

The Benefits of Marine Protected Areas in Fighting Inequality and Fostering Environmental Sustainability in Indonesia

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Abstract

Climate change is deteriorating Indonesia's marine and coastal ecosystems, consequently worsening the economic condition of people living in coastal areas. The concept of marine protected area (MPA) was introduced to conserve marine ecosystems, with various potential benefits both for environmental sustainability and the fight against inequality. By assessing government documents and relevant literatures, this paper aims to explore the potential benefits of MPAs and assess their impact on environmental sustainability and inequality in Indonesia. We find that various studies have documented that MPAs do contribute to poverty alleviation to some extent. We identify several challenges for future implementation of MPAs, particularly related to awareness, human resources, short-term trade-off between programs and opportunity costs, and program sustainability.

Keywords: Marine Protected Areas, Inequality, Environment, Sustainability.

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Introduction

Indonesia's marine ecosystems are severely threatened by climate change. This phenomenon, which is the result of the rise of global emissions (IPCC 2019), is detrimental to Indonesia's coastal and marine areas and the livelihoods and food security of coastal inhabitants. Several areas in Indonesia have been experiencing changes in weather pattern and seasonality, changes in wind direction and intensity, increases in landslide and flood frequency, and increases in saltwater intrusion (Savo et al. 2016). Ocean warming caused by climate change is also expected to result in a 20% decrease in marine fisheries production in Indonesia by 2055 (Cheung et al. 2010). In short, the damage caused by climate change affects Indonesia's coastal population both directly and indirectly.

As Indonesia is an archipelagic country, a significant proportion of its population relies on the fisheries sector. The 2019 national labor force survey estimated that over 1.8 million households worked in the fisheries sector, with most of these households residing in the province of Papua. This number is even higher if we include other coastal activities outside the fisheries sector, such as coastal tourism, industries, as well as local retail SMEs (small and medium-size enterprises). The deterioration of the coastal environment caused by climate change may therefore affect the sustainability of coastal lives.

The concept of marine protected areas (MPA) was introduced as clearly defined geographical spaces that are managed in such a way as to ensure the long-term conservation of nature while promoting associated ecosystem services and cultural values. MPAs have the potential to reduce the impact of climate change by improving marine ecosystems in designated areas. Their creation may also have greater long-term advantages both environmentally and economically. This paper aims to explore the potential benefits of MPAs in reducing inequality and fostering environmental sustainability in Indonesia. It is based on various information related to the implementation of MPAs and assesses their impact in the country. Additionally, we identify various challenges and opportunities that the government of Indonesia (GoI) should take into account to improve the implementation of MPAs in the future.

Inequality and Environmental Sustainability in Indonesia

A Glance at Inequality in Indonesia

Economic inequality

Since 2000, the Indonesian economy has experienced growth. The country's Human Development Index (HDI) value increased significantly, and the number of people living below the poverty line decreased from 40% to 8%. However, the benefits of economic growth are not evenly distributed. In the last 20 years, inequality between the richest and the rest of the Indonesian population has increased much faster than in other countries in Southeast Asia². One of the most widely-used indicators of inequality is the Gini coefficient. This coefficient measures how wealth is distributed across a population. A higher Gini coefficient indicates a higher degree of economic inequality in the area. Over the past ten years, Indonesia's Gini coefficient has followed a rather parabolic trajectory. In 2010, the Gini coefficient was 0.378. It rapidly increased in the next year to reach 0.399, despite a similarly fast increase in GDP in the same year³. The coefficient continued to increase and reached its peak of the decade in 2012 at 0.412. Over the following years, inequality showed signs of improvement as the Gini coefficient gradually decreased to 0.380 in 2019.

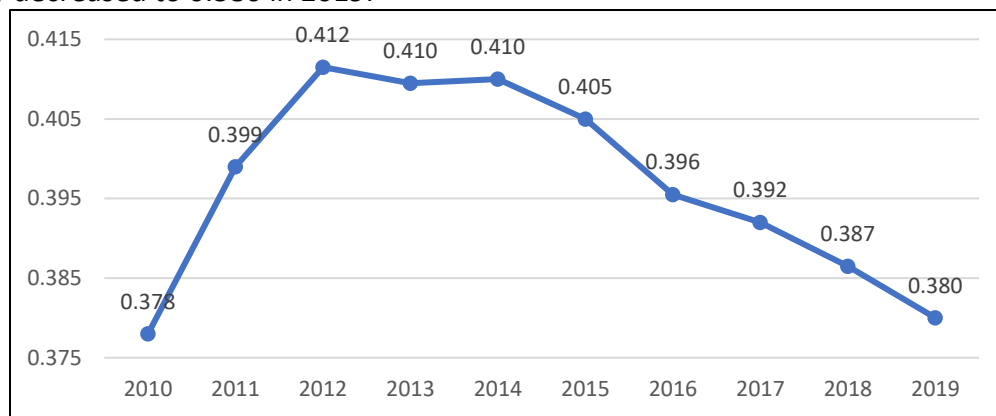


Figure 1. Gini coefficient for Indonesia

Source: Statistics Indonesia (2021)

The figure above shows the existence of moderate-to-high income inequality in Indonesia. The coefficient is relatively higher in Indonesia than in neighboring countries from the same income group, such as Thailand (34.9 in 2019) and Vietnam (35.7 in 2019), although Indonesia is still ahead of Malaysia (0.411 in 2015) and the Philippines (0.423 in 2018).

However, if we zoom in at the provincial level, we find that the situation differs across regions. In 2019, Bangka Belitung was the province with the best income distribution, as illustrated by its relatively low Gini coefficient. Conversely, DI Yogyakarta Province showed rather severe income inequality in comparison to other provinces. The capital city also scored higher than the national average. On average, provinces in the western part of Indonesia had a relatively lower Gini coefficient than those in the eastern part.

According to Village Potential data (*Podes*) from Statistics Indonesia, coastal communities account for 5.3% of all villages in Indonesia, with almost 12,857 villages located in coastal areas.

2. Based on the World Bank Databox in 2021

3. The constant price GDP was USD 750 million in 2010 and reached USD 890 million in 2011.

The poverty rate in coastal communities is going down faster than in non-coastal communities, but inequality is also increasing faster than in non-coastal communities (BPS, 2021; SMERU, 2021)⁴.

Considering that Indonesia is an archipelago, a significant share of the population works in the fisheries sector (BPS, 2021). Out of 1.8 million households relying on this sector, the average household expenditure⁵ for households working in the fisheries sector is lower than for households employed in other sectors⁶. The median expenditure per capita is IDR 789,507 per month for households in the fisheries sector as opposed to IDR 967,311 per month in other sectors. In the province of Papua, the gap is wider between those in the fisheries group (IDR 613,188) and the other group (IDR 1,217,058). The figures above suggest that an initiative to alleviate the gap between the two groups through marine protected areas could be critical. In the last decade, fishermen's income has persistently remained below the regional minimum wage. In 2013, the average income of fishermen was only about Rp561,000 per month, which is much lower than the Rp860,000 of the minimum regional wage (Cahyagi dan Gurning, 2017). In March 2018, 744,000 people working in the fisheries sector lived below the poverty line, and they tended to be more vulnerable compared to other sectors (Anna, 2019). Despite the importance of the fisheries sector is, its contribution to the Indonesian GDP is relatively low: its share was 2.83% in the second quarter of 2021, more than 7% lower than the agriculture sector (BPS, 2021).

In addition to fisheries workers being less wealthy compared to workers in other sectors, they also face various uncertainties in their professional activities that make them more vulnerable. The rare use of technology to predict weather conditions and limited access to professional insurance may potentially result in financial losses considering their activities are heavily reliant on weather conditions. Some of the growing effects of climate change, such as high tides and severe weather conditions, will also exacerbate the vulnerability of coastal communities. Moreover, a study by Burke et al. (2015) estimated that Indonesia could lose up to USD 2.6 billion over 20 years due to destructive fishing, which would have a major impact on the social-economic condition of coastal communities. In the context of a projected rapid growth of coastal populations in Indonesia, i.e. up to 240% by 2060 (Neumann et al. 2015), the country could further lose economically valuable resources if threats to those resources are not well addressed. In response to pressures on marine resources and the need for sustainable fisheries management, the GoI has implemented a series of policies and tools, one of which is MPAs.

4. This data was presented by Widjajanti Isdijoso and C. Nila Warda (SMERU) during LPEM – AFD Workshops on Marine Protected Areas and Inequality on September 2, 2021.

5. The survey used expenditure as a proxy for income.

6. The difference in mean of income using t-test is statistically significant at the 5% level.

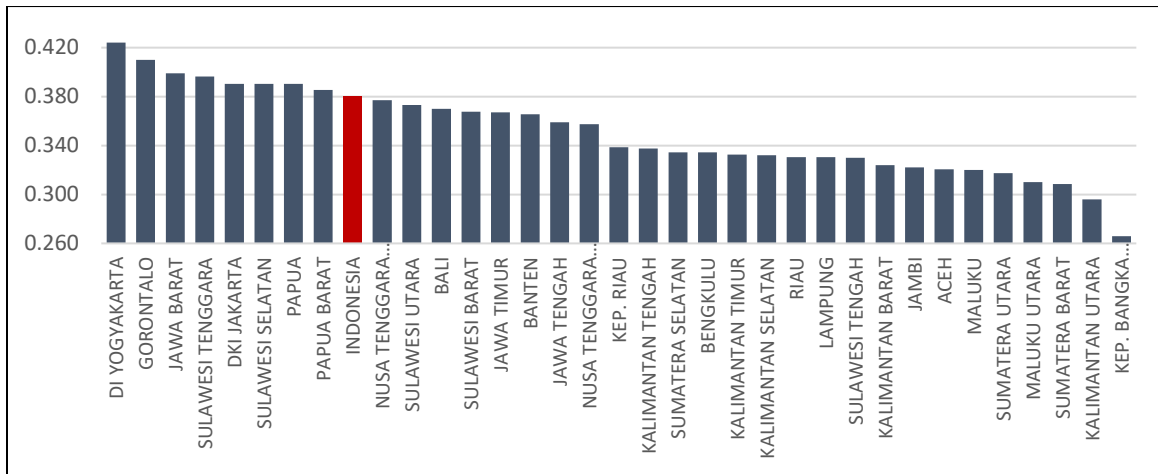


Figure 2. Gini coefficient by province

Source: Statistics Indonesia (2021)

Gender Inequality

Across the world, men and women in the fisheries sector engage in different and often complementary activities that are strongly influenced by the social, cultural, and economic context in which they live. Male-female relationships vary widely and are based on economic status, power relations, and access to productive resources and services.

In most areas, fishing is dominated by men. Ocean cruiser, offshore, and deep-sea fishing all have male crews, while in traditional coastal fishing communities, women often manage smaller boats and canoes. Women are primarily responsible for low-skilled and time-consuming land tasks, such as making and repairing nets, processing and selling the catch, and providing services to boats. In western Africa and Asia, as much as 60 percent of seafood is sold by women, and in many parts of the world they also take on a large share of shellfish collection – a fishing activity that is often under-recognized or not recognized at all.

In fisheries value chains, men and women have different roles, and their socioeconomic status influences their power relations. Both women and men can have a dominant role, or they can be in a position of high dependence. Women constitute about half of the population involved in fisheries development activities. In some developing areas, women have become essential fishery entrepreneurs controlling large sums of money, financing various fish-based businesses, and generating significant profits for households and communities.

Compared to men, women often face more problems related to technology, funding for business expansion, and transportation. Their difficulties are exacerbated at market level where they face price fluctuations for their products, or where social and cultural pressures limit their market opportunities to locations close to home. Even if women can sell their products in local markets, they may still not be able to access national or global markets accessible to men due to societal beliefs. Indeed, women are often considered to be responsible for the daily needs of their families, which sometimes drastically depletes their working capital. This is true in some places, particularly in large developing countries, including Indonesia.

In Indonesia, women represent up to 42% or more of people working in the fisheries sector (Wulandari, 2020). Women in small-scale fisheries account for 169 000 metric tons of fish caught annually in the country, worth USD 253 million⁷. This includes the often-overlooked catches taken along coastlines, on foot, or from small, non-motorized vessels using low-tech, low-emission equipment in coastal waters. Women also do a considerable amount of work pre- and post-harvest, with working hours exceeding 17 hours a day. Pre-harvest work varies from repairing nets, preparing food and logistics before the trip, while post-harvest tasks include handling the fish, processing catches, and finally selling the fish. Women also play an essential role in the economic chain of fisheries through financing the fleet, recording catches, bookkeeping, and marketing the fisheries' products.

However, the significant contribution of women to the fisheries sector goes largely unrecognized. Although Law UU no.7/2016 protects fishers (or "nelayan") regardless of gender, in practice, "nelayan" is considered to only apply to male fishermen. Due to social and cultural norms that consider women as housewives and men as breadwinners, women tend to be seen as fishermen's wives or as being involved in fishing as part of their household duties, without being paid. As a result, men tend to be involved in higher-end activities such as fish harvesting, transportation, distribution, and intermediate trade, while women occupy lower-end value chain roles, including grading, sorting, and market selling. Additionally, since they are not recognized as fishermen, women do not have the relevant legal rights and may struggle to get support from the government.

While monetary inequality in Indonesia has been slowing down in the from 2012 to 2019, the gap between among sectors remains a challenge. People living in a coastal area are more prone to poverty and attributed to low-income, compared to the others. In terms of gender, women contribute in a lower value added coastal related job compared to men. Bringing in more sustainable policies for marine areas is an opportunity to reduce such inequality.

Marine Sustainability in Indonesia

Fish also constitutes an animal-based protein source for Indonesians, particularly in the provinces of Sulawesi Tenggara, Nusa Tenggara Timur, Papua, and Papua Barat. In this regard, studies have found that households living in MPAs tend to have better food security (Amkieltiela et al., 2020). However, the current harvesting rate is still unsustainable and is expected to reduce yield in the future (World Bank, 2021), which has led Indonesia to be ranked 137 out of 221 countries on the Ocean Health Index (OECD, 2021). Current fishing practices may accelerate ocean ecosystem degradation, particularly due to pollution, overfishing, and climate change. Maintaining a sustainable harvest rate requires policy reform under a sustainable fisheries management framework.

In addition, other external factors affect the ocean significantly, including waste leakage from land. The current waste management system in Indonesia tends to cause the leakage of various waste into the ocean, which can have a severe impact on fish catchment level and tourism. One study estimated that in Indonesia, plastic debris leaked to the ocean at a rate of up to 1.3 million tons per year (Jambeck et al., 2015). The COVID-19 pandemic has exacerbated the issue

7. Based on <https://wri-indonesia.org/en/blog/3-reasons-why-women-fisheries-matter-inclusive-economic-recovery>.

even further: more plastic products are used then discarded, including some types of waste that are categorized as hazardous, particularly masks, medical gloves, and other personal protective equipment (PPE)⁸.

Additionally, a case study in Aceh Utara revealed that fishers in the area had been experiencing unpredictable rainy seasons, high waves, frequent tropical cyclones, and increasing temperatures. This has important ramifications for fishers and fishing behavior, since many fishers are discouraged from going to sea due to strong waves, while others choose to fish further away from the coast. Furthermore, highly damaging trawling methods are becoming more popular as fishers seek to maximize their catch, despite the fact that the effects of such practices have cut local catches by 40% (Stiles et al. 2010). Considering that fishing is the main occupation among the coastal population, the reduction of local catches has a significant impact on local income. This issue does not only apply to Aceh Utara but is also relevant for most of Indonesia's coastal population. As a result, it would not be surprising if the rate of poverty remained high among Indonesia's coastal communities.

8. <https://sdg.iisd.org/commentary/generation-2030/ppe-waste-in-the-ocean-standardized-approach-urgently-needed/>

The Benefits of MPAs in Reducing Inequality and Fostering Environmental Sustainability

How MPAs reduce inequality

Efforts to protect natural areas are always challenged by politicians who want to know how high the economic benefits of protecting one particular area are as opposed to, for instance, exploiting it for money that can then be distributed to the poor. The arguments in favour of establishing MPAs are and always should be long-term arguments since the fundamental idea behind their creation is to preserve and conserve the ecosystem for long-term benefits. Thus, the key challenge is to determine how to identify and measure the potential benefits of MPAs, and in the case of early MPAs, how to evaluate the policy. An early study highlighted some channels and evidence on how marine protected areas may mitigate inequality and reduce poverty. This study by Ban et al. (2019) explores various potential well-being outcomes of marine protected areas, including how they help reduce inequality.

Reviewing a well-documented literature, Ban et al. (2019) identify potential channels through which MPAs impact human well-being and categorize this impact as relating to several aspects, such as the social domain, health, economics, culture, and governance. Based on their literature review, they find that MPAs have more positive outcomes (51%) than negative outcomes (31%). The most important well-being outcomes found in the literature relate to community involvement (76%), catch per unit effort / CPUE (73%), and income (65%). In this section, we identify the potential channels through which MPAs may improve equality in various aspects.

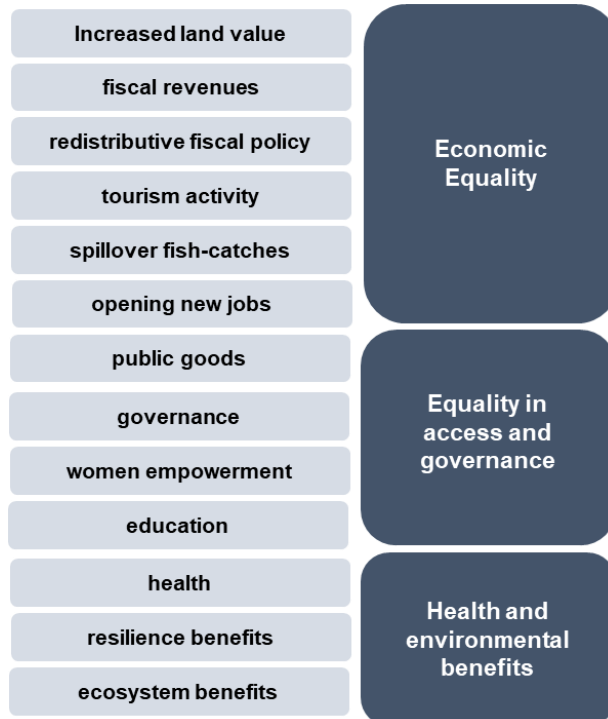


Figure 3. Benefits of MPAs in reducing various aspects of inequality

Figure 3 shows several benefits of MPAs in various fields. We find that MPAs may lead to improvements in economic equality, equality of access and governance equality, as well as providing health and environmental benefits to improve the quality of life (Ban, et al., 2019). As

far as the reduction of economic inequality is concerned, well-managed MPAs may potentially increase land value around MPAs, since it is more attractive to live next to an MPA, whether for economic or environmental reasons. A successful MPA will not only generate revenues for the community but can also indirectly benefit state or local fiscal revenue. Additionally, MPAs are a measure of redistributive fiscal policy that benefits those in need in the surrounding area.

Besides fish-catching activities, one of the main sources of revenue for coastal communities is tourism. Among these communities, the tourism industry is a major source of new livelihoods, and one study found that switching to a job in tourism approximately doubled household incomes in Bunaken and Apo island (Leisher, van Beukering, & Scherl, 2008). The tourism sector benefits from MPAs as they improve marine ecosystems and boost attraction for natural tourism.

Another benefit of protecting designated marine areas is the spillover of fish from no-fishing zones to regular fishing zones. Leisher et al. (2008) thus found that 80% of fishers in Navakavu perceived an improvement in fish catch levels (Leisher, van Beukering, & Scherl, 2008). While the short-term opportunity costs of MPAs may still affect fish catch levels, this helps reduce overfishing. The establishment of a MPA in a given area prevents fishermen from catching fish in that area. In the long term, fish spilling over from MPAs to fishing areas will ensure the sustainability of fishing activities. While the long-term benefit is clear, there are also some findings of which shown a short-term spillover benefit, for example in several MPAs in Navakavu (Fiji) and Apo Islands (The Philippines) [insert citation].

While the opening of new jobs in fish selling, reef gleaning, seaweed farming, or tourism may not be specifically earmarked for men or women, prior studies have shown it particularly benefits women (Leisher, van Beukering, & Scherl, 2008). This helps empower women economically and socially, including by giving them a stronger voice in community meetings and gatherings. As such, we can argue that MPAs may help equalize the social and economic status of women in society.

The establishment of MPAs is always followed by assistance from local authorities. In many cases, new government mechanisms were implemented when managing MPAs and the local community was involved in the decision-making process. This made MPAs more responsive to community needs, with committees to address various community issues. Better governance, in the form of a better understanding of what the community wants and identification of the most effective and efficient way to satisfy those needs, can improve the local government's capacities to provide various public goods for the community. As such, it can also improve the equality of access to basic public goods and services.

Lastly, MPAs may also bring benefits in the fields of health and the environment. Those benefits are the direct result of positive externalities due to ecosystems improving in the surrounding area. Indirectly, MPAs may also increase community funds to finance health-related infrastructure, including health practitioners, improved water supply tanks, public toilets, and washing places (Leisher, van Beukering, & Scherl, 2008). In addition to these positive outcomes, an increase in environmental awareness often translates into better knowledge and a deeper understanding of sanitation problems, as well as its more environmentally-friendly solutions. This in turn leads to better health and environmental outcomes for society.

How MPAs improve the sustainability of marine areas

The concept of protected area usually has to compete with other demands on land or water. For instance, when trying to protect forests, we may be competing with the opportunity costs (the economic cost) of not using timber as raw material for other industries or extracting it for consumption. Marine Protected Areas are no different. The idea of protecting marine areas clashes with the cost-benefit analysis of not protecting them (Dudley, Mansourian, Stolton, & Sukswan, 2008). Some may argue that MPAs prevent fish-catchers from getting more fish from the sea, even though the growing understanding of environmental economics theory might say differently. This section explains how MPAs may affect both the environment and inequality to further identify and calculate the costs and benefits of MPAs.

A marine area is a huge ecosystem consisting of animals, plants, coral reefs, as well as humans. Not only does it provide fish to consume, but it also stores carbon and heat, offers a space for economic activities, and provide other non-monetary benefits such as an opportunity for collaboration and advancing scientific knowledge (Osterblom, C.C.C. Wabnitz, D. Tladi, et al., 2020). Understanding the impact of MPAs on the environment starts with identifying the key pressures on marine ecosystems. Several key issues threaten marine ecosystems, such as resource exploitation, including overfishing, marine pollution, habitat destruction, and climate change.

Overfishing and exploitation

The issue of overfishing may cause unsustainable development with consequences for both food consumption and ocean biodiversity. An estimated 31% of fish stocks are fished at biologically unsustainable levels (OECD, 2017). Illegal, Unreported, and Unregulated (IUU) fishing is making this situation even worse. MPAs can help preserve fish in several parts of the ocean and ensure the sustainability of fish stocks in the future. The establishment of MPAs in certain fishing areas allows the marine ecosystem to recover. A study by Yunanto, Halimatussadiyah, and Zakaria (2019) found an empirical evidence that MPAs has significant impact on the overfishing index in Indonesia. Using 2001 to 2015 data, they found that area with MPA has lowest overfishing index compared to non-MPA, indicating a substantial impact of MPAs in reducing overfishing in Indonesia.

Marine pollution

Most marine pollution is land-based (OECD, 2017). The establishment of MPAs aims at preserving coastal or marine areas that are still unpolluted or underpolluted to protect their ecosystems. The creation of a MPA prohibits any kind of land-based pollution or waste dumping in the area. By establishing a MPA, the authorities can prevent any industry from settling in the surrounding area and ban any activities that may cause harm to the MPA's ecosystem. In practice, the implementation of such a policy requires a strong monitoring and evaluation framework. The main objective of this policy is to use designated coastal and marine areas to store greenhouse gas emissions by keeping them clean.

Habitat destruction

Aside from helping to reduce overfishing, MPAs can also prohibit fishers from resorting to harmful practices to catch fish, such as trawling and dynamite fishing. Once again, this policy requires close monitoring and control from the authorities to ensure that MPAs are protected

from the use of destructive fishing tools. This can help conserve ocean habitat, which will lead to an increase in fish populations to catch and other spillover benefits for the ecosystem.

Climate change

The signs of climate change are undeniable. It affects not only humans but also other species. Climate change has already resulted in the loss of 50% of salt marshes, 30% of coral reefs, and 20% of seagrass worldwide (OECD, 2017). Establishing MPAs may hamper the rate of ecosystem degradation until more positive actions are taken to reduce and mitigate climate change effects.

MPAs in Indonesia

Government's Commitment to Reduce Inequalities and Improve the Environment

The Government of Indonesia has aligned its objectives in terms of sustainability and inequality reduction. By the end of the 2020-2024 National Mid-Term Plan (*Rencana Pembangunan Jangka Menengah Nasional / RPJMN*⁹), the target is to reach a poverty rate of 6%-7%, 3,6-4,3% of open employment, a Gini coefficient of 0,360-0,374, a HDI value of 75,54, and a 27,3% reduction in GHG emissions, in keeping with Paris Agreement commitments. This planning document states that resource utilization for economic growth must take into account the sustainable carrying capacity of the environment by directing national development towards increasing environmental quality, reinforcing disaster and climate change mitigation, and fostering low carbon development.

The outcome indicators related with marine conservation fall within the second of these outcomes, i.e. climate change resilience. The target is to reduce the potential loss of GDP due to climate change in 2024 by 0.732% in marine and coastal areas, by 0,072% in the water sector, by 0,251% in the agriculture sector, and by 0,093% in the health sector¹⁰.

Local governments also play a role in inequality reduction and environmental improvement program. A strong coordination and share political will are required for both national, provincial, and district government to ensure climate change programs delivery run well, which sometimes not the case for Indonesia. Different local government may have different priority and objectives, as such it results in different commitment to deliver climate change policies on local level.

The Human Development Index (HDI) and poverty rate of each region also explain the challenges in delivering climate change programs equally in Indonesia. Regions with higher HDI responses better to climate change programs than regions with lower HDI. Similarly, regions with lower poverty rate put a higher commitment in climate change policies than the others. The lack of awareness of how climate policies may subsequently reduce poverty rate as well as inequality is one of the reasons behind the gap. Indicators related to inequality and climate change in the national mid-term plan is presented in Table 1.

Table 1. Indicators related to Inequality and Climate Change in National Mid-term Plan 20202-24

Indicators	2019	2024
1. Percentage of people living in poverty in less developed region	25.5	23.5-24
2. HDI level in less developed regions	58.82	62.2-62.7
3. Number of local regions integrating climate and disaster resilience into their regional spatial planning	37	250
4. Region poverty rate (%)*)		

9. RPJMN is the national strategy for development planning created by the Central Government of Indonesia.

10. In general, the baseline situation for outcome indicators in 2019-2024 is the achievement of 2015-2019 targets at third quarter. Marine-related indicators in these sectors for the present period are new indicators of climate resilience, so that no baseline numbers are available. The related previous outcome indicators were piloting climate change adaptation projects in some high disaster index regions and preparing a regulatory framework for the adaptation programs of the sectors.

Indicators	2019	2024
Papua	26.3	18.2
Maluku	13.2	9.0
Nusa Tenggara	17.9	12.1
Sulawesi	10.2	3.5
Kalimantan	5.9	3.4
Sumatera	10.0	3.6
Jawa and Bali	8.3	4.1

Source : 2020-2024 National mid-term plan.

The 2030 Sustainable Development Goals

The Indonesian government's commitment to fight inequalities and improve the environment is in line with the 2030 Sustainable Development Goals, and MPAs play an important role in achieving the SDGs. We identify at least four SDGs goals that may benefits from establishment of MPAs, including SDG 1 (poverty), SDG 10 (inequality), SDG 13 (climate action) and SDG 14 (life below water). Table 2 shows the current achivement status of each SDGs related to MPAs for Indonesia.

Table 2. SDG-related indicators of poverty, inequality and marine protection at the national level

SDG #1: No Poverty	2017	2018	2019
Percentage of people living below the poverty line in rural areas	20.5	20.1	26.4
SDG #10: Reduced Inequality	2017	2018	2019
Percentage of central budget allocation to the social protection function	11.8	11.9	12.3
SDG #13: Climate Action	2017	2018	2019
Number of deaths, injuries, and missing persons due to disasters per 100.000 population			
Deaths	0.2	2.0	0.2
Injuries	0.4	8.0	1.3
Missing persons	1,403	3,931	1,935
SDG #14 Life below water	2015	2016	2017
Coverage of MPAs in sub-national level	7,265,77	7,941,085	9,107,724

Source: BPS (2020).

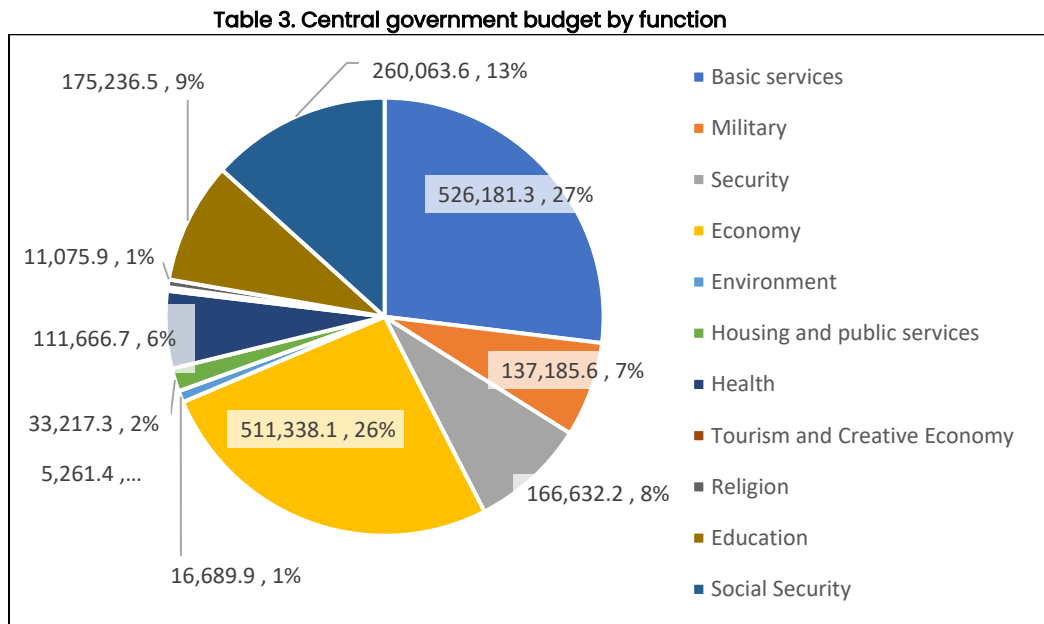
The planning and budgeting framework for MPAs in Indonesia

In Indonesia, the commitment to achieve SDG 14 is included in RPJMN 2020 – 2024. In this document, MPAs are part of the sixth development agenda, which aims to improve the environment, to increase the country's disaster resilience, and to manage climate change. This broad agenda consists of a number of priority programs, one of which relates to conservation and aims to increase the quality of the environment through a priority project dedicated to avoiding the pollution and destruction of natural resources and the environment. This project

includes various conservation indicators, such as the size of nationally preserved areas with high conservation value, the size of conservation areas, and the size of marine and coastal areas.

These conservation indicators fall under the responsibility of two ministries, the Ministry of Environment and Forestry (MEF) and the Ministry of Marine Affairs and Fishery (MMAF). The MMAF is responsible for the marine and coastal area conservation scheme known as the MPA. Overall, this ministry is the key central government institution to achieve the national target of expanding MPAs to 32,5 million hectares by 2030.

MMAF Regulation No.31 of 2020 about the Management of Marine Financing classifies the possible sources of funding as the central budget, local budget, or other legal sources. While the lack of accessible, detailed data limits our analysis, we will analyze the available central government data as proxy. Table 3 depicts the 2021 central government budget by function. This data is limited to central government spending and, as such, it excludes fund allocations from the central government to local governments. In the 2021 government budget, the environmental budget amounts to 1% of total spending, representing IDR 16,7 trillion for the year 2021. While this may partly result from the reallocation of resources to health spending during the pandemic, this share is still considered to be low. We expect that this number should increase in the future.



Source: Ministry of Finance (2021)

On the revenue side, under current regulation, revenues collected from MPAs is considered as non-tax revenue (PP No 85/2021). It includes area entry tickets, activity licenses, and equipment use permissions, with rates that vary depending on the types of activities permitted (individual, group or business, Indonesian citizen or foreigner, daily/monthly/annual), as well as a contribution of 10% of the investment value per business license and 10% of annual net profit

for tourism and fishery activities. It also extends to which the revenue can be used for permanent infrastructures of MPAs.

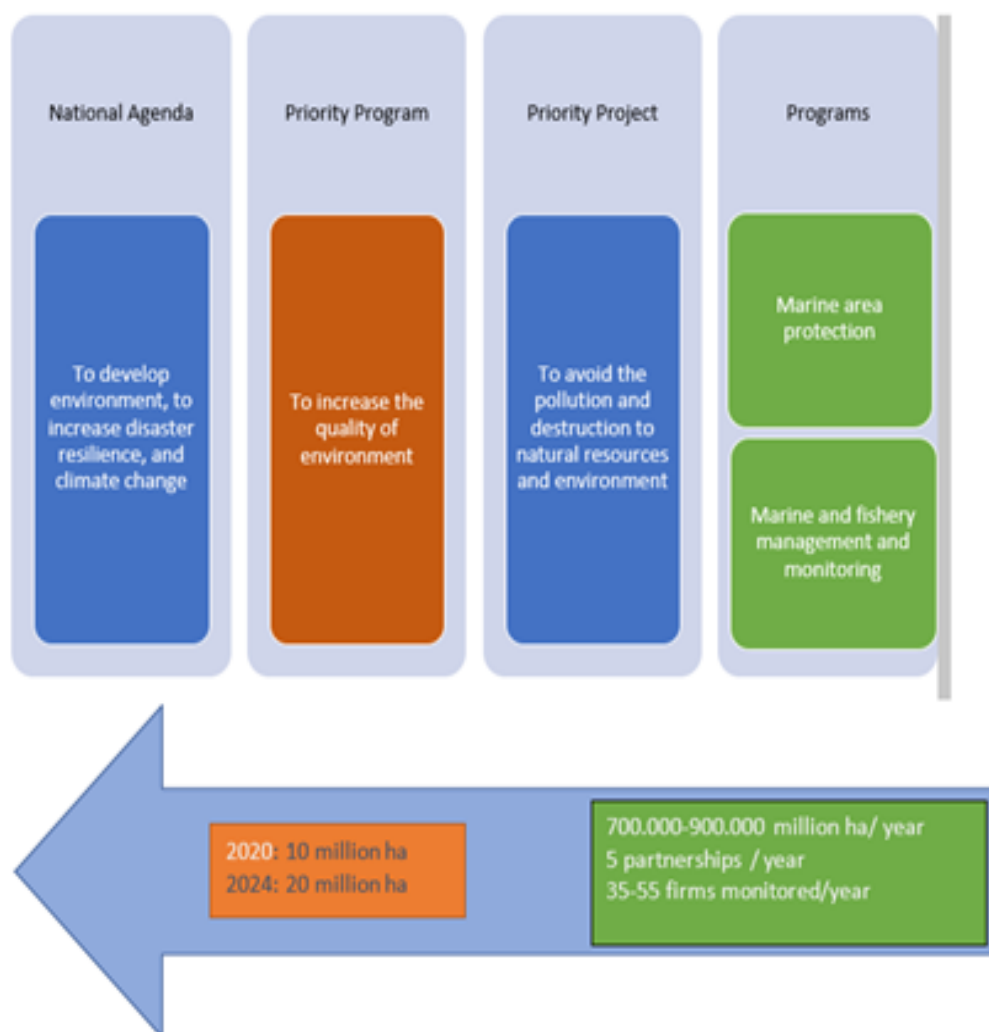


Figure 4. MPAs' position in the National Medium-Term Plan 2020 - 2024

Source: National Medium-Term Plan 2020 – 2024

Government Programs

Indonesia, as the second-largest fishing nation next to China, has huge potential in terms of ocean resources to support its economy sustainably—both environmentally and socially. As of 2021, Indonesia had expanded its marine protected areas to include up to 377 areas in 34 provinces, mostly managed by the Ministry of Marine Affairs and Fisheries (MMAF). A few others are managed by the Ministry of Environment and Forestry (MEF). The existing MPAs cover 28 million ha, already achieving the Indonesian Government's target of 26.9 million ha by 2024. The latest aggregation data from Handayani et al. (2020) shows that most MPAs are located in Sulawesi (25%), Sumatera (22%), Papua (20%), and the Lesser Sunda islands (i.e., Bali, Nusa Tenggara Barat, and Nusa Tenggara Timur) (19%). The mapping of national protected

areas for marine wildlife shows that they include 43% of coral reefs, 37% of seagrass beds, and 25% of mangrove forests. However, the proportion of marine ecosystems incorporated in the non-extractive zone—where extractive activities are forbidden—is still low, with only 7% of coral reefs, 7% of seagrass beds, and less than 1% of mangrove forests (Handayani et al., 2020).

The central and local governments share the responsibility of marine and fisheries management, in keeping with the principle of autonomy-sharing under the decentralization regime, or *dekonsentrasi*. This is the result of the implementation of Law No.23 of 2014 and Government Regulation No.8 of 2008. Under MMAF Regulation No. 64 of 2020, the authority on marine and fisheries management is partly shared with local governments (at the province and district levels). In 2021, this autonomy-sharing regime allowed the local government to implement programs focusing on increasing the added value and competitiveness of industries, environmental quality, marine and fisheries management, and management support. The provincial government is responsible for these programs within the 12 miles of marine area from the coastline, including the monitoring and evaluation of fish stock management, marine capture fisheries business license issues, the registration of 5-30 tonnage fishing boats, and fishing port development. Moreover, the provincial government can put forward an area for MPA status by following the standard procedure of MPA establishment. This falls under the local government’s environmental quality program.

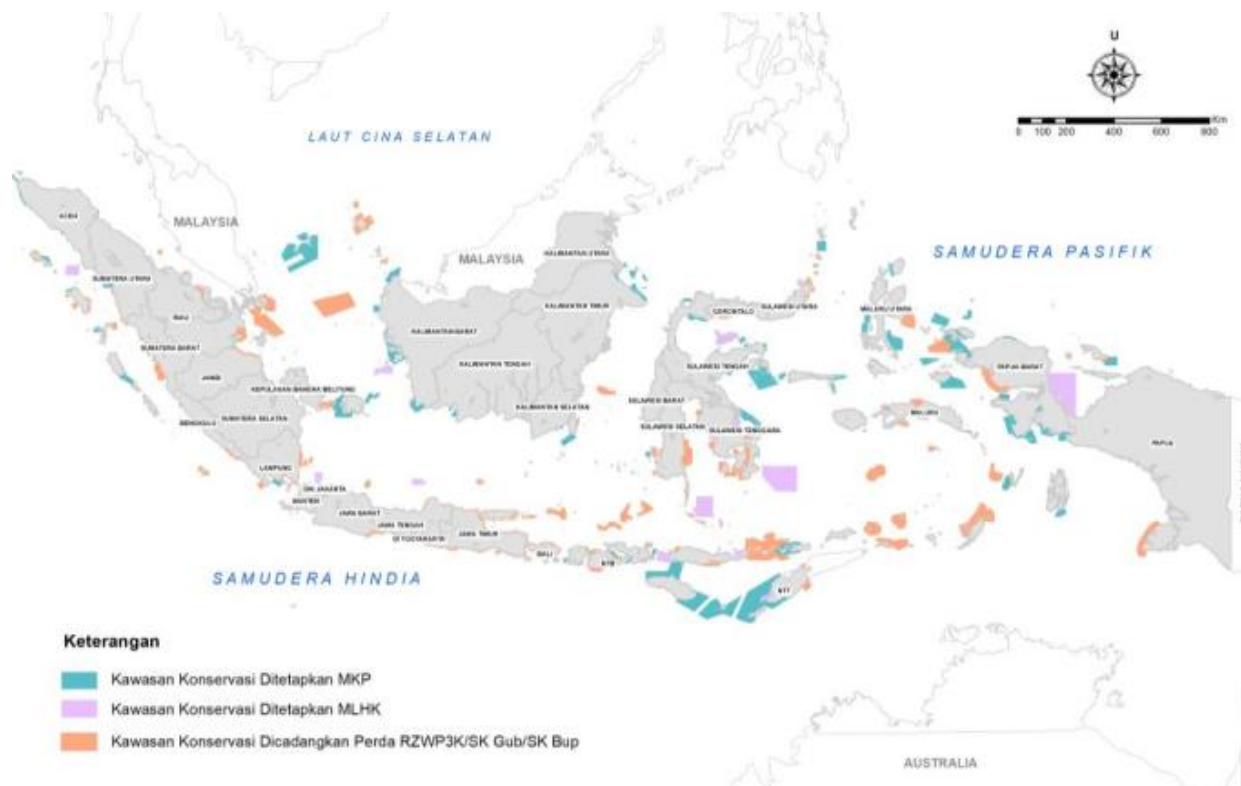


Figure 5. The current coverage of MPAs in Indonesia

Source: Ministry of Marine Affairs and Fishery (2021)

In 2021, a presentation by the Ministry of National Development Planning of the Republic of Indonesia (Bappenas)¹¹ showed that in the business-as-usual (BaU) scenario, by 2030 Indonesia would be catching more fish than its allowable catch rate, which may endanger the sustainability of fishery activities in the country. It is said, however, that with the implementation of several measures and interventions, including establishing a no-fishing zone area, the catching rate may be reduced to below 80%, or slightly under the sustainable catch rate. Similarly, as regards the extent of MPA coverage, without proper intervention, the Gol can only hope to achieve 28.2 million hectares of MPAs by 2030, while proper measures and interventions can allow the country to meet the RPJMN target of 32.5 million hectares of MPAs by 2030.

The MMAF has two programs to achieve MPA objectives, i.e. (i) marine area protection and (ii) marine and fishery management and monitoring. The protection of marine areas is achieved by establishing MPAs and developing partnership networks in marine and coastal biodiversity, but also by conserving marine and coastal biodiversity and increasing the level of independence of integrated fishing facilities. The marine and fishery management and monitoring program deals with law enforcement in MPAs where the area is utilized. The local government must monitor the compliance of businesses operating in these MPAs, targeting 35-55 firms each year. Moreover, in terms of participatory approach, the government is developing a network of partnerships in marine biodiversity conservation between stakeholders and the central government, with a target of at least 5 partnerships over the 2020-2024 period.

The role of MPAs in supporting economic growth is realized through improvements in maritime, fishery, and marine management. This is achieved through strengthened management, the sustainable utilization of the MPA, and increasing use of marine bio-products and biotechnology. In this regard, the MMAF strategic plan for 2020-2024 gives top priority to MPA-related programs as part of the strategic target of sustainable marine and fishery resources, with the addition of biologically safe catch limits in 2024. The ministry, through Special Allocation Fund (*Dana Alokasi Khusus/DAK*) to the local government, complements the programs by building new infrastructure or rehabilitating existing ones in marine, coastal and small island conservation areas. The DAK is the consequence of the division of authority between the central and local governments under Law No 23 of 2014. According to this law, marine affairs fall under the authority of the provincial government within a 12-mile limit from the coastline. At the local level, a MPA is established by a Local Regulation (*Peraturan Daerah*) about a spatial zoning plan known as *Rencana Tata Ruang Wilayah Zonasi Perairan (RTRWZ)*.

Other than the national plan, the Gol issued other documents as a road map for implementation or action plan. Among them is Presidential Regulation No 16 of 2017 about the Indonesian Ocean Policy. This regulation outlines seven pillars of ocean policy, with MPAs falling under the pillar of marine and human resources development. Within this pillar, MPAs are included as part of the development of sustainable tourism taking into account local community interests, traditional wisdom, and environmental conservation. Another document

11. Bappenas (2021) in AFD – LPEM Workshop on Marine Protected Areas (October 2nd – 3rd, 2021)

is the MPA Vision 2030, a reference document for stakeholders to achieve the 2030 targets, including the establishment of 32.5 million hectares of MPAs by 2030, all managed effectively.

The budgetary commitment for MPAs is allocated the budget for Marine Management Program under the MMAF . During the 2018-2020 period, the budget realization amounted to about 400-600 trillion rupiahs, or 8%-9% of the ministry's total budget. This resulted in the consistent increase in the area of MPAs and the number of targeted MPAs at the subnational level. Until today, the effort to meet the MPAs target continues through government facilitation and spread the information related to MMAF regulation No 31/2020 on MPA Management. The key performance indicators used by the MMAF, such as the size of MPAs and the compliance of boats entering MPAs, reached the targets set, as shown in Table 4.

Table 3 Budget and realization of the MMAF Marine Management Program

Year	Budget (IDR)		Realization (IDR)	Percentage of Marine Management budget to Total Ministry	Percentage of budget realized
	Marine Management	Total Ministry	Marine Management		
2020	411,880,638,000	5,269,641,991,000	393,614,623,041	8%	96%
2019	439,034,380,000	5,510,787,032,000	378,208,774,925	8%	86%
2018	679,122,286,000	7,635,526,314,000	429,402,243,123	9%	63%

Source: Annual Accountability Report (MMAF 2020).

Table 4. Key Performance Indicators for Marine Protected Area programs

Indicators	2018		2019		2020	
	Target	Actual	Target	Actual	Target	Actual
Cumulative size of MPAs (Million hectares)	19.3	20.88	21.5	23.4	23.4	24.11
Compliance rate of marine and fishery business firms to regulation (%)	81	96.45	87	93.57	94	92.31

Source: Annual Accountability Report (MMAF 2020).

Under the *Dirjen Pengelolaan Ruang Laut* Regulation No 28 of 2020, the effectiveness of MPA management is classified into five categories, i.e. red, yellow, green, blue and gold. This classification is part of an adaptive policy framework assessing MPA management from input to outcomes. The economic benefits of MPAs to communities are one of the measured outcomes. It includes three components, i.e. (i) creating additional field jobs in the tourism or fishery sectors, (ii) creating jobs for new workers, and (iii) at least maintaining the income level of the population, or increasing it. As part of the effectiveness evaluation, each component is given a score depending on the magnitude of the outcome, as shown in Table 5. This assessment is carried out by an evaluation team led by the director of marine conservation of MMAF and consisting of community institutions, academics, and the MPA technical implementing unit.

Table 5 Illustration of the evaluation of a MPA's economic benefits to the community

Criteria	Standard magnitude of outcome	Score	Weight	Points
1. Creation of field jobs in tourism or fishery sector	1	1	25	25
	2-5	2	25	50
	>5	3	25	75
2. Creation of jobs for new workers	<25%	1	25	25
	25-50%	2	25	50
	>50%	3	25	75
3. Change in people's income level	No change	1	25	25
	Increase up to 5%	2	25	50
	Increase > 5%	3	25	75

Source : Directorate General of Marine and Spatial Management Regulation No 28 of 2020.

To measure the effectiveness of MPAs, traditionally we need to calculate the change in fish capture by traditional fishermen (in size and quantity). However, it is difficult to find a consistently measurable data on such things. The alternative, according to Directorate General of Marine Affairs, Coastal, and Small Islands Regulation No 44/2012, measures through five level of MPAs Management Effectiveness Status, assessed by the MMAF. The level from the lowest to the highest is red, yellow, green, blue, and gold. Until 2019, none has reached blue or gold status. The remaining fills the green, yellow, and red status as presented in **Table 6**.

Table 6 MPA Management Effectiveness status

Status	2017	2018	2019
Green	18	24	26
Yellow	2	11	9
Red	15	-	-
Total number of MPAs	35	35	35

Source: Annual Accountability Report (MMAF 2019).

Designing and Managing MPAs in Indonesia

The management of MPAs in Indonesia involves many stakeholders. MPA programs under the MMAF are divided into two types of management. The first type of MPA is under the responsibility of the central government, in this case MMAF, while the second type is managed by local government under the provincial governor. The MMAF has developed a process for the design, management, and evaluation of MPAs. The figure below depicts the complete process as well as the actors involved in managing MPAs.

Based on the figure below, we can see that cooperation and partnerships between actors, both in establishing and managing MPAs, is one of the key challenges in Indonesia. To ensure that

monitoring and evaluation are conducted and addressed properly through relevant channels, such a process needs to be carried out regularly by the government. In addition to the government and MPA authority, it is also important to ensure involvement from non-governmental organizations (NGOs) and local universities in evaluating the benefits and management of MPAs in Indonesia.

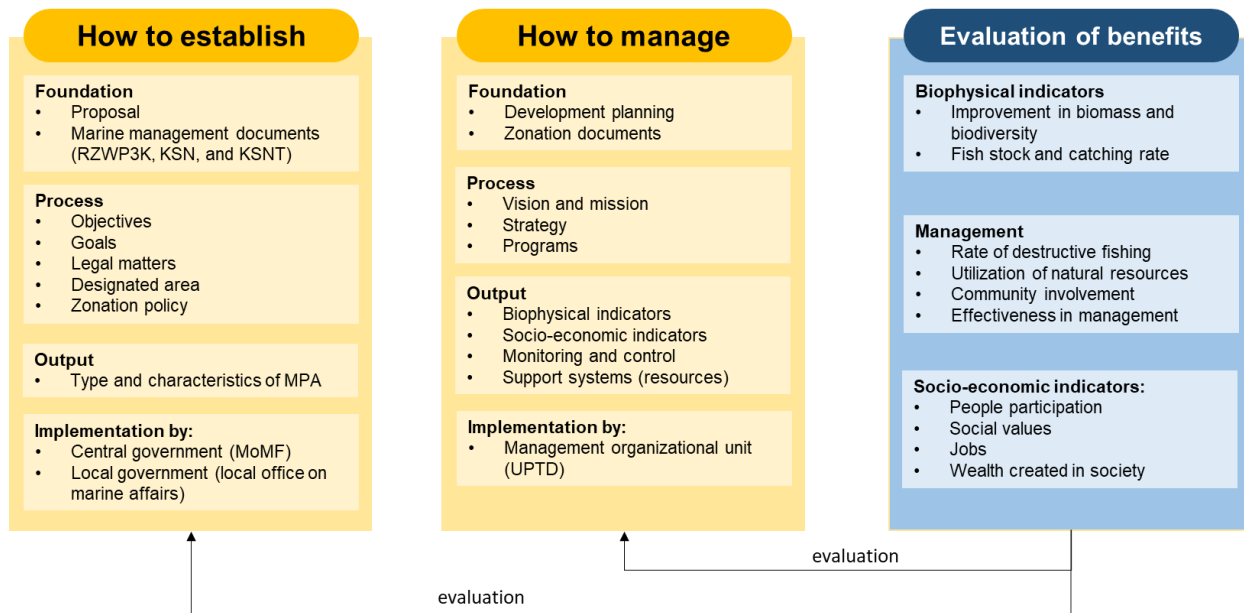


Figure 6. Process for good MPA governance

Source: Ministry of Marine Affairs and Fisheries (MMAF)

The management of the national MPAs by the central government is handled by the technical unit of *Dirjen Pengelolaan Ruang Laut, Balai Kawasan Konservasi Perairan Nasional*. One BKKPN is responsible for managing several MPAs in a given area. An example is BKKPN Kupang, which is responsible for 8 MPAs in the five provinces of Nusa Tenggara Barat, Sulawesi Selatan, Maluku, Papua, and Papua Barat.

At the subnational level, a MPA is established by the signing of a Governor Regulation, which initially gives it the status of back-up MPA or potential zone. When the process of developing a Zoning and Management Plan for the conservation area is completed, the proposed MPA is established as a conservation area at the provincial level by the MMAF. The province then issues a local regulation, known as *peraturan daerah*, for the MPA zone.

Case Studies

The Case of MPAs in Indonesia

Each MPA in Indonesia has its own features and characteristics that differentiate them from each other. Each experience of MPA implementation can provide great lessons and insights to understand what works and what does not, thus enhancing our knowledge of sustainable fisheries management. It was also identified that a combination of economic, interpretative, knowledge, legal, and participatory incentives is important for effective governance (Jones,

2014). Two case studies of MPA implementation in Indonesia, in Nusa Penida and Nusa Tenggara Barat respectively, are discussed below.

Nusa Penida Marine Protected Area

The Nusa Penida Marine Protected Area is located around 32 km off the South-East coast of Bali island. It covers an area of 20,057 hectares, managed by the District Government of Klungkung, Bali, Indonesia. The MPA is home to highly diverse coral ecosystems and marine megafauna, including the mola mola (ocean sunfish) and manta rays (Pokja KKP Nusa Penida, 2012). Most residents who live along the coastline depend on fisheries, seaweed farming, and marine tourism for their livelihoods, while the income source of in-land residents mostly comes from agriculture and animal husbandry.

Engagement with the local community plays a critical role in ensuring the effectiveness of MPA implementation. In the case of Nusa Penida, the communication and consultation process with the local community was set up at the earliest time prior to the establishment of the MPA. This ensures that the community actually buys in and supports the idea of a marine protected area. Key takeaways are (1) facilitate long-term and open dialogue, (2) communicate in a consistent manner and use repeated messaging to ensure everyone is on the same page and no one is left behind, and (3) always be positive, tackle any disagreement through compromise and aim to seek the best possible solutions for all parties.

Although each MPA has its own challenges and opportunities, some experiences and insights may be transferable and applicable to other MPAs. First, it is crucial to be inclusive and collaborative. The establishment of a MPA will definitely require support from the local population and community buy-in for marine protected areas. While the process of engagement takes time, it is definitely worth the effort to prevent undesirable conflict in the future. Second, it is essential to always show respect to every stakeholder, particularly in cases where opposing opinions arise. It is critical to ensure that no one is left behind as the idea of building marine protected areas is also aligned with the notion of inclusivity. Third, one challenge in securing global buy-in is to make sure never to overpromise. The commitments and promises that are agreed upon must be delivered. And last but not least, MPA staff or practitioners must maintain integrity at all times to gain respect and trust, particularly from the local community.

Marine, Coastal, and Small Island Protected Areas in Nusa Tenggara Barat

The waters of Nusa Tenggara Barat (NTB) are strategically located in the Coral Triangle region, an area which is a migration route for biodiversity originating from two major oceans—the Indian and the Pacific Ocean. This contributes to enriching Indonesia's marine biodiversity. The waters are home to a complete coastal ecosystem, including coral reefs, seagrass, and mangroves, which are spread evenly in every district and city in the province of NTB. In addition to the migration route for marine mammals, it also constitutes one of the main tourist destinations in Indonesia, both for foreigners and the local population. As far as the characteristics of the MPAs in NTB are concerned, the existing MPAs belong to at least two

categories according to the International Union for Conservation of Nature (IUCN), namely Category V (Protected Seascape), mainly for conservation and recreation, and Category VI (Protected Areas with sustainable use of natural resources), dedicated mainly to the sustainable use of the natural ecosystem.

Under the Regional Regulation of the Nusa Tenggara Barat Province No. 12/2017 concerning the Zoning Plan for Coastal and Small Island Protected Areas (*Rencana Zonasi Wilayah Pesisir dan Pulau-pulau Kecil/RZWP3K*), the province has allocated areas for coastal and small island conservation areas (KKP3K). These protected zones cover an area of 341,641.44 hectares spreading over eight districts. The KKP3K is managed by the Department of Marine Affairs and Fisheries of the Province of NTB under the Management Unit of the Center for the Conservation and Supervision of Marine and Fishery Resources (*Balai Konservasi dan Pengawasan Sumberdaya Kelautan dan Perikanan*).

The government of NTB engaged with various stakeholders—district/city administrations, local and indigenous communities, NGOs and other relevant parties—in order to improve the management of MPAs and to build accountable monitoring processes based on the Technical Guidelines for Evaluating the Management Effectiveness of Marine, Coastal, and Small Island Conservation Areas (*Evaluasi Efektivitas Pengelolaan Kawasan Konservasi Perairan, Pesisir, dan Pulau-pulau Kecil, EKKP3K*)¹². The results of the evaluation of 15 protected areas indicated that 3 areas had reached green status (“conservation area managed minimally”), 2 had reached yellow status (“conservation area established”), and 10 were still at the red level (“conservation area initiated”). Nevertheless, MPA improvements have increased the population of herbivorous fish and hard coral cover in several protected areas.

Several factors that significantly contributed to these improvements in MPA effectiveness were identified, including (1) the participation of the local community throughout the process, including the planning, implementation, monitoring and evaluation of the MPA; (2) the effective allocation of human resources according to their competencies; (3) the synergy of policy direction on land and sea; and (4) the development of new regulations that support existing regional regulations (Tarigan et al., 2019; Ford et al., 2020).

Marine Conservation Movement Community Group (KOMPAK)

One of the main programs under the MMAF, called KOMPAK (*Kelompok Masyarakat Penggerak Konservasi*), aims to support community-managed MPAs. In 2020, 174 coastal communities received as much as 94 million rupiahs to finance their MPA activities, whether in the form of improving biota, coral reef, or eco-tourism. A program called Penyu House (*Rumah Penyu/Sahabat Penyu*) in West Sulawesi is one of the success stories of KOMPAK. It is a community dedicated to conserving sea turtles in Polewali Mandar, West Sulawesi. The program aims to prohibit coastal inhabitants from selling sea turtle eggs and, instead, to conserve those eggs to ensure the preservation of sea turtles. Penyu House has expanded its activities beyond sea turtle conservation to include community activities, such as social and

12. More information can be accessed through this link <http://kkji.kp3k.kkp.go.id>

cultural activities as well as coastal education for visitors. Through MMAF, the GoI hopes to replicate similar successes in other regions.

A partnership between MMAF and CSIRO to monitor conservation zones

Starting in 2017, MMAF and the Commonwealth Scientific and Industrial Research Organization (CSIRO) established a series of collaborative programs designed to monitor marine conservation zones. This partnership has been beneficial in reducing illegal, unreported, and unregulated (IUU) fishing in the exclusive economic zones (EEZ) of Indonesia. Its activities involve not only operational activities but also research and development.

In terms of operational activities, MMAF established a conservation area monitoring scheme which enables fishermen and coastal communities to report boats/ships that operate in Indonesia's EEZ. As for research and development, MMAF and CSIRO worked together to develop a fishing bomb detector which is ready to start trialling this year. Other activities include monitoring catch transshipment using remote sensing data and estimating the location of fish aggregation devices using vessel monitoring systems (VMS) and satellite radars.

The Case of Global MPAs

Several countries are leading in marine protected area management, such as the US, Japan, and the Philippines. Among G20 countries, France, Germany, and Australia have the highest proportion of MPAs, respectively¹³. Each country has its own unique policy and approach for sustainable fisheries management. . MPA governance may involve (Day, Laffoley, and Zischka, 2015):

- 1) the central government (e.g., Great Barrier Reef Marine Park, Australia and United States National Marine Sanctuary System, US);
- 2) a subnational government (e.g., Wakatobi National Park, Indonesia and Ha Long Bay Natural World Heritage Property, Vietnam);
- 3) the private sector (e.g., Chumbe Island Coral Park Ltd.); or even
- 4) the local community (e.g., Kimbe Bay, Papua New Guinea, and Isla Natividad, Mexico).

Several cases will be discussed below.

Kimbe Bay, Papua New Guinea.

The local community in Kimbe Bay, Papua New Guinea relies heavily on marine resources for their livelihoods, which motivated them to establish a locally managed marine area (LMMA). This approach heavily emphasized the engagement and participation of local communities in conservation planning and activities. The LMMA has developed a governance and management framework, legal foundation, and training network, while also engaging with relevant stakeholders to support better implementation of marine conservation in the area (Weeks et al., 2014; Day, Laffoley, and Zischka, 2015).

Marine Protected Areas in Brazil

13. https://www.g20-insights.org/policy_briefs/g20s-role-in-marine-biodiversity-policy-options-and-best-practices-for-enhancing-marine-protected-areas-mpa/

As a developing country, Brazil tends to face challenges in enforcing effective MPA governance. The country has developed the Rapid Assessment and Prioritization of Protected Area Management methodology, known as RAPPAM. This methodology provides insights into key factors that influence MPA effectiveness. A study found that the five main indicators significantly influencing MPA effectiveness are (1) higher levels of monitoring and research; (2) higher investments; (3) adequate human resources; (4) increased social participation; and (5) lower levels of conflict between users and managers (Júnior et al., 2016).

Insights from Existing MPAs

Welfare Benefits

With the restriction of certain human activities such as fishing in protected areas, MPAs can help preserve the ecosystem and fish population. Furthermore, they also improve fishers' awareness of how to protect marine areas. Several studies, including Darmawan & White (2021), show that conserving marine areas increases fish abundances, including average fish size and number and size of fish eggs. The better quality and quantity of fish leads to a significant increase in income and welfare for fishers. Studies by Andam et al. (2010) and Sims (2010) show that improvements in coastal community household wealth could also be associated with higher fisheries yield. Additionally, a study conducted by Prisanti & Halimatussadiah (2020) shows that fishing productivity is higher in regencies with MPAs than in those without one. This is demonstrated by showing that regencies with a MPA have a higher mean CPUE (1209,501) than regencies without a MPA (814,627). Fishing productivity is thus measured using the Catch Per Unit Effort (CPUE).

MPA programs in Indonesia could also create new jobs in sectors such as fish production, construction and marine tourism (Leisher et al.). By creating new jobs, they could automatically reduce the unemployment rate in the area and also increase community income, later leading to an increase in wealth and a decrease in poverty. One of the main activities in MPAs is marine tourism, which is managed by the local community.

According to Dwyer and Gill (2019), marine tourism presents opportunities for tourism stakeholders to raise local income and strengthen and enhance local infrastructure. In Indonesia, marine tourism has become a priority in the 2005–2025 Long-Term National Development Plan. This has created several job opportunities for the population as tourist guides, tourist attraction providers and many more. It could also boost SMEs creating items that can be sold as souvenirs to tourists. SMEs could also absorb employment.

A study conducted by Leisher et al. in the Bunaken area showed that 75% of tourism workers experienced an increase in their families' welfare. Furthermore, according to Leisher et al., MPA activities in the Bunaken area increased the quality of community livelihoods through fisheries and tourism, even though fishers earn substantially less than people working in the tourism sector. It indicates a higher monetary benefits from MPA compared to status quo condition,

A study conducted by Gurney (2014) in Indonesia shows that integrated MPAs appeared to contribute to poverty alleviation, but these improvements occurred mostly during the implementation period and did not continue to develop after the end of the large injection of funds and the withdrawal of external support. During the decade after the end of their implementation, changes in poverty indicators were less significant in MPA villages (e.g., environmental knowledge) than in control villages (e.g., empowerment indicators). Furthermore, wealth was positively affected by the integrated MPAs during the implementation period, a finding consistent with some recent evaluations of protected areas (e.g., Andam et al., 2010; Sims, 2010) and fisheries co-management (Evans et al., 2011).

Eriksson et al. (2019) conducted an evaluation of the socio-economic impacts of MPAs in Nusa Penida, Tanjung Luar and Komodo National Park, where they showed that 37% of interviewees

in those three areas had experienced an improvement in their life since the implementation of conservation efforts in the form of species protection or MPAs in their area. The economic situation of the residents was associated with their access to alternative livelihoods, access to information on conservation rules, and relationship with conservation authorities.

Furthermore, according to Dwyer and Gill (2019), Marine Protected Areas may also improve the quality and quantity of infrastructure in the area, especially in the sector of marine tourism. In order to boost tourist visits, good infrastructure is necessary, especially transportation infrastructure.

A study conducted by Leisher et al. shows that MPA activities in the Bunaken area allow women to find employment in the tourism sector by working in the resorts. Previously, there was no job opportunity available for women. As the number of SMEs increases around MPAs, opportunities for women to work in SMEs also become more numerous.

Governance

A better governance system is important in implementing MPAs, especially for the management of the protected areas. According to Prisanti & Halimatussadiyah (2020), who evaluated the MPA in Kepulauan Anambas, Kabupaten Pariaman dan Kabupaten Berau, a well-managed MPA has higher fish productivity. Furthermore, the presence of a MPA also forces the area to have a clear division of responsibilities between the provincial and regency governments in order to achieve MPA goals. On the same topic, when evaluating a MPA in Raja Ampat, Wartini (2020) found that Law Number 32/2004 had expanded the respective authority of the provincial government and regency government. The provincial government focuses on fishery management issues, while the regency government focuses on managing the existing MPAs in its territory. This may cause a conflict of authority between both governments for the management of MPAs.

MPAs in Indonesia: Challenges and Opportunities

Some challenges remain in the implementation of MPAs in Indonesia, including limited technical and management capacity, poor governance and management, a lack of stakeholder involvement, and low concern for the marine environment (Nagelkerken, 2009). The high human dependency on the oceans for resources, as well as for the exchange of goods in the era of globalization, undermines people's awareness regarding the sustainable utilization of these resources. Support for all stakeholders' awareness of the marine environment is underlined as the highest priority factor affecting the realization of MPAs, followed by the enforcement of regulations and engagement of local communities in monitoring. This is relevant since many issues facing the marine environment are anthropogenic stressors, such as overfishing, aquaculture, pollution, coastal erosion, habitat loss, and the introduction of invasive species, and these issues mostly arise due to the absence of environmental awareness (Jackson, 2001; Halpern, Selkoe, Micheli, and Kappel, 2007; Duarte, Dennison, Orth, and Carruthers, 2007; Ling S. D., Johnson, C. R., 2012).

Challenges

In Indonesia, public consciousness of environmental issues remains scant, as it is largely confined to privileged groups. Even though this is known to be the result of different factors, it is still true that the low level of understanding and literacy on environmental matters is the main factor behind it (Quevedo et al., 2020; Ogunbode & Arnold, 2012). Moreover, concerns about human exploitation of the natural environment might be explained by examining human understanding of and attitudes toward the environment (Ogunbode & Arnold, 2012). Therefore, in Indonesia's context, the greatest challenge is to seek methods for enhancing people's knowledge of the significance of marine ecosystems by including them in ecosystem management (Nadiarti et al., 2012). This is vital because awareness plays a crucial part in driving people to adopt more pro-environmental behaviors, which can then support the success of environmental policy (ECLAC, 2000).

An empirical study on environmental awareness in the context of Indonesia was conducted by Kusumawati (2015). The study claimed that poor awareness of marine ecosystems might have created more obstacles for MPA management, such as a lack of support from local communities (Bennet et al., 2014). Prior studies mentioned that a better understanding of the benefits of MPAs correlated with their success (FAO, 2019; Rossiter et al., 2014). Greater understanding will encourage the community to become involved in MPA management, or at a minimum to consider sustainability in their approach to the marine system, with the aim to recognize the advantages of MPAs. Moreover, it may also increase public attention to the marine environment. At least, the community can grasp the consequences of disrupting the ecosystem, inspiring higher engagement in managing the MPA as well.

To summarize the challenges faced by MPA implementation in Indonesia, a number of issues relating to MPA policy implementation are highlighted below:

- 1) Sustainability Awareness

As mentioned above, marine tourism, as one of the main activities of MPAs, creates job opportunities for coastal communities, which leads to increased income and wealth. The more tourists come to the area, the more money the community earns. The most important challenge for this sector is sustainability, both for tourism activities and the environment, which becomes the sector's main asset.

Communities in MPAs is more likely to be aware of how to keep these resources sustainable compared to general public living in non-MPAs area. This is due to various capacity building and promotion of MPA program. Similar awareness is sometimes not the case for tourists. They sometimes show irresponsible behavior such as littering or coral destruction, which could disrupt the protected area. If such behavior continues, it will not only damage the area but also reduce community income. Sustainability may be achieved if both parties are fully aware of how to keep the area clean and avoid conducting harmful activities. Gurney et al. (2014) suggested that, although the MPA project achieved some success in improving environmental knowledge, broader-scale factors, such as regional media awareness campaigns or growing national awareness of environmental issues were likely to be more important in influencing people's understanding of social-ecological systems.

2) Sustainability of MPA Implementation

Furthermore, as several studies have shown that the positive impact of MPA programs was limited to the implementation period (e.g., Gurney et al., 2014; Andam et al., 2010; Sims 2010), it is crucial to ensure the sustainability of such programs. One of the factors at stake relates to financing mechanisms. According to CEA (2018), private foundations and development aid organizations (which include both bilateral and multilateral donors) have been an important source of funding for marine and fisheries issues in Indonesia. MPAs received an outsized proportion of funding, approximately USD 117 million in total between 2007 and 2016. Even as some funders look to transfer long-term management and financial sustainability of these MPA networks to local governments and communities, funder interest will likely remain strong in related aspects (i.e., human and financial capacity) to ensure that the success of these projects is enduring. This condition should be a concern not only for the local government but also for the central government to keep the funding sustainable. More sustainable financing mechanisms will make MPA programs more effective, not only in protecting the marine and coastal areas but also in increasing the wealth of the community.

Budget challenges have also been a problem for climate financing programs. The national budget can only cover 30% of the climate financing needed to fight climate change, which is why the Fiscal Agency Policy is currently designing Climate Change Financing Frameworks (CCFF)¹⁴. Holding the presidency of G20 in 2022 raises an opportunity for the GoI to meet the target of sustainable finance for climate change.

3) The short-term trade-off between Fish Abundance and Resource Sustainability

14. Fiscal Policy Agency (2021) in AFD – LPEM Workshop on Marine Protected Areas (October 2nd, 2021)

Another challenge is the trade-off between giving assets to fishermen and preventing overfishing. Providing fishermen with sufficient knowledge on MPAs and responsible fishing methods will increase their awareness of the need to protect MPAs from disruption and could also increase their income. The challenge is that once the fishermen have adequate assets for fishing, they will tend to use these assets fully, which may lead to overfishing. Thus, even though fishermen already have the necessary environmental awareness, monitoring mechanisms should also be enhanced to avoid overfishing. Furthermore, it is also necessary to have sufficient infrastructure and human resources, as well as a local community leader to maintain and spread awareness.

Moreover, as fishing develops, another challenge is how to open the market to absorb the fish and other related products. Fishers only have a limited network and therefore need support in terms of networking or even promotional activities to access wider markets and thus make their activity sustainable.

4) Human Resources

Poverty and the quality of human resources have also been identified as problems in MPA program implementation¹⁵, and it is therefore necessary to foster a strong partnership between the central government, local government, private sector, NGOs, and local community. A collaborative partnership should be cultivated, especially in managing the economic activities around the protected areas. Such a partnership could take the form of capacity building, which could enhance the skills of the community, or of initiating a more sustainable funding mechanism by giving productive assets to the community, such as boats or fishing tools. As previously mentioned, studies have shown that community wealth only increased during the implementation period. Thus, given the limited budget of the government, more sustainable financing can be created through such a partnership.

Opportunities

The IUCN has developed the IUCN Protected Area Matrix to help visualize the combinations of management categories and governance types that can occur within a system of protected areas. The matrix can be used by the Indonesian government to determine which MPAs are classified under a given management category and governance type. They can further analyze issues of responsibility using the continuum also introduced by the IUCN (2013). Furthermore, this matrix can also be used to benchmark the best MPA practices from other countries against Indonesian MPAs by looking at which combination of management category and governance type is the most fitting. Using the matrix and learning from best MPA practices might help to improve the sustainability of MPAs in Indonesia.

15. <http://kkji.kp3k.kkp.go.id/index.php/dokumen/finish/102-presentasi/967-indonesian-marine-protected-areas-a-new-paradigm-for-sustainable-marine-ecosystem-and-fisheries-management>

Governance Type Management Category	A. Governance by government		B. Shared governance		C. Private governance		D. Governance by indigenous peoples and local communities				
	Federal or national ministry or agency in charge	Sub-national ministry or agency in charge	Government-delegated management (e.g. to an NGO)	Transboundary governance	Collaborative governance (various forms of pluralist influence)	Joint governance (pluralist governing body)	Conserved areas established and run by individual landowners	...by non-profit organisations (e.g. NGOs, universities)	...by for-profit organisations (e.g. corporate landowners)	Indigenous peoples' conserved areas and territories – established and run by indigenous peoples	Community conserved areas and territories – established and run by local communities
I a. Strict Nature Reserve											
Ib. Wilderness Area											
II. National Park											
III. Natural Monument											
IV. Habitat/ Species Management											
V. Protected Landscape/ Seascape											
VI. Protected Area with Sustainable Use of Natural Resources											

Figure 7. The IUCN Protected Area Matrix

Secondly, the use of incentives to encourage the creation of more MPAs and improve existing ones should also be considered as an option. The central government has committed to strengthening MPA programs in Indonesia to achieve its 2030 goals. This commitment includes providing incentives for MPAs to grow. A report by UN Environment (2019) has identified various incentives that can be used to nudge the development of MPAs.

Incentive category	Incentive
Economic	Payment for ecosystem services (PES)
	Assigning property rights
	Reducing the leakage of benefits
	Promoting profitable and sustainable fishing and tourism
	Promoting green marketing
	Promoting diversified and supplementary livelihoods
	Providing compensation
	Investing MPA income/funding in facilities for local communities
	Provision of state funding
	Provision of NGO, private sector, and user fee funding
Communication	Raising awareness
	Promoting recognition of benefits
	Promoting recognition of regulations and restrictions
Knowledge	Promoting collective learning
	Agreeing approaches for addressing uncertainty

Incentive category	Incentive
	Independent advice and arbitration
Legal	Hierarchical obligations
	Capacity for enforcement
	Penalties for deterrence
	Protection from incoming users
	etc
Participation	Rules for participation
	Establishing collective platforms
	Independent arbitration panels
	Peer enforcement
	Etc

Discussion

The growing trend of MPA creation is great news for environmental sustainability. However, it does not mean that the operation of MPAs should remain “business as usual”. It is important to identify the various challenges in optimizing the benefits of MPAs, but also to be aware of the opportunities to improve existing MPAs. The previous section identified the challenges and opportunities associated with MPAs. The challenges included MPA sustainability awareness, program sustainability, short-term trade-offs, and human resources. On the other hand, we also explained how the IUCN matrix may help to analyze certain MPA programs, as well as the possible incentives to tackle the challenges identified. It is important for both the national and local governments to improve the effectiveness and efficiency of current and future MPAs by mitigating the challenges and maximizing the opportunities.

Recommendations and Action Plan

This paper identifies various potential benefits of MPAs for environmental sustainability and inequality reduction in Indonesia. We find that various studies have noted that MPAs do contribute to poverty alleviation to some extent through improvements in fish catches, new green jobs (additional workers for MPA management, eco-tourism, sustainable fishery industry jobs), and gender equality. This policy is, however, believed to become unsustainable once the large injection of funds and external expertise are withdrawn. We identify several challenges for further implementation of MPAs, particularly related to awareness, human resources, the short-term trade-off between programs and opportunity costs, and program sustainability. Below are several recommendations we have identified to enhance the benefits of MPAs and improve the sustainability of the programs:

1. Several **monetary and non-monetary incentives** can be given to improve the sustainability of the economic benefits of the programs, such as incentives for potential investors in coastal eco-tourism and sustainable fishing, conditional payment for services mechanisms for financing MPAs, promotion activities in favour of MPAs, and building better infrastructure in coastal areas. **The financing issues of MPAs should also be addressed** and the GoI should take advantage of the Indonesian presidency of G20 in 2022 to build momentum and push forward its MPA development agenda.
2. Improved cooperation aiming at **establishing a co-management system with all stakeholders** should be the goal behind the implementation of MPAs in Indonesia in the future. The co-management strategy could hasten the pursuit of a sustainable coastal ecosystem benefitting not only the environment but also the social and

economic situation. To ensure the success of co-management, several incentives should be offered to local governments and communities to participate in management. One thing to keep in mind is that the efficacy of MPAs is dependent on how much local people rely on area resources and how well local institutions collaborate with local communities.

3. **Strong collaboration and monitoring** from all stakeholders can be a resilient instrument to ensure the long-term viability of maritime resources. Since marine resources, in contrast to other resources, are classified as common property, they are difficult to detect and regulate. Conflict of interest in the form of how to manage and utilize marine resources is sometimes occurred, however, but as long as there are solid regulations in place and support in raising awareness, this can be overcome.
4. **The improvement of institutional capacities behind the MPA policy** is essential. Prior studies identified constraints in the form of a lack of funding and expertise. Hence, there is a need to strengthen institutional capacities and human resources to increase the competency of the institutions responsible for coordinating and managing MPAs.
5. **A holistic approach to developing MPA programs.** MPA programs need a comprehensive roadmap or blueprints to ensure that they develop properly, involving not only a top-down approach but also bottom-up participation. Local communities should be the center of MPA planning, and we should ensure that monitoring and evaluation are done comprehensively in collaboration with local communities.
6. It is widely recognized by many researchers and academicians that it is difficult to evaluate inequality on a more disaggregated level to understand the situation in coastal communities. It is therefore important to **promote a diagnostic of inequality in Indonesia** to understand the issue comprehensively, including among coastal communities. To this end, we can target, monitor, and evaluate the impact of MPA programs on inequality in a coastal community.

References

- Amkieltiela, C., & et, a. (2020). Ecological and Social Status and Trends of Marine Protected Areas in Indonesia. *Management of Marine Protected Areas in Indonesia*, 89-124.
- Andam, K. S., Ferrari, P. J., Sims, K. R., Healy, A., & Holland, M. B. (2010). Protected areas reduced poverty in Costa Rica and Thailand. *Procurement National Academic of Science* 107, 9996-10001.
- Anna, Zuzy., 2019. Pemanfaatan Model Bio-Ekonomi Dalam Pengelolaan Sumber Daya Perikanan yang Berkelanjutan. Orasi Ilmiah Pengukuhan Guru Besar. Universitas Padjadjaran. Bandung, 8 November 2019
- Badan Pusat Statistik, Upah Minimum Regional/Provinsi (UMR/UMP) dan rata-rata Nasional per tahun (Dalam Rupiah), 1997-2016, Jakarta, 2017.
- Badan Pusat Statistik. 2021. PDB Seri 2010 (Milyar Rupiah) 2019. Jakarta, Indonesia
- Badan Pusat Statistik. 2021., Survei Sosial Ekonomi Nasional 2019. Jakarta, Indonesia
- Badan Pusat Statistik. 2021. Survei Angkatan Kerja Nasional 2019. Jakarta, Indonesia
- Ball, I., Possingham, H., & Watts, M. (2009). *Marxan and relatives: Software for spatial conservation prioritisation*. Oxford, UK: Spatial conservation prioritisation: Quantitative methods and computational tools. Oxford University Press.
- Bappenas. 2020. Rencana Pembangunan Jangka Menengah Nasional 2020- 2024.
- Ban, Natalie,. C. et al, 2019. Well-being outcomes of marine protected areas. *Nature Sustainability* 2, 524-532.
- Bennett NJ, Dearden P. Why local people do not support conservation: community perceptions of marine protected area livelihood impacts, govern- ance and management in Thailand. *Mar Policy* 2014;44:107–16.
- Borrini-Feyerabend, G., N. Dudley, T. Jaeger, B. Lassen, N. Pathak Broome, A. Phillips and T. Sandwith (2013). Governance of Protected Areas: From understanding to action. Best Practice Protected Area Guidelines Series No. 20, Gland, Switzerland: IUCN. xvi + 124pp
- Burke, Lauretta, Selig, L., & Spalding, M. (2002). *Reefs at Risk in Southeast Asia*. World Resource Institute.
- California Environmental Associates. (2018). *Trends in Marine Resources and Fisheries Management Indonesia: A 2018 Review*. California Environmental Associates & The David and Lucile Packard Foundation.
- Cesar, H. S. J., editor. 2000. Collected essays on the economics of coral reefs. CORDIO, Kalmar.
- Cesar, H. S. J., L. Burke, and L. Pet-Soude. 2003. The economics of world-wide coral reef degradation. Cesar Environmental Economics Consulting (CEEC), Arnhem, The Netherlands.
- Cheung, William W. L., Vicky W. Y. Lam, Jorge L. Sarmiento, Kelly Kearney, R. E. G. Watson, Dirk Zeller, and Daniel Pauly. 2010. "Large-scale Redistribution of Maximum Fisheries Catch Potential in the Global Ocean under Climate Change." *Global Change Biology* 16(1):24–35.
- Darmawan, Agus., Alan White. 2021. Why Effective Marine Protected Areas Matter. Tuesday, 19 January 2021. <https://www.thejakartapost.com/academia/2021/01/19/why-effective-marine-protected-areas-matter.html>
- Day, J.C., Laffoley, D., & Zischka, K. 2015. Marine Protected Area Management. Chapter 21 in Protected Area Government and Management. 9gg pages, Australian National University Press, Canberra, Australia.
- Duarte, C.M., Dennison, W.C., Orth, R.J.W. & Carruthers, T.J.B. (2008). The Charisma of Coastal

Ecosystems: Addressing the Imbalance. *Estuaries Coasts*, 31, 233-238.

Dudley, N., Mansourian, S., Stolton, S., & Suksuwan, S. 2008. Safety net: protected areas and poverty reduction: a research report by WWF and Equilibrium. WWF International, Gland, Switzerland.

Dwyer, L., A. Gill. 2019. Coastal and Marine Tourism: Addressing Some Wicked Problem. *Acta Turistica*, 2019, Vol 31 (2019), (No 2), pp. 213 - 242 (30)

ECLAC, 2000. Role of Environmental Awareness in Achieving Sustainable Development. Economic Commission for Latin America and the Caribbean.

Eriksson, B., Johansson, F., & Blicharska, M. (2019). Socio-economic impacts of marine conservation efforts in three Indonesia fishing communities. *Marine Policy* 103, 56-67.

Evans, L., Cherrett, N., Pems, D., 2011. Assessing the impact of fisheries comanagement interventions in developing countries: a meta-analysis. *J. Environ. Manage.* 92, 1938–1949.

FAO. 2003. The ecosystem approach to fisheries Food and Agriculture Organisation of the United Nations, Rome.

FAO. 2011. FAO Code of Conduct for Responsible Fisheries. Rome.

Hall, S. J. 1999. The effects of fishing on marine ecosystems and communities. Blackwell Science, Oxford.

Hamilton, R. J., T. Potuku, and J. R. Montambault. 2011. Community-based conservation results in the recovery of reef fish spawning aggregations in the Coral Triangle. *Biological Conservation* 144:1850-1858.

Giakoumi, S., McGowan, J., Mills, M., Beger, M., Bustamante, R., Charles, A., . . . Guidetti, P. (2018). *Revisiting "success" and "failure" of marine protected areas: a conservation scientist's perspective*. *Frontiers in Marine Science*.

Green, A., White, A., & Kilarski, S. (2013). Designing marine protected area networks to achieve fisheries, biodiversity, and climate change objectives in tropical ecosystems: A practitioner guided. Cebu City: The Nature Conservancy and the USAID Coral Triangle Support Partnership.

Gurney, G. G., Pressey, R. L., Cinner, J. E., Pollnac, R., & Campbell, S. J. (2015). Integrated conservation and development: Evaluating a community-based marine protected area project for equality of socio-economic impact. *Philosophical Transaction of Royal Society B*, 370.

Halpern, B.S., Selkoe, K.A. , Micheli, F., Kappel, C. V. 2007. *Conservation Biology*. <https://doi.org/10.1111/j.1523-1739.2007.00752.x>

Handayani, C. N., & et, a. (2020). Status and Trends in Indonesia Protected Area Coverage of Marine Ecosystems. In M. o. Fisheries, *Management of Marine Protected Areas in Indonesia: Status and Challenges* (pp. 61-86). Jakarta: Ministry of Marine and Fisheries and WWF Indonesia Foundation.

IPCC. 2019. IPCC Special Report on the Ocean and Cryosphere in a Changing Climate e [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (Eds.)].

IUCN-WCPA. 2008. Establishing Marine Protected Area Networks - making it happen. IUCN World Commission on Protected Areas, Washington D.C.

Jackson JBC, Kirby MX, Berger WH, Bjorndal KA, Botsford LW, Bourque BJ, et al. Historical overfishing and the recent collapse of coastal ecosystems. *Science* 2001;293:629–38.

Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., & et, a. (2015). Plastic waste inputs from land into the ocean. *Science* 347 (6223), 768-771.

Kusumawati, I., & Huang, H. W. (2015). Key factors for successful management of marine protected areas: A comparison of stakeholders' perception of two MPAs in Weh island, Sabang, Aceh, Indonesia. *Marine Policy*, *51*, 465-475.

Leisher, C., van Beukering, P., & Scherl, L. M. (2009). Nature's Investment Bank: How Marine Protected Area contribute to poverty reduction. The Nature Conservancy.

Ling, S.D., and C.R. Johnson. 2012. Marine reserves reduce risk of climate-driven phase shift by reinstating size-and habitat-specific trophic interactions. *Ecological Applications* *22*(4):1,232–1,245, <https://doi.org/10.1890/11-1587.1>.

Marshall, P. and H. Schuttenberg. 2006. A reef manager's guide to coral bleaching. Great Barrier Reef Marine Park Authority, Townsville.

McLeod, E., R. Salm, A. Green, and J. Almany. 2009. Designing marine protected area networks to address the impacts of climate change. *Frontiers in Ecology and the Environment*.

Metuzals, K., R. Baird, T. Pitcher, U. R. Sumaila, and P. Ganapathiraju. 2010. One fish, two fish, IUU, and no fish: unreported fishing worldwide. Pages 165-181 in R. Q. Grafton, R. Hilborn, D. Squires, M. Tait, and M. J. Williams, editors. *Handbook of marine fisheries conservation and management*. Oxford University Press, New York.

Ministry of Finance. 2021. National Government Budget by Function. Ministry of Finance. Jakarta, Indonesia.

Nadiarti, Riani E., Djuwita, I., Budiharsono, S., Purbayanto, A., Asmus, H., 2012. Challenging for seagrass management in Indonesia. *J. Coast Dev.* *15* (3), 234–242.

Nagelkerken I. *Ecological connectivity among tropical coastal ecosystems*. Netherlands: Springer; 2009.

NRC. 2001. *Marine protected areas: tools for sustaining ocean ecosystems*. National Academy Press, Washington D.C.

OECD. (2021). *Sustainable Ocean Economy Country Diagnostics of Indonesia*.

Ogunbode, C.A., Arnold, K., 2012. A study of environmental awareness and attitudes in Ibadan, Nigeria. *Human and Ecological Risk Assessment* *18*, 669–684. <https://doi.org/10.1080/10807039.2012.672901>.

Österblom, H., C.C.C. Wabnitz, D. Tladi et al. 2020. *Towards Ocean Equity*. Washington, DC: World Resources Institute. Available online at www.oceanpanel.org/how-distribute-benefits-ocean-equitably.

Oliveira Júnior, José Gilmar C., Ladle, Richard J. Correia, Ricardo and Vandick S. Batista,.2016. Measuring what matters – Identifying indicators of success for Brazilian marine protected areas, *Marine Policy* Volume 74 Pages 91-98. <https://doi.org/10.1016/j.marpol.2016.09.018>.

Pratchett, M. S., P. L. Munday, N. A. J. Graham, M. Kronen, S. Pinca, K. Friedman, T. D. Brewer, J. D. Bell, S. K. Wilson, J. E. Cinner, J. P. Kinch, R. J. Lawton, A. J. Williams, L. Chapman, F. Magron, and A. Webb. 2011. Vulnerability of coastal fisheries in the tropical Pacific to climate change. Pages 493-576 in J. D. Bell, J. E. Johnson, and A. J. Hobday, editors. *Vulnerability of tropical Pacific fisheries and aquaculture to climate change*. Secretariat of the Pacific Community, Noumea.

Quevedo, J.M.D., Uchiyama, Y., Kohsaka, R., 2020b. Perceptions of local communities on mangrove forests, their services and management: implications for Eco-DRR and blue carbon

management for Eastern Samar, Philippines. *J. For. Res.* <https://doi.org/10.1080/13416979.2019.1696441>.

Rossiter JS, Levine A. What makes a successful marine protected area? The unique context of Hawaii's fish replenishment areas *Mar Policy* 2014;44: 196–203.

Rudyanto, A. (2004). Kerangka Kerjasama dalam Pengelolaan Sumber Daya Pesisir dan Laut.

Russ, G. R., A. J. Cheal, A. M. Dolman, M. J. Emslie, R. D. Evans, I. Miller, H. Sweatman, and D. H. Williamson. 2008. Rapid increase in fish numbers follows creation of world's largest marine reserve network. *Current Biology* 18:1-2.

Russ, G. and A. Alcala. 2010. Decadal-scale rebuilding of predator biomass in Philippine marine reserves. *Oecologia* 163:1103-1106.

Savo, V., Dana Lepofsky, J. P. Benner, Karen E. Kohfeld, Joseph Bailey, and Ken Lertzman. 2016. "Observations of Climate Change among Subsistence-Oriented Communities around the World." *Nature Climate Change* 6(5):462–73.

Sims, K.R., 2010. Conservation and development: evidence from Thai protected areas. *J. Environ. Econ. Manage.* 60, 94–114.

Stiles, Margot L., Julie Stockbridge, Michelle Lande, and Michael F. Hirshfield. 2010. "Impacts of Bottom Trawling." *Oceana, Washington DC*.

USAID. (2020). A Guide, Framework and Example: Designing Marine Protected Areas and Marine Protected Area Networks to Benefit People and Nature in Indonesia. Jakarta.

Ward, T. J., D. Heinemann, and N. Evans. 2001. The role of marine reserves as fisheries management tools: a review of concepts, evidence and international experience. Bureau of Rural Sciences, Department of Agriculture, Fisheries and Forestry, Canberra.

Wartini, S. 2020. The Implementation of Establishing Marine Protected Area: Lesson Learned from Raja Ampat to Achieve Sustainable Fishery. *Law reform vol 16, no.2*, pp. 224-242. <https://doi.org/10.14710/lr.v16i2.33774>

Weeks, R., Pressey, Robert L., Wilson, Joanne R., Knight, Maurice., Horigue, Vera., Abesamis, R. A., Acosta, R., Jompa, J. . (2014) Ten things to get right for marine conservation planning in the Coral Triangle. *F1000Research* 3, pages 91.

White, W. T. and P. M. Kyne. 2010. The status of chondrichthyan conservation in the Indo-Australasian region. *Journal of Fish Biology* 76:2090-2117.

World Bank. (2021). *Oceans for Prosperity: Reforms for a Blue Economy in Indonesia*. Washington DC: The World Bank.

Wulandari, & Fadhilah, T. (2020). *Overview: Gender barriers in aquaculture and fisheries*. Australia - Indonesia Center.

Yunanto, A. Halimatussadiyah, A. & Zakaria, N. A. 2019. IOP Conference Series: Earth and Environmental Science 241 012013. doi:10.1088/1755-1315/241/1/012013