lower than sustainable potency, there are some threats in sustainable fisheries, such as destructive fishing by using explosive and poison gears. Most MPAs are managed under the Marine and Fisheries Agency in Provincial Government (22 out of 34 provinces) with no specific management unit entity [30]. As a result, many MPAs were established with a lack of management, so that destructive fishing still exists, for example, in Selat Pantar MPA. In 2014–2017, the percentage of rubble corals increased from 21% to 28%. In contrast, the portion of hard-coral cover was relatively stable, at 37%, but decreased to 27% in 2021. However, fish abundance and biomass showed growth (fish abundance increased from 746 individuals/hectares (ha) in 2014 to 1755 individuals/ha in 2021; fish biomass risen from 381 kg/ha in 2014 to 600 kg/ha in 2021) [31]. An example of a fisherman's profile is presented in **Figure 8**.

Fisheries management can also have a positive impact in a smaller area within MPAs that are managed by the local communities with local wisdom, commonly in Indonesia called "sasi." Sasi is known as traditional regulation for an open and closed season of fisheries utilization.

Anambas Islands MPA (1,262,686 ha) was established in 2014 and managed under a national government named Loka Kawasan Konservasi Perairan Nasional (LKKPN/National MPA Office) Riau Province (**Figure 9**). Apart from formal MPA, community-based conservation management such as Territorial Use Rights in Fisheries (TURF) practices exists in Mesabang Island. It is an example of how

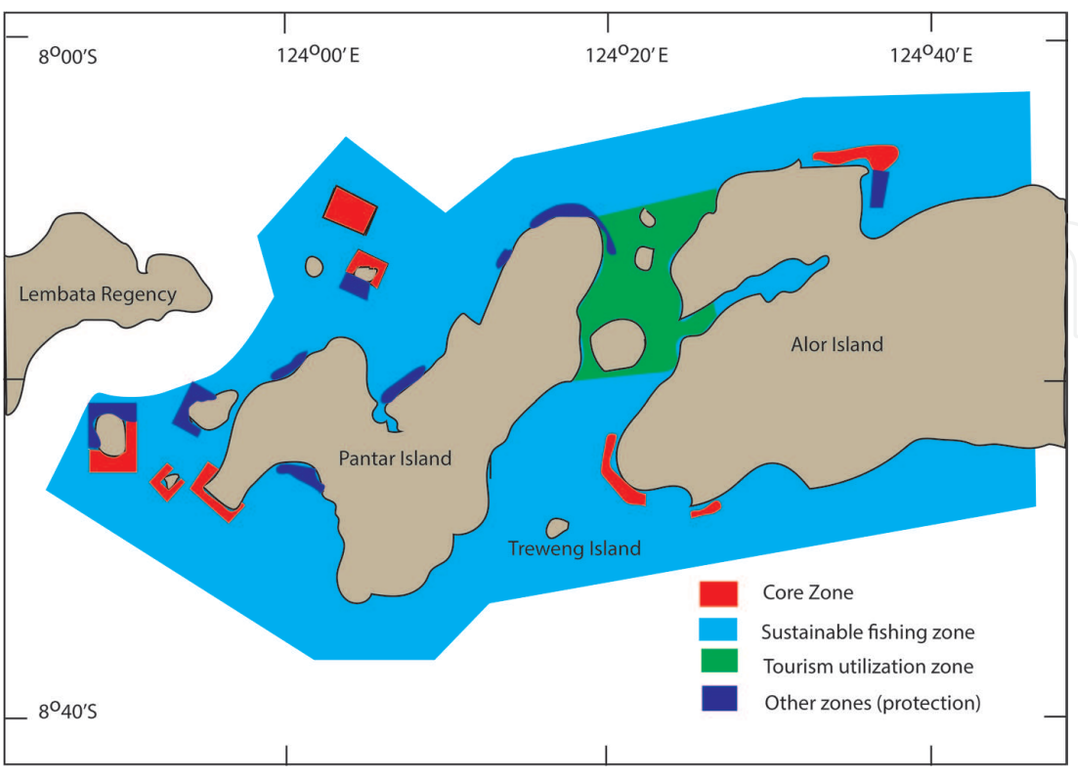

Figure 7.
Map of the Selat Pantar MPA of East Nusa Tenggara Province with its zoning based on the decree of the minister of marine and fisheries No. 35/2015.

Figure 8.
Fisherman's boats in the Selat Pantar MPA, Alor District, East Nusa Tenggara Province catching fish using environmentally friendly fishing gear.

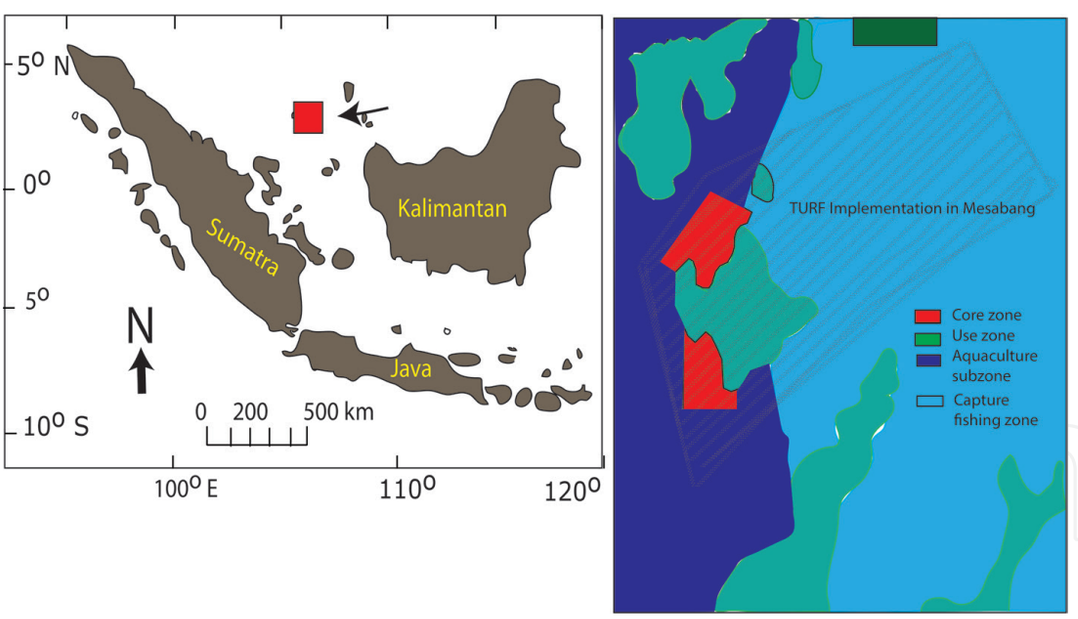

Figure 9.
Map of TURF practice in Mesabang Island within Anambas MPA Islands, Riau Islands province.

legal MPA can be integrated with community-based conservation. The purpose is to increase fisheries sustainability and produce higher-quality catches. Several regulations applied, such as the minimum size of reef fish (body girt should be up to 10 cm) and lift net only operated 6 days a month [32]. Sea surveillance is supported by villagers. As a result, from monitoring 2015–2016, live coral cover increased by 4.5%, mangrove forests cover by 5.8%, and seagrass beds cover by 7% [32].

Selat Pantar MPA was established in 2015, and the management authority under the provincial government is named KCD (Kantor Cabang Dinas/Representative Office of MAF Province Government). Community-based conservation

management also exists within Selat Pantar MPA. For example, Baranusa, a traditional kingdom acknowledged by the local government, lived in five Pantar Barat Island villages.

Formal recognition of the marine tenure rights of the Baranusa Kingdom is acknowledged by a local regulation [33]. It is stated that the Alor Regency Government recognizes this traditional tenure and is committed to allocating funds to finance and strengthen traditional institutions.

In response, as part of the MPA design, the tenure scheme has been integrated into the zonation and management of SAP Selat Pantar. Their resources are to be covering reef fishes, coral reefs, clams, snails, and sea cucumbers. The communities manage their marine resources through the "Mulung" system (open-close system). Hading Mulung and Hoba Mulung are a combined system to open or close the fishery to harvesting. Hading Mulung is the closed season, while Hoba Mulung is the open season. Baranusa customary law also supports local MPA regulations such as restricting gear use to traditional fishing gears. During the closed season, fishers usually fish outside the closed areas (**Figure 10**) or focus on seaweed farming [34].

The positive impact based on a community perception study found that the implementation of Hading Mulung and Hoba Mulung increases the fisherman's income and catch (23% strongly agree; 73% agree). In addition, an ecological survey conducted in the Baranusa shows that high-value invertebrate species density increased from 231 individuals/ha in 2015 to 277 individuals/ha in 2017 within the Mulung area (**Figure 11**). Over the same period, outside the Mulung, the invertebrate density decreased from 520 to 100 individuals/ha. The key fisheries species (grouper, snapper, sweetlips) increased from 329 to 507 individuals/ha in Mulung area and from 245 to 460 individuals/ha outside Mulung areas [34].

Therefore, local initiative or local wisdom as community-based conservation management is a good example of how MPA benefits local people. It is also showing that community involvement in MPA management is needed.

In terms of marine tourism opportunity, in East Nusa Tenggara Province (**Figure 11**)—where has 4.8 million ha of land and 20 million ha of waters—the number of tourist visitors varies from 600 thousand in 2017, increased 800 thousand in 2018, then decreased in 2019, and become 570 thousand visitors per year.

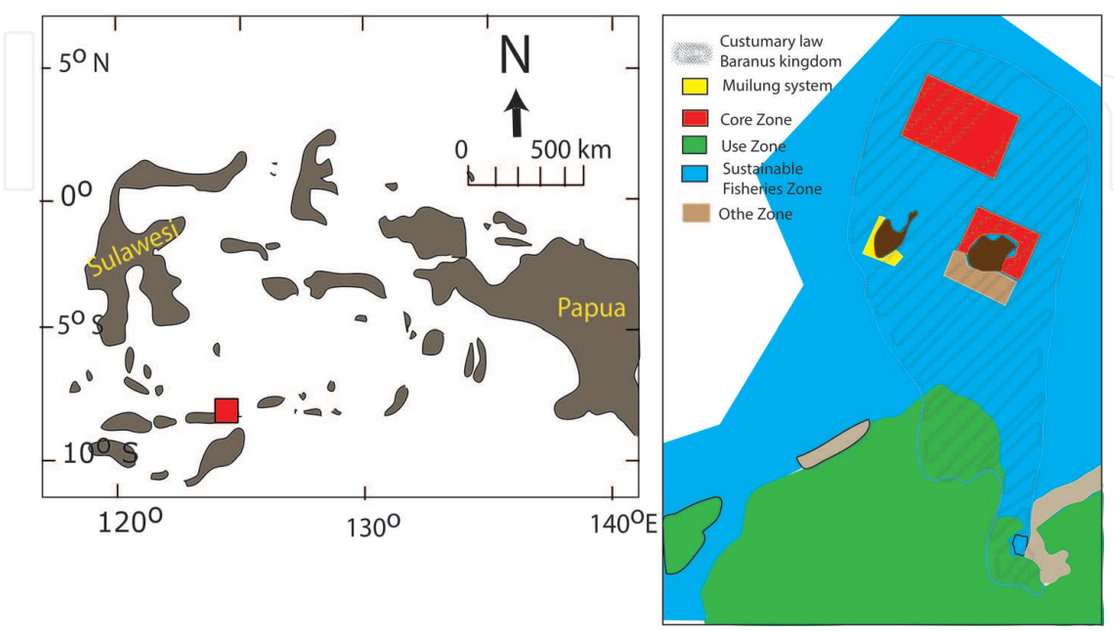

Figure 10.
Map of Baranusa kingdom within Selat Pantar MPA in Alor District, East Nusa Tenggara Province.

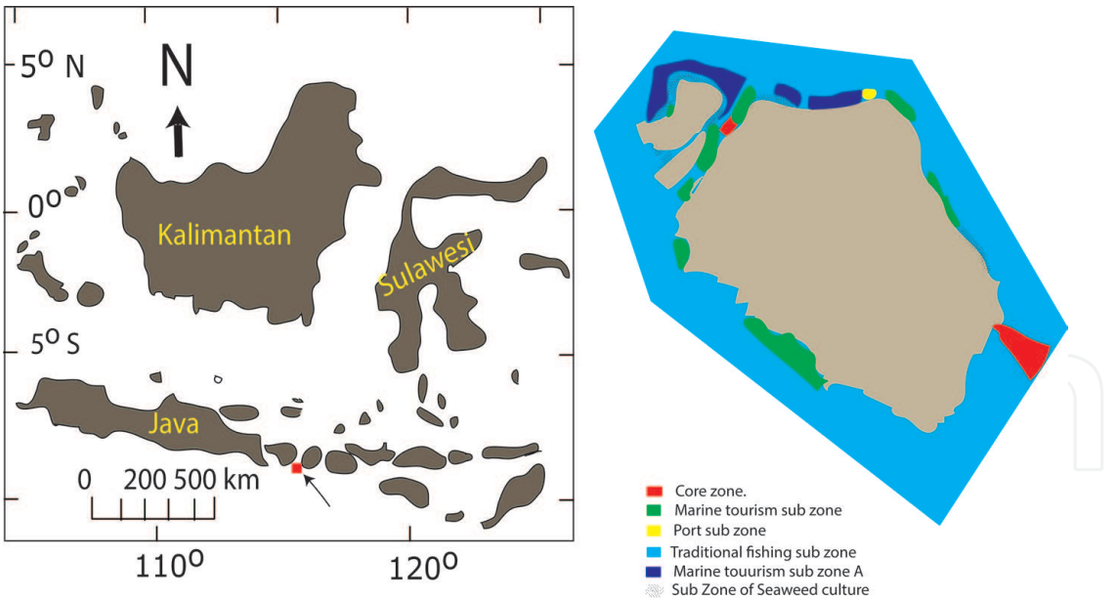

Figure 11.
Map of Nusa Penida MPA, Bali Province with its zoning based on the decree of the minister of marine and fisheries No. 90/2018.

However, it is only 9% of visitors in Bali 2019, whereas the land of Bali has only 12% compared to East Nusa Tenggara Province. Therefore, in many provinces where MPAs exist, marine tourism may have good potential to be developed. Surely, MPAs must be equipped with responsible marine tourism principles such as ecotourism, reducing plastic use, supporting local social, economic, and cultural, and avoiding any negative impacts from its activities in terms of environmental and social effects.

Nusa Penida MPA (20,057—Aquatic Tourism Park) was established in 2014 (renewed in 2018) and is located in Bali Province. The ecosystems and marine life targets for conservation in Nusa Penida include coral reefs, mangrove forests, seagrass beds, manta rays, sunfish, sea turtles, sharks, whales, and dolphins. These natural assets have become attractive destinations for tourists. Marine tourism activities have developed quite fast, with the number of domestic and international visitors to the islands growing almost every year, from nearly 100,000 in 2011 to nearly 300,000 tourists in 2017 [35]. However, as many other places have been facing the COVID-19 pandemic situation, the number of tourists also decreased since mid of 2020.

Moreover, facilities to support the growing tourism industry have expanded, with the number of hotels and accommodations on the islands more than doubling between 2015 and 2017 resembled mass rather eco-tourism. This condition has raised challenges in the management of Nusa Penida MPA, as some of the facilities and recreational activities that support tourism threaten the natural resources, the MPA is intended to conserve [35]. Increasing damage of the seabed was caused by pontoons—moored structures with shower and toilet facilities that accommodate dozens or even hundreds of visitors at the same time, increasing waste and lack of environmental awareness. In addition, the growing number of speedboats and divers at popular sites such as Crystal Bay and Manta Point posed a threat to coral reefs, manta rays, and sunfish. On the other hand, marine patrols to enforce MPA regulations were limited. One of the problems is the change of authority from Klungkung District to the Bali Provincial Government (as regulated in Act No. 23/2014). Therefore, many challenges appeared to manage Nusa Penida MPA even though a regulation such as the marine tourism code of conduct exists for the MPA [35].

However, management authority and Nusa Penida stakeholders are still handed in hand to address those challenges. A carrying capacity study has been conducted and hoped that all stakeholders agreed and regulation can be implemented soon. Sustainable financing also developed from tourist entrance fees to ensure management authority can run MPA activities/programs such as marine patrols, reef health monitoring as well as resource use monitoring. Moreover, enough resources and capacity to manage marine tourism activities are needed for the MPA management authority, including development plans for sustainable marine tourism in MPAs [35].

3. Conclusion and recommendation

Communities in several archipelagic areas have created marine-protected areas, and conservation of inland fishery resources has been passed down from generation to generation since the fifteenth century. Protected areas function as an effort to preserve natural resources. The area of marine-protected areas in Indonesia has overgrown since 2000. The government targets a marine-protected area of 32.5 million ha, and by 2021, it has reached 71.81%. Community involvement in managing marine-protected areas can preserve ecosystems and improve the welfare of the people involved. MPAs give benefits to local people through fisheries and marine tourism livelihood, although the current data or information are limited. In some cases, MPAs also can be integrated with local initiatives or local wisdom as community-based conservation management (named "sasi") within MPAs. MPAs may still have threats such as destructive fishing activities due to a lack of management capacity within MPA management authorities/units.

It is recommended to involve a broader range of stakeholders in managing marine-protected areas, especially those living within the region. Wider community involvement is expected so that the community gets more significant benefits, the community can protect and save marine-protected areas, and marine-protected areas grow better and can generate income to finance activities.

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Conflict of interest

The authors declare no conflict of interest.

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