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ASEAN STRATEGY

ON SUSTAINABLE MANGROVE ECOSYSTEM MANAGEMENT

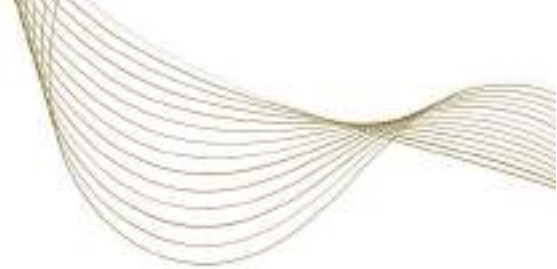
2024 - 2030



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Endorsed by

ASEAN Working Group on Forest Management on 7th June 2024

ASEAN Senior Officials on Forestry (ASOF) on 18th July 2024

Adopted by

ASEAN Ministers Meeting on Agriculture and Forestry on ... (date of endorsement)



Foreword

As our world grapples with the escalating challenges of environmental degradation and climate change, it is imperative that we forge united efforts towards safeguarding our invaluable ecosystems. Mangroves, often referred to as the "rainforests of the sea," stand as critical ecosystems that support biodiversity, protect coastal areas from erosion and storm surges, and serve as vital carbon sinks. However, these invaluable habitats continue to face pressing threats from human activities and the changing climate.


The Association of Southeast Asian Nations (ASEAN) has long recognized the significance of mangrove conservation and sustainable management. It is with great pride and commitment that the Ministry of Environment and Forestry of Indonesia, in collaboration with the ASEAN Senior Officials on Forestry (ASOF), presents the ASEAN Strategy on Sustainable Mangrove Ecosystem Management. This comprehensive strategy embodies a shared vision of promoting the resilience and vitality of mangrove ecosystems across the ASEAN region.

Through the formulation of this strategic framework, we embrace a holistic approach that integrates science, policy, community engagement, and international cooperation. By aligning our efforts with global sustainability goals and regional priorities, we aim to enhance the adaptive capacity of mangrove ecosystems, mitigate climate change impacts, and uphold the well-being of communities dependent on these vital coastal resources.

I commend the dedication and expertise of all stakeholders involved in the development of this strategy, whose collective wisdom and collaborative spirit have shaped this forward-looking roadmap for sustainable mangrove ecosystem management. It is through our concerted actions, unwavering commitment, and innovative solutions that we can secure a more resilient and sustainable future for our mangrove ecosystems and the communities they support.

May this ASEAN Strategy on Sustainable Mangrove Ecosystem Management serve as a beacon of hope and catalyst for transformative change, guiding us towards a harmonious coexistence between nature and society. Together, let us embark on this crucial journey towards safeguarding the wonders of mangrove ecosystems for generations to come.

The Minister of Environment and Forestry
Republic of Indonesia



Prof. Dr. Siti Nurbaya

Preface

The ASEAN Strategy for Sustainable Mangrove Ecosystem Management (or ASEAN Mangrove Management Strategy (AMMS) in short) has been developed by ASEAN Member States to guide actions to support management of mangroves in the ASEAN region in the period of 2024 to 2030.

ASEAN has a coastline of 173,000 km and 34% of the world's mangrove area. Mangroves are coastal vegetation that has a distinctive morphology with a root system that can adapt to tidal areas with mud or sandy mud substrates. Mangroves have a flat and dense canopy, distinctive roots, and always have leaves. A mangrove ecosystem is a unique ecosystem with specific vegetation that lives in a coastal area and needs certain conditions of tides, salinity, and substrate. Mangrove ecosystems provide multiple ecosystem services: as a home of biodiversity; land and sea-based pollutant filtration; sediment trapping; coastal protection from high-level waves, storms, and tsunamis; controlling coastal abrasion; provision of recreational areas with natural atmosphere and beautiful scenery; provision of livelihood-related fishery, ecotourism, and mangrove derivative products; high-capacity carbon storage (4-5 times than terrestrial forest).

Concerning the important function of mangrove ecosystems, degradation and loss of mangroves can make significant and long-lasting impacts on environmental sustainability and human well-being. In the last two decades, there has been a decline in mangrove cover in the ASEAN region. The decline can be categorized into natural phenomena (non-anthropogenic factors) and human activities (anthropogenic factors).

Considering the importance of the mangrove ecosystem for the ASEAN region, and commonalities as well as concerns on the mangrove ecosystem and their management among the ASEAN Member States, there is a need for the region to have strategies on mangrove ecosystem management. The strategy is aimed as a guidance to reach the goal: all mangrove landscapes are sustainably managed to achieve mangroves' ecosystem health and coastal resilience and advance ASEAN's contribution to climate change mitigation and adaptation. The strategy will also unite the ASEAN movement in mangrove management, while still respecting the sovereignty of each country. The strategy will serve as direction and guidance in managing the mangrove ecosystem by various stakeholders as 'users' in the ASEAN region: the central government, local government, scientists/academia, NGOs, community groups, and any other stakeholders involved in the mangrove ecosystem management. From the time frame perspective, this strategy document will be implemented as guidance starting from 2024 to 2030.

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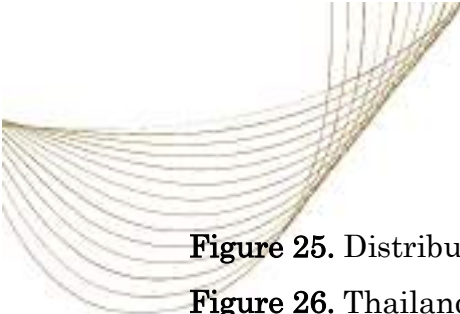


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I. Introduction


Background

Mangroves are coastal vegetation that has a distinctive morphology with a root system that can adapt to tidal areas with mud or sandy mud substrates. Mangroves have a flat and dense canopy, distinctive roots, and always have leaves. A mangrove ecosystem is a unique ecosystem with specific vegetation that lives in a coastal area and needs certain conditions of tides, salinity, and substrate. Mangrove ecosystems provide multiple ecosystem services: as a home of biodiversity; land and sea-based pollutant filtration; sediment trapping; coastal protection from high-level waves, storms, and tsunamis; controlling coastal abrasion; provision of recreational areas with natural atmosphere and beautiful scenery; provision of livelihood-related fishery, ecotourism, and mangrove derivative products; high-capacity carbon storage (4-5 times than terrestrial forest). Concerning the important function of mangrove ecosystems, degradation and loss of mangroves can make significant and long-lasting impacts on environmental sustainability and human well-being.

ASEAN has a coastline of 173,000 km, where an estimated 77 percent of the region's total population of 2.62 billion lives in the coastal areas (PEMSEA 2015). ASEAN mangrove area is around 4,512,000 ha mangrove area (Richards, Daniel R., Friess, Daniel A., et al., 2015), or 34% of the world's mangrove forest with high ecological, social, and economic value. In the last two decades, there has been a decline in mangrove cover in the ASEAN region. The decline can be categorized into natural phenomena (non-anthropogenic factors) and human activities (anthropogenic factors).

The non-anthropogenic factors that cause the degradation of the mangrove ecosystem are high sea waves, storms, and plant pests, which are closely related to climate change. Meanwhile, for the anthropogenic factors, several things including exploitative charcoal production, expansion of pond areas for aquaculture, oil palm plantations, mining, and land clearing for settlements and coastal infrastructures caused this decline. Based on conditions in several countries in the ASEAN Region, drivers of the decline include a lack of public understanding, economic considerations that do not consider ecological aspects, and governance that does not acknowledge the importance of mangrove ecosystems.

The importance of the mangrove ecosystem, many interests in coastal land use and the mangrove ecosystem use with various factors, the degradation that occurs in the field,



the impacts on environmental sustainability and human well-being, and the challenges faced in mangrove management make it important to develop governance in mangrove management.

Objectives

Considering the importance of the mangrove ecosystem for the ASEAN region, and commonalities as well as concerns on the mangrove ecosystem and their management among the ASEAN Member States, there is a need for the region to have strategies on mangrove ecosystem management. The strategy is aimed as a guidance to reach the goal: all mangrove landscapes are sustainably managed to achieve mangroves' ecosystem health and coastal resilience and advance ASEAN's contribution to climate change mitigation and adaptation. The strategy will also unite the ASEAN movement in mangrove management, while still respecting the sovereignty of each country.

The strategy will serve as direction and guidance in managing the mangrove ecosystem by various stakeholders as 'users' in the ASEAN region: the central government, local government, scientists/academia, NGOs, community groups, and any other stakeholders involved in the mangrove ecosystem management. From the time frame perspective, this strategy document will be implemented as guidance starting from 2024 to 2030. As a living document, the strategy will be reviewed to allow continual improvement. In addition, to concretely demonstrating the examples of good practices in the implementation of mangrove ecosystem management strategy in the region, this strategy document will also include some examples of plans for pilot projects on mangrove ecosystem management. Taking into account the differences within the ASEAN Region, through the pilot projects, this strategic guidance will allow flexibility for implementation in the field.

II. Mangrove Ecosystem Dynamics

The mangrove ecosystems are a unity of the mangrove vegetation community associated with fauna and microorganisms so that it can grow in areas along the coast, especially in tidal areas, lagoons, rivers, and estuaries which are protected by mud or sandy substrates to form a sustainable environmental balance. The mangrove ecosystems form zoning of mangrove types, starting from the coast to the mainland which consists of a single zone and a complex zone.

According to FAO, 2007, mangrove habitat is generally located at the boundary between 30°S and 30°N which covers 124 countries. The environmental conditions where mangroves grow have specific characteristics, including minimal wave movement, wide tidal zones, sufficient dissolved oxygen, and abundant plankton.

Mangrove ecosystem sustainability is under high threat from various forms of disturbance, both human (anthropogenic disturbance) and natural factors (natural disturbance). According to FAO (2007), the decline in Indonesia's mangrove area in the period 1980-2005 is estimated at 1.3 million ha (31%), namely from 4.2 million to 2.9 million ha. In the 1980s, around 185,000 ha of world mangroves were lost every year, then in the 1990s this fell to around 118,500 ha per year. In the period 2000-2005, 102,000 ha of mangroves were lost per year. Meanwhile, according to GMA (2021), the decline in mangrove areas is estimated at 4.3% in the last two decades.

Mangrove ecosystem function

There are several functions of the mangrove ecosystem, that can be classified into four aspects, those are physical, chemical, biological, and socio-economic functions. The physical function consists of protecting land from erosion and seawater abrasion, reducing the impact of tsunamis, natural biofilters for saltwater and hazardous substances, binding sediment, and preventing seawater intrusion. The chemical function consists of carbon sinks and nutrient recycling process place. The biological function consists of flora and fauna habitat and genetic sources. The socio-economic function related to community livelihoods includes mangrove-derivative products, ecotourism, and non-timber forest products.

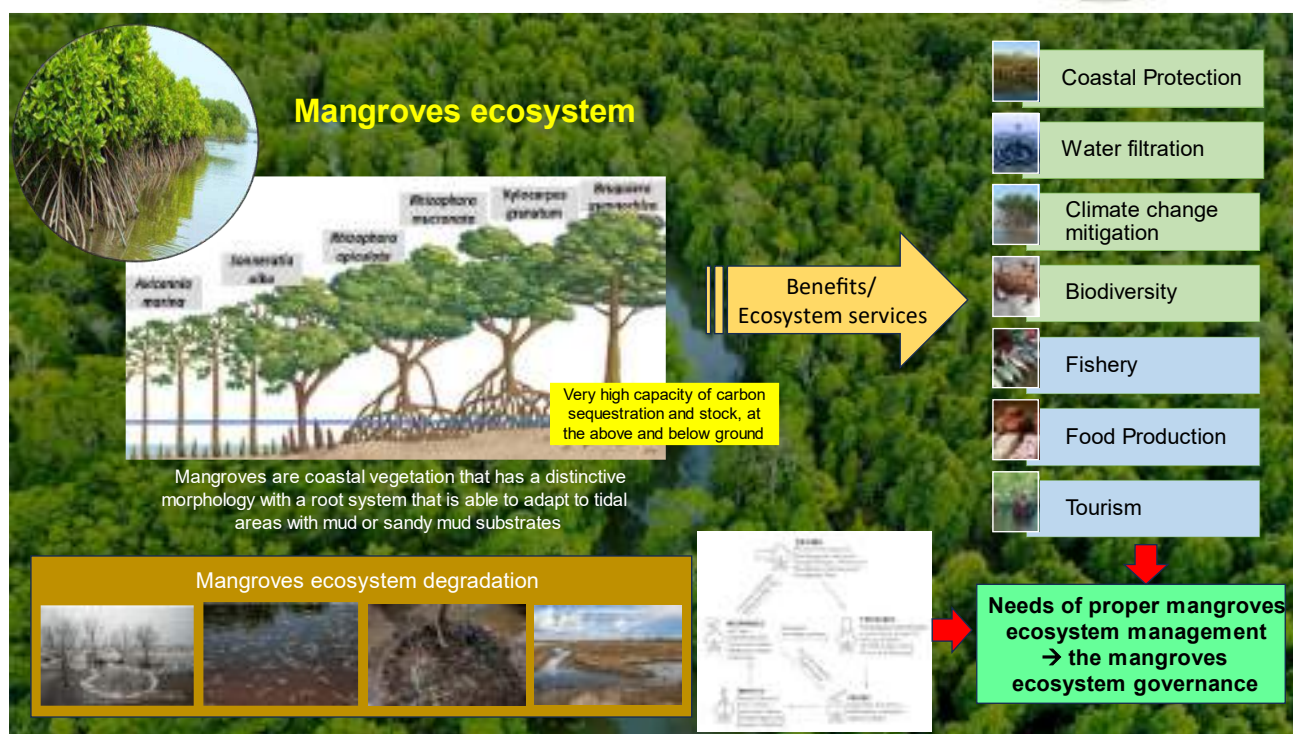


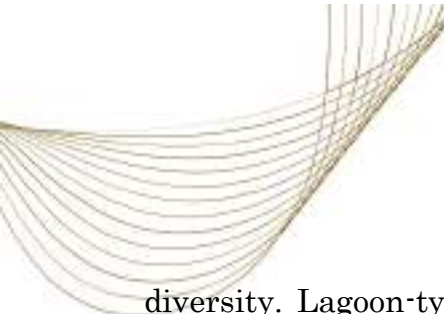
Figure 1. Mangrove ecosystem

Understanding on mangrove landscape needs proper knowledge of the mangrove tree itself, the mangrove habitat, and the mangrove ecosystem which consists of biophysics and non-biophysics components. At the regional level, the existence of mangroves is associated with coastal areas, which are ecotone between terrestrial and marine areas that are influenced by changes in both terrestrial and marine, including sea waves, tidal, and sedimentation. Furthermore, the mangrove ecosystem is closely related to the surrounding ecosystem, in particular seagrass and coral reefs.

Mangrove ecosystem typology

Based on geomorphology, there are at least four types of mangrove ecosystems, those are delta, estuary, lagoon, and island, which can be more detailed based on ecological characteristics including hydrology and topography. These mangrove characteristics implicate ecosystem services as well as limiting factors that must be considered in their use.

Delta-type mangroves are formed due to the presence of large amounts of sediment carried by rivers that flow into the sea which are retained and deposited by the roots of the existing mangrove and become wider to form extensive mudflats and deltas. Estuary-type mangroves grow along muddy rivers, whereas the mud beds formed by waves or rivers are generally associated with the fertility of mangrove areas and support a vast

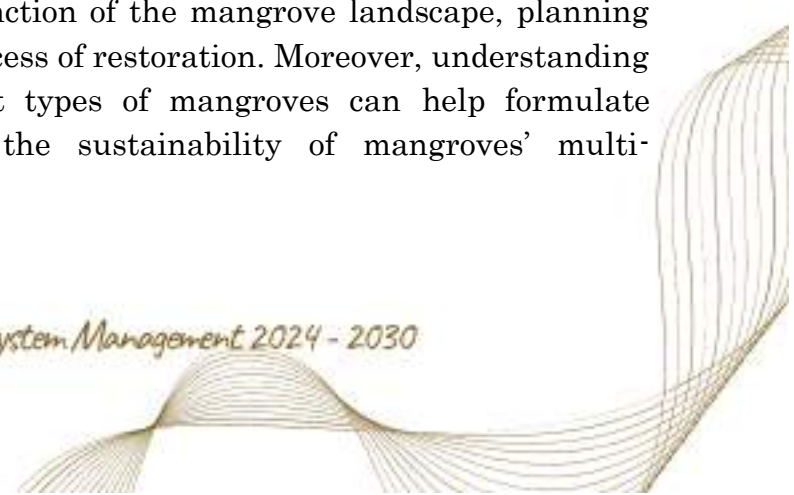



diversity. Lagoon-type mangroves grow in coastal areas protected from big waves by islands or coral reefs as barriers, not directly facing the ocean. Island-type mangroves are found on many islands that are protected from big waves and spread evenly in groups of islands.

The classification can also be defined based on physical processes which include three extreme types, namely tide-dominated (fringe), river-dominated (riverine), and interior mangroves (basin). Intermediate types can be included in this categorization system. Fringe mangroves grow as a thin layer along the coast and are most influenced by tides and sea waves, as well as winds and storms. This type of mangrove does not get abundant amounts of nutrients because it continues to be washed by high and low tides every day. Mangrove height ranges from 10-12 m. Riverine mangroves receive inundation from river water and tidal water from the sea so that their salinity is moderate. This type is the most productive mangrove, with mangrove trees reaching a height of 35 m. Mangrove basins generally cover large areas behind fringe and riverine mangroves. This mangrove only occasionally gets inundated with seawater. Salinity can vary greatly. Soil with high salinity can be found at high elevations with high evapotranspiration processes which cause salt accumulation, whereas in places with high rainfall or frequent floods, the salt content can be moderate or even low.

These mangrove types clearly show differences in productivity, hydrology, and nutrient cycles. Productivity is closely correlated with water exchange movements. Water exchange affects increasing the supply of nutrients, clay, and mud, reducing the accumulation of toxic substances, and increasing aeration. The order of productivity is river-dominated > tide-dominated > basin-dominated, so the carbon absorption capacity is also different for different types of mangroves.

In terms of the landscape, the main functions of these types of mangroves are different. Fringe mangroves are essential for shoreline protection; riverine mangroves are optimal for wildlife habitat and fish protection; while basin mangroves play a role in absorbing nutrients and purifying pollutants. However, wood utilization often occurs in basins due to consideration of the homogeneity of the species and the lack of wetting which makes this type of business more economical. Recognition and mapping of these mangrove types in the field is important for zoning the function of the mangrove landscape, planning rehabilitation action, and assessing the success of restoration. Moreover, understanding the importance and best use of different types of mangroves can help formulate management policies that can ensure the sustainability of mangroves' multi-functionality.





Landscape conditions related mangrove ecosystem dynamics

The causes of deforestation are mainly human activities, which cover 60% of the lost mangrove area. The remainder is caused by natural factors or indirect impacts from human activities, including erosion, sea level rise, and storms triggered by climate change. The impacts of the factors of mangrove ecosystem degradation vary per country. In countries with major fishing industries such as Thailand, Indonesia, Philippines, and Vietnam, conversion of mangroves to aquaculture is a major pressure of mangrove loss (GMA, 2021 in KLHK, 2021).

Land-use changes for various purposes (housing, industry, trade, commodity cultivation, transportation, and infrastructure) continue to occur in line with population growth, technological advances, changes in consumption patterns, and the demand of the commodity market. However, the availability of land is limited, particularly land that is related to mangrove habitats. The area of mangroves in the world is only 1% of the total land area of the earth's surface, but have a significant role in maintaining the balance and productivity of the environment's carrying capacity. Land-use changes in the mangrove affect ecological balance, soil fertility, biodiversity, and stability of the coastal areas.

The dynamics of these changes can be studied through comprehensive land systems knowledge, which needs an understanding of the complexity of the land process. The land system represents the relationship between human activities on land, socio-economic conditions, the natural environment, and the system that regulates these interactions. The land system combines the concepts of land use (all activities, arrangements, and inputs related to land use) and land cover (physical characteristics of land that can be identified from earth observations).

Changes in land systems occur as a result of decision-making at various scales, from local landowner decisions to national-scale land use planning. The aggregate of many local land systems changes has far-reaching consequences for the earth system providing feedback on ecosystem services, human well-being, and subsequent decision making. It has been realized that land use in areas that constitute mangrove ecosystems provides economic benefits, but at the same time causes negative impacts in the form of decreasing the quantity and quality of mangrove ecosystems.

Regulating mangroves with a comprehensive approach is important to balance various interests. The concept of land systems can be used to analyze various factors and actors, interactions between factors, changes, and design of conservation or rehabilitation framework that is also able to leverage the strengthening of protection and management

efforts. The initial step in management is usually related to the division of space through the provision of spatial boundaries to the land within which management practices can or cannot be carried out. This spatial arrangement requires bio-geo-physical attributes of the terrestrial component. In this context, mangrove ecosystem management requires a landscape approach to accommodate and regulate various interests.




Figure 2. Variety of community activities

Climate change-related mangrove ecosystem dynamics

Mangrove forests are important carbon sinks, and this is especially true for Indonesia where about 24% of the world's mangroves exist. Unfortunately, vast expanses of these mangroves have been deforested, degraded, or converted to other uses resulting in significant greenhouse gas emissions. A study has been done to quantify the climate change mitigation potential of mangrove conservation and restoration in Indonesia. We calculated the emission factors from the dominant land uses in mangroves, determined mangrove deforestation rates, and quantified the total emissions and the potential emission reductions that could be achieved from mangrove conservation and restoration.

Based on the analysis of the carbon stocks and emissions from land use in mangroves it is found that: (1) Indonesia's mangrove ecosystem carbon stocks are among the highest of any tropical forest type; (2) mangrove deforestation results in greenhouse gas emissions that far exceed that of upland tropical deforestation; (3) in the last decade the



rates of deforestation in Indonesian mangroves have remained high; and (4) conservation and restoration of mangroves promise to sequester significant quantities of carbon. While mangroves comprise only $\approx 2.6\%$ of Indonesia's total forest area, their degradation and deforestation accounted for $\approx 10\%$ of total greenhouse gas emissions arising from the forestry sector. The large source of greenhouse gas emissions from a relatively small proportion of the forest area underscores the value for inclusion of mangroves as a natural climate solution.

Mangrove conservation is far more effective than mangrove restoration in carbon emissions reductions and an efficient pathway to achieve Indonesia's nationally determined contribution (NDC) targets. The potential emission reduction from halting deforestation of primary and secondary mangroves coupled with restoration activities could result in an emission reduction equivalent to 8% of Indonesia's 2030 NDC emission reduction targets from the forestry sector.

III. Mangrove General Conditions and Management Experiences

Mangrove General Conditions

Mangrove's condition in the ASEAN Region varies per country. In 2000–2012 the mangrove areas and loss in Southeast Asia are as in Table 1 below.

Table 1. Mangrove areas and loss in Southeast Asia 2000 – 2012

Country	Total mangrove in 2000, ha	Mangrove deforestation, ha	Mangrove habitat area lost, ha	Percentage of mangrove loss 2000-2012, %
Brunei Darussalam	11.054	48	41	0.37
Cambodia	47.563	1.218	1.086	2.28
Indonesia	2.788.683	60.906	48.025	1.72
Malaysia	557.805	18.836	15.809	2.83
Myanmar	502.466	27.957	27.770	5.53
Philippines	257.575	1.423	1.296	0.5
Singapore	583	-	-	-
Thailand	245.179	3.504	3.344	1.36
Viet Nam	215.154	531	528	0.25
Timor Leste	1.066	2	2	0.19
Total Southeast Asia	4.626.545	114.424	97.901	2.12

Source: Rates and drivers of mangrove deforestation in Southeast Asia, 2000–2012 (Richards, Daniel R., Friess, Daniel A., et.al. 2015)

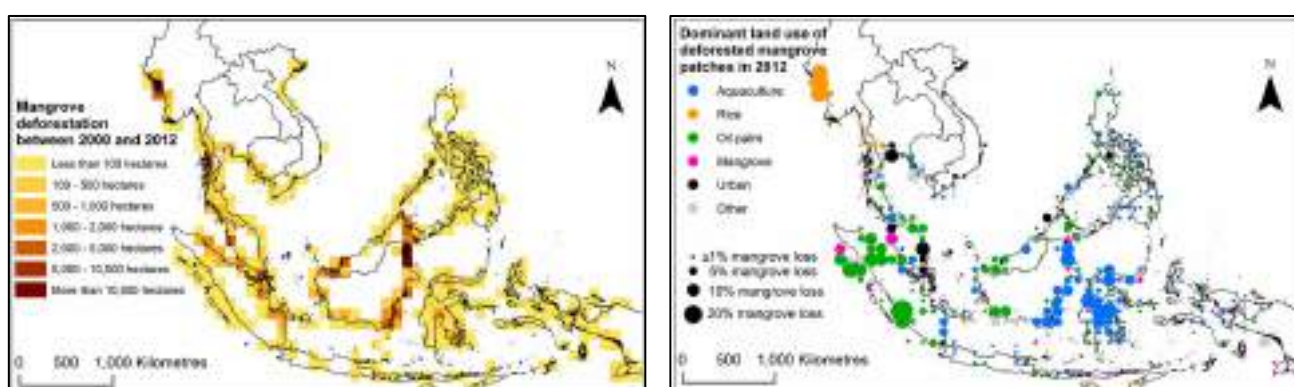



Figure 3. Mangrove deforestation between 2000 and 2012
Source: Richards, Daniel R., Friess, Daniel A., et.al. 2015



FAO estimated the total global area of mangroves in 2020 at 14.8 million ha, of which is nearly 44 percent (6.48 million ha) is in South and (677 thousand ha) was offset by the establishment of Southeast Asia. The mangrove area in 2020 was 2.14 million ha in South America, 2.09 million ha in Western and Central Asia, 1.85 million ha in North and Central America, 1.46 million ha in Oceania, 0.73 million ha in Eastern and Southern Africa, and around 200 thousand ha in Western and Central Asia and East Asia.

According to the study, around half of the total loss of mangrove area between 2000 and 2020 expansion of new mangrove areas was not present in 2000 (393 thousand ha). Thus, there was a net decline in the global mangrove area of 284 thousand ha over the period. The rate of net global mangrove loss slowed between the two decadal periods, with the net loss of mangrove area decreasing by 44 percent between the two periods, from 18.2 thousand ha per year in 2000–2010 to 10.2 thousand ha per year in 2010–2020. Accordingly, the annual rate of mangrove loss globally declined from 0.12 percent in 2000–2020 to 0.07 percent in 2010–2020. Of the regions, Asia accounted for 68 percent of global mangrove area loss in 2000–2010 and for 54 percent of the loss in 2010–2020. Of the global mangrove area gains, 47 percent in 2000–2010 and 54 percent in 2010–2020 were in Asia.

The main direct drivers of mangrove loss globally between 2000 and 2020 were aquaculture development (27 percent) and natural retraction (26 percent), followed by conversion to oil palm (8 percent), rice cultivation (8 percent), and other forms of agriculture (12 percent). The significance of aquaculture as a driver of mangrove area loss declined between the two decadal periods (from about 31 percent in 2000–2010 to 21 percent in 2010–2020), but the importance of conversion to oil-palm plantations increased substantially (from about 4 percent in 2000–2010 to 14 percent in 2010–2020), mostly in Southeast Asia. Natural expansion accounted for 82 percent of all gains in mangrove areas between 2000 and 2020 and restoration for the rest.

In South and Southeast Asia, the main driver of mangrove loss between 2000 and 2020 was aquaculture, accounting for 35 percent, followed by natural retraction (17 percent). Conversion for rice cultivation and oil palm plantations was also important, with each land use accounting for 13 percent of the loss.

The findings of this study have important implications for future work in conserving, restoring, and sustainably managing mangroves, including the following:

- In Southeast Asia, the subregion with the largest extent of mangroves globally, efforts to address land-use drivers of mangrove loss should continue, directing

agricultural development to conserve remaining mangrove forests.

- In Western and Central Africa, where a high rate of mangrove loss persisted over the two measurement periods, conversion to aquaculture and various forms of agriculture needs to be addressed by promoting sustainable use and livelihood support.
- Mangrove restoration should be given priority in global, regional, and national restoration initiatives because of their crucial benefits for livelihoods, coastal resilience, and biodiversity conservation.
- Mangrove restoration, sustainable use, and conservation should be further emphasized in nationally determined contributions and climate-change mitigation strategies in general, given the importance of mangroves as carbon sinks and the co-benefits of adaptation and disaster risk reduction.
- Given the ability of mangroves to naturally colonize suitable habitats, mangrove restoration should focus on creating conducive biophysical and social conditions for the re-establishment and growth of healthy mangrove forests.
- The contributions of climate-change impacts to the retraction of mangroves should be monitored carefully because they further expose coastal communities to disasters.

Management Experiences

Brunei Darussalam

Main legal instruments for Forest Management in Brunei Darussalam are:

- Forest Act, Chapter 46, Laws of Brunei: Law for administration of the forests, reservation of forest lands, harvesting of forest produce, stipulating penalties for violations, prescribing forest royalties; and emphasized the importance of biological diversity and benefit sharing, enforcement and forest protection.
- National Forestry Policy: provide planning and management principles and guidelines for the country's forest resources.

Other relevant Legislation <ul style="list-style-type: none"> • Wildlife Protection Act • Land Code and Land Acquisition Act • Antiquities and Treasure Trove Act • Town and Country Planning Act • Wild Fauna and Flora Order 2007 • Fishery Act • Environmental Protection and Management Order, 2015 • Biodiversity Order – in pipeline final stage of drafting 	Policies <ul style="list-style-type: none"> • Forestry Strategic Plan 2020-2022 • Brunei National Climate Change Policy, 2020 • Green Protocol Guideline, 2021 • Brunei Selective Felling System (BSFS) Guideline • National Land Use Masterplan 2006-2025 • Reduced Cut Policy, 1990 • No Logging Policy at Peat Swamp Forest, 2017 	Sub Regional, Regional and International Involvement <ul style="list-style-type: none"> • ASEAN Forestry Meetings • APEC SOM EGILAT Meeting • Heart of Borneo Initiative • Convention on Biological Diversity • Convention on International Trade in Endangered Species of Wild Fauna and Flora • United Nations Forum on Forests • United Nations Framework Convention on Climate Change
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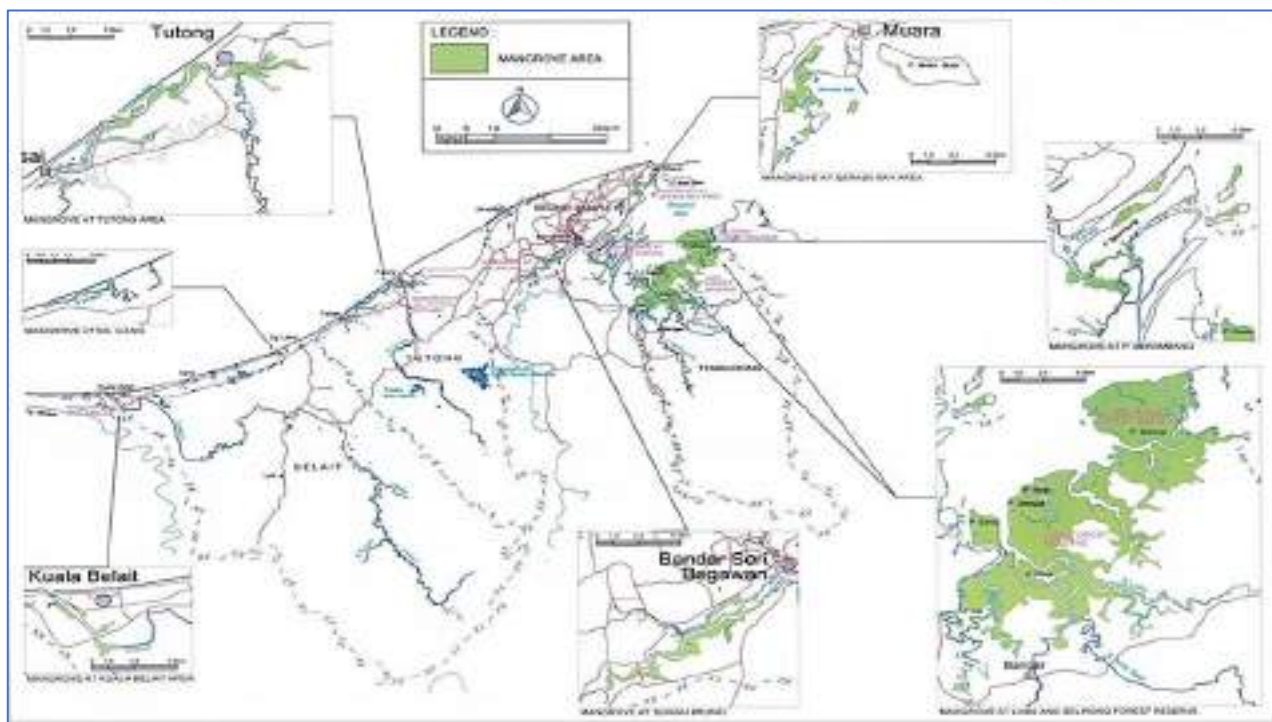


Figure 4. Major mangrove forests in Brunei Darussalam

Mangrove Forest Types	Dominant Plant Species
'Bakau' Forest	Bakau Minyak or <i>Rhizophora apiculata</i>
'Nyirih Bunga' Forests	Nyirih Bunga or <i>Xylocarpus granatum</i>
'Lenggada' Forests	<i>Bruguiera gymnorhiza</i>
'Nipah' Forests	Nipah or <i>Nypa fruticans</i>
'Nipah-Dungun' Forests	Nipah palms with 'dungun' or <i>Avicennia glaberrima</i>
'Padada' Forests	Padada or <i>Sonneratia caseolaris</i>
'Mabong' Forests	Mabong or <i>Gracilaria tikvahiae</i>



Bakau Minyak or *Rhizophora apiculata*



Nipah or *Nypa fruticans*



Padada or *Sonneratia caseolaris*

Figure 5. Mangrove forest types in Brunei Darussalam



Flower of pedada (*Sonneratia alba*)



Close-up of fruits of *Rhizophora mucronata*



Fruits of Nyireh Merah (*Xylocarpus granatum*)



The fruits of Api-Api (*Avicennia alba*)

Figure 6. Mangrove flora in Brunei Darussalam



(1) Proboscis Monkey / Bangkai, *Nasalis larvatus*
Source: Forestry Department, Brunei Darussalam, 2014
Photographer: Haji Zulkifli bin Haji Abd Lurah



(2) King's Pit-Viper, *Trachocercus wagleri*
Source: Forestry Department, Brunei Darussalam, 2014
Photographer: Haji Firdaus bin Mamat



(3) Lizard, *Agkistrodon*
Source: Forestry Department, Brunei Darussalam, 2014
Photographer: Haji Rahim bin Haji Naser



(4) Tree Lizard
Source: Forestry Department, Brunei Darussalam, 2014
Photographer: Haji Rahim bin Haji Naser

Figure 7. Mangrove fauna in Brunei Darussalam



Figure 8. Others mangrove fauna in Brunei Darussalam



Figure 9. Social and environmental values of mangrove ecosystem in Brunei Darussalam

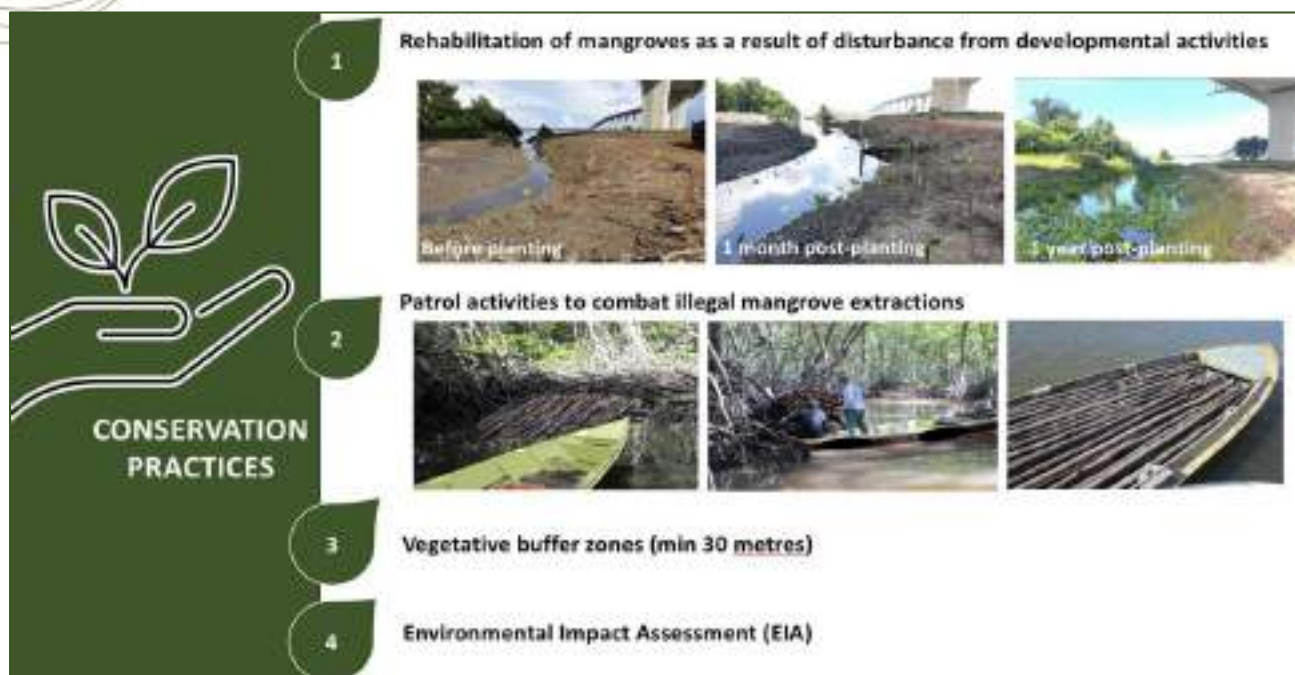


Figure 10. Conservation practices for mangrove ecosystem management in Brunei Darussalam

Implementation of mangrove ecosystem management in Brunei Darussalam is facing some challenges, among others: resources capability (planting techniques and manpower), land use conflicts (conservation efforts versus development needs), and climate change impacts (sea level rise and biodiversity loss).

For addressing the challenges, the recommendations are:

- Strengthen regional cooperation on mangrove management through sharing of best practices and lesson learnt among AMS, and
- Capacity building and training activities related to mangrove management.

Cambodia

Fishery Administration (FiA) of the Ministry of the Agriculture, Forestry Fisheries (MAFF) and Ministry of Environment (MoE) has estimated that 58,852 ha located in 04 provinces (Koh Kong, Preah Sihanouk, Kampot and Kep) of land cover in Cambodia are covered by mangrove forests in 2015. Mangrove forests are vital feeding and nursery habitats for many fish species, and act as coastal protection for the many communities living along Cambodia's coastline.

Table 2. Total area of mangrove, coral reef and seagrass in Cambodia

Province	Coral reef	Seagrass	Mangrove
Koh Kong	576,36	1.496,86	46.529
P Sihanouk	627,23	836,58	9.352
Kampot	611,23	5.158	1.966
Kep	67,83	6.399	1.005
Total	2.882,65	13.890,44	58.852

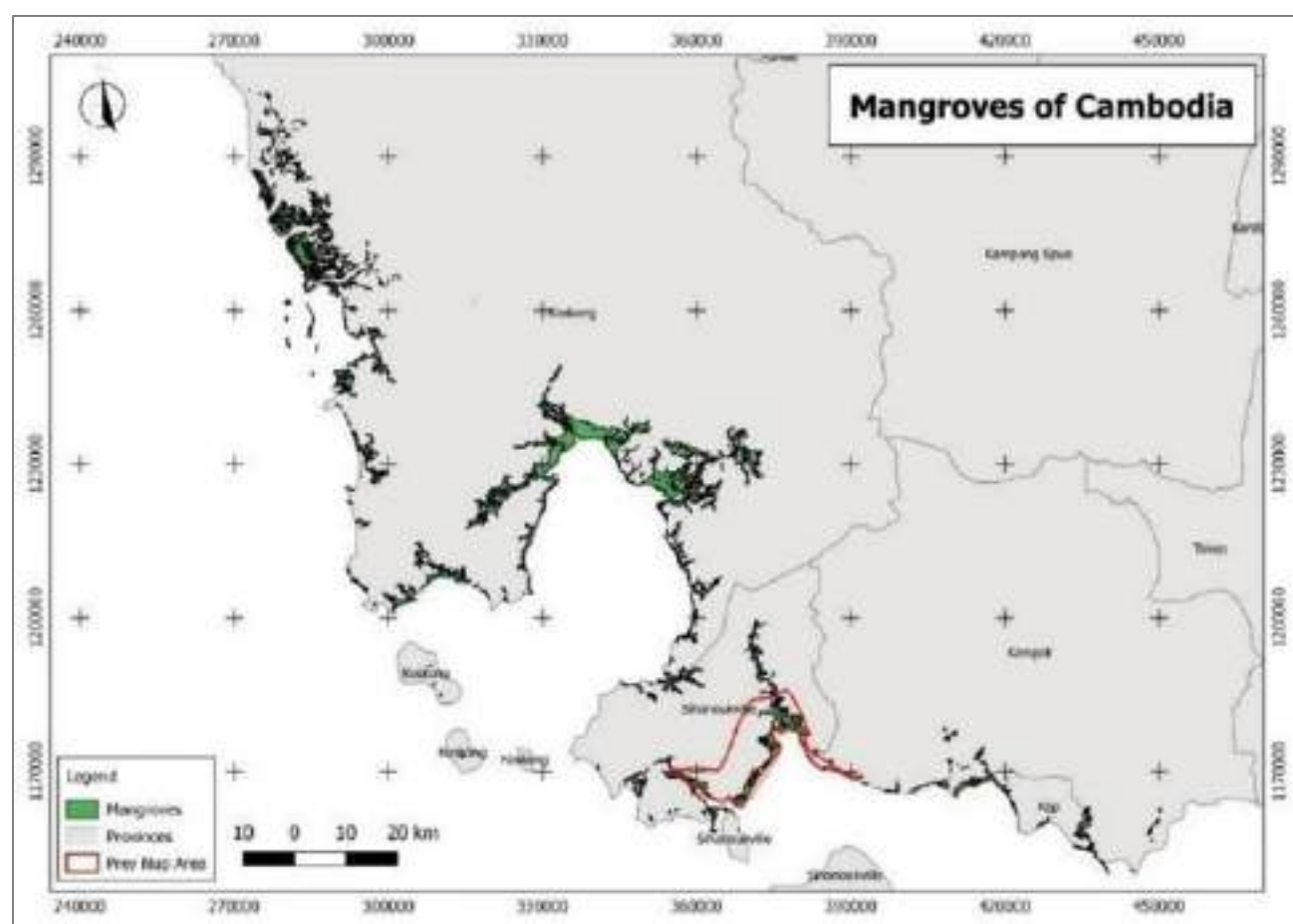


Figure 11. Cambodia's Mangrove Map

Main Drivers of Mangrove Deforestation in Cambodia:

- Agriculture and aquaculture farming and land expansion
- Infrastructure development of coastal area
- The impact of climate change
- Unsustainable harvesting and use of mangrove forests
- Land development from private investment.

Mangrove Management Strategy in Cambodia:

- Cambodia has been established 5 National Marine Fisheries Management areas and 44 Coastal Community Fisheries established to manage the marine resources including mangrove
- Some Key Actions are included:
 - Strengthening of Community Fisheries management and development
 - Livelihood improvement and law enforcement
 - Zoning and Demarcation (Land tenure registration)
 - Carbon financing
 - Ecotourism

Proposal from Cambodia for the Regional Cooperation is:

- Promote regional collaboration platform between AMS to ensure sustainable mangrove resources management
- Strengthen forest law enforcement and governance
- Develop nature-based solutions to address the adverse impacts of climate change
- Enhance social-economic fisheries community around Mangrove forest Area.

Indonesia

Concerning the high ecology and socio-economic value of mangrove ecosystems, including the high capacity of carbon sequestration and stock, mangrove conservation and rehabilitation become an important program in Indonesia, in particular to achieving the Nationally Determined Contribution of climate change mitigation and adaptation through Forest and Other Land Use Sector. This commitment has become one of Indonesia's flagships in the G20 Presidency Indonesia 2022, The Leaders of G20 planted the mangrove trees together, as a symbol of joint effort in facing climate change and other related environmental challenges.

Based on the National Mangrove Map 2023, Indonesia has 3.44 million hectares of mangroves, which are spread around the country, in all provinces. Indonesia's mangrove area is 23% of the world's mangrove area. Besides the existing mangroves, potential habitats for mangroves are also identified, which will be assessed in more detail to be the target of mangrove rehabilitation. Indonesia determines Mangrove Landscape Units to identify mangrove areas.



Figure 12. Indonesia's National Mangrove Map 2023

Indonesia has 202 types of mangrove species, of which 43 of them are original species, and the others are associated with mangroves. The mangrove tree itself is the biodiversity. Furthermore, the mangrove ecosystem species is home to several species of fauna. In Indonesia, there are 119 species of fauna associated with mangroves, including gastropods, bivalves, crustaceans, mammals, reptiles, amphibians, and birds. Besides that, there are 1.914 mangrove-related genetic sources surrounding Indonesia.

From this view of socio-economic, the mangrove ecosystem is closely related to community livelihood, which increases the productivity of fisheries such as fish, shrimp, and crab; and can provide derivative products of mangroves such as chips, crackers, syrup, raw materials for skin care; and very good views place for ecotourism with some attractions such as mangrove exploration by booth and canoe.

Indonesia has a strong commitment to mangrove conservation and restoration. From 2019 to 2023, Indonesia, through several funding sources, has rehabilitated around 70 thousand hectares of mangrove, and in 2024-2025 Indonesia will rehabilitate a large-scale mangrove area with targets of 600.000 hectares. The mangrove rehabilitation program is not only for planting mangrove trees but also for enhancing community awareness and capacity to be involved in the efforts and have socio-economic benefits. For that, community engagement and empowerment including through field school is an

important part of the program. Some examples of implementing this are through the development of silvofishery, ecotourism, and some derivative products of mangroves.

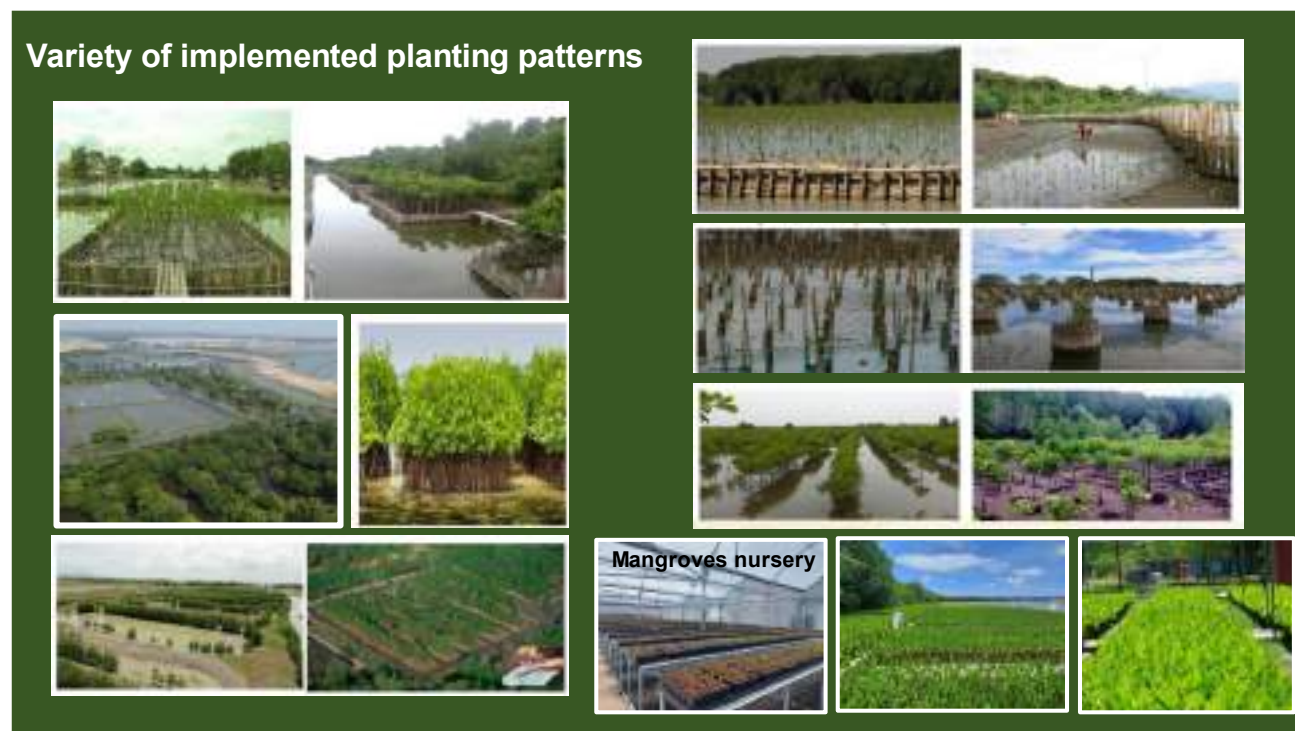


Figure 13. Variety of implemented planting patterns concerning bio-physic conditions and socio-economic function

To strengthen mangrove protection and management, Indonesia developed governance of the mangrove ecosystem for climate resilience, environmental sustainability, socio-economic benefits, and technological development, through among others:


- a. Establishing National Agency on Peatland and Mangrove Rehabilitation;
- b. Formulating a Roadmap of mangrove rehabilitation, which guided three stages: preparing enabling conditions, implementation of action, and sustainability;
- c. Issuing updated National Mangrove Map;
- d. Enhancing scientific-based assessment, policy, and guideline on mangrove ecosystem health and its sustainability;
- e. Developing policies for managing mangroves that emphasize integrated planning, environmental degradation control, community engagement and empowerment, collaboration, compliance, and law enforcement;
- f. Establishing profile of each mangrove's Landscape Management Unit consists of bio-physics and socio-economic conditions, and recommended action plan
- g. Formulating Mangrove Ecosystem Protection and Management Plan at National and Sub-national levels;

- h. Internalizing the management into spatial planning and zoning regulation;
- i. Establishing national and sub-national task forces for mangrove management;
- j. Enhancing certainty of land tenurial states;
- k. Enhancing community awareness and education, community engagement and empowerment, and mangrove-related community livelihoods and socio-economic benefit;
- l. Developing database and information system;
- m. Implementing intensive monitoring;
- n. Enhancing collaboration among stakeholders;
- o. Guiding the implementation of environmental degradation control of mangrove ecosystem, consisting of preservation, countermeasures, and restoration;
- p. Guiding the implementation of inspection, compliance, and law enforcement regarding mangrove ecosystem protection and management; and
- q. Developing a mechanism for taking the mangrove landscape context into the carbon scheme.

All of the efforts are carried out by the government of Indonesia and jointly through international cooperation.



Figure 14. Success story of mangrove ecosystem conservation and restoration



At the global level, Indonesia proposed the UNEA Resolution on Sustainable Management for Global Health of Mangroves, which was adopted at the UNEA 4 in Nairobi, in 2019. Furthermore, the Government of Indonesia initiated the establishment of the World Mangrove Center in 2021, as a center of excellence and information hub of knowledge and management regarding mangrove ecosystems. The establishment of the World Mangrove Center is an effort to frame the complexity of mangrove management, including restoring damaged mangroves and developing a global movement in conservation, restoration, and sustainable mangrove management. Indonesia's commitment to establishing the center can strengthen regional strategies in mangrove ecosystem management and on the other hand, can also promote the center more widely through the role of ASEAN.

Malaysia

The mangrove forest in Malaysia is the second largest wetland forest in the country, covering a total size of 629,038 hectares (as of 2017), approximately 1.9% of the country's land area. Most of Malaysia's mangroves are located in East Malaysia, with 60% found in Sabah, spanning an area of 378,195 hectares, and 22% in Sarawak, covering 139,890 hectares. Peninsular Malaysia (West Malaysia) contains around 18% of the total area of mangroves, which amounts to 110,953 hectares. The mangroves are predominantly located along the western coast of Peninsular Malaysia, the western coast of Sarawak, and the eastern coast of Sabah (Hamdan and Muhamad Afizzul, 2020). It is recorded that Malaysia is home to around 36 mangrove species (Honculada-Primavera, 2000).

The primary use of mangroves in Malaysia, particularly in the peninsular region, is predominantly for the manufacturing of charcoal from wood. According to historical records, the Matang Mangroves in Perak have been renowned for their charcoal production since the early 20th century. This reputation was established with the publishing of the Matang Working Plan by A.E. Wells in 1904, which aimed to control timber production specifically for charcoal purposes (Shaharuddin et al., 2005). A proper 10-year working plan was produced in 1930 but discontinued due to the Second World War. Since 1952, the Perak State Forestry Department has been responsible for creating a 10-year rotation working plan, which continues to be in effect (Mohamed Zin and Nor Lokman, 2021).

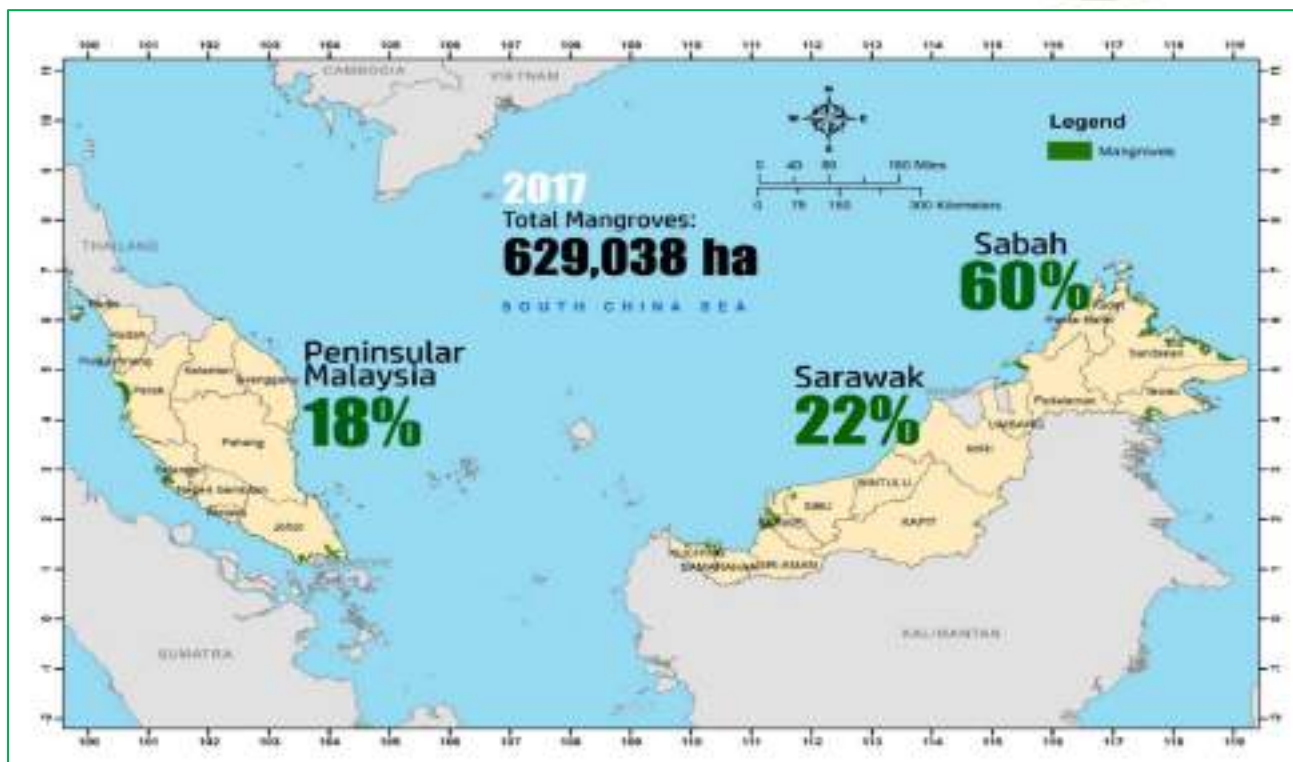
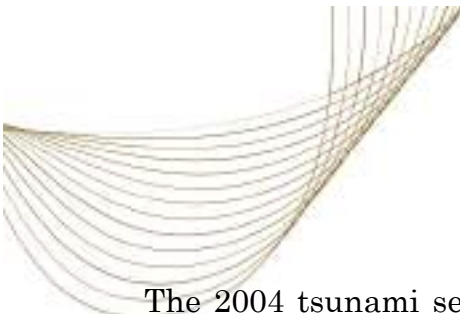


Figure 15. Distribution of mangroves in Malaysia for 2017
Source: Hamdan and Muhamad Afizzul, 2020

According to the Guidebook on Preparing Mangrove Forest Management Plan for the States in Malaysia (NRE, 2016), mangroves have multiple applications beyond wood production. These uses can be categorized into six primary categories as follows:

- (i) forestry for wood and charcoal products;
- (ii) socioeconomics which involves people who rely on the mangrove forest for their livelihood;
- (iii) ecotourism such as for bird watching;
- (iv) fisheries;
- (v) food that can be generated from by-products of mangroves; and
- (vi) research and development conducted by research institutions.

The extensive depletion of mangroves predominantly took place in places outside of the permanent reserved forests (PRF), particularly in regions designated as state land forests. These regions have been designated as land banks for state development projects and are part of the State Structural Planning. Mangrove coverage in Malaysia declined from 650,311 ha in 1990 to 629,038 ha in 2017, resulting in a total loss of 21,274 ha, or 3.3% (Hamdan and Muhamad Afizzul, 2020).



The 2004 tsunami served as an eye-opener and clearly demonstrated the necessity of enhancing coastal protection through increased vegetation. In Malaysia, it is observed that areas with thick mangrove vegetation survived or having less damage than otherwise (Keizrul et al, 2005). Thus, the Malaysian Cabinet on 26 January 2005 decided to improve the country's programme for rehabilitating and protecting the coastline and introduced a nationwide coastal tree planting program with mangroves and other suitable coastal species. As of 2023, nearly 7,952,431 seedlings of mangroves and other coastal species have been planted, covering an area of over 3,461.64 hectares along the coast of Malaysia.

Myanmar

Myanmar's forest cover is 42,195 of the country's area, while 0,66% of the country's area, or 448,480 ha is mangrove forest (FRA, 2020 in Maung Aye, Win, 2023). Mangroves in Myanmar are the eighth largest mangrove extent in the world, which has 34 original mangrove species and 148 associated mangrove species. Major issues and threats to Myanmar's mangroves are land use change due to human settlement, rice field encroachment, and shrimp farming, whole degradation of the mangrove ecosystem is occurred due to charcoal production and fuel wood cutting (Maung Aye, Win, 2023).

Myanmar is applying mangrove management as a part of forest management through ecosystem-based approaches, with 3 major focuses:

1. Protection and extension of existing Reserved Forests Protected Public Forests,
2. Designating the Protected Areas (Pas) and establishing PA Networks across the country, and
3. Restoration of natural habitats and forest ecosystem.

The Strategy of Mangrove Management in Myanmar is:

1. Marine Protected Area Development,
2. Constitution of Permanent Forest Estates, and
3. Restoring the mangrove ecosystems.

Some implementations of the mangrove management are:

1. Green Belt Project in the Mottama Gulf of Yangon Region,
2. Mangrove Protection Measures in Myeik/Mergui Archipelagos, and
3. Myanmar Reforestation and Rehabilitation Programme (2017-2027).



Figure 16. Community participation and public awareness in Myanmar
Source: Maung Aye, Win, 2023

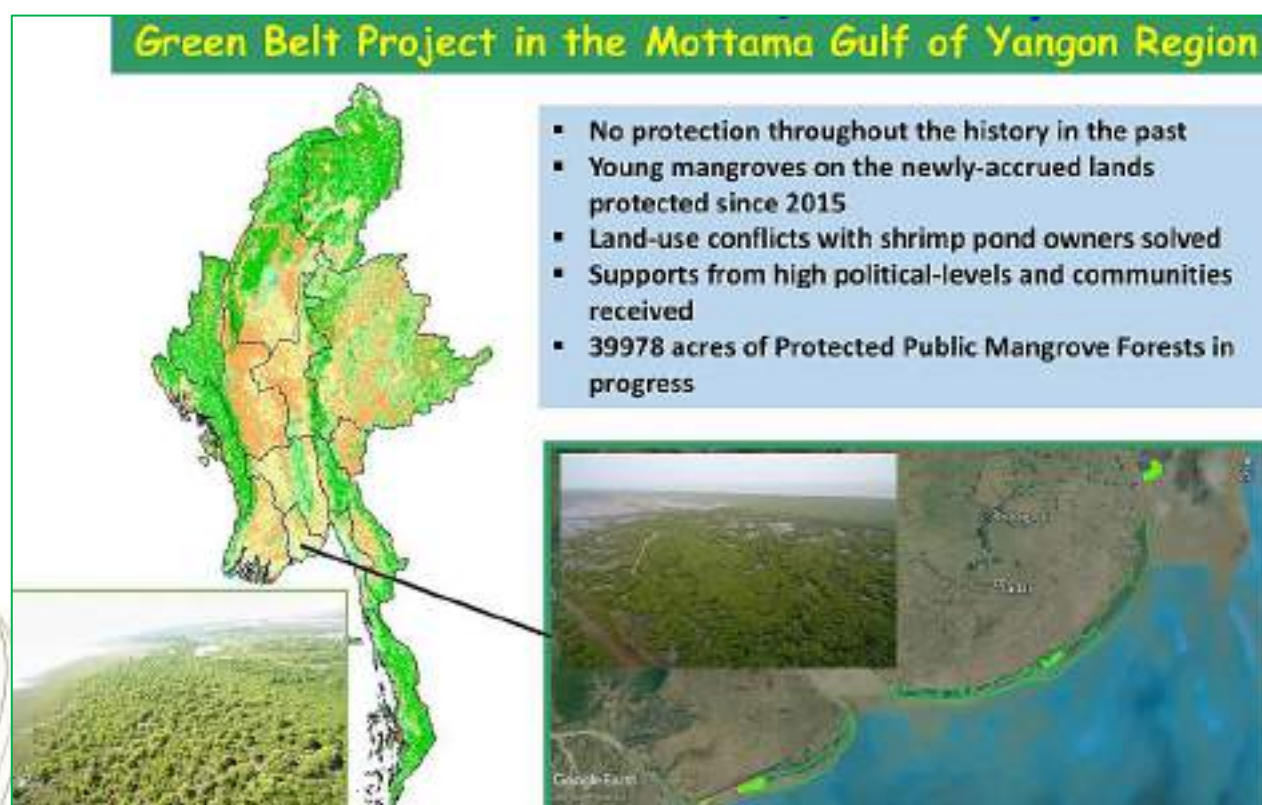


Figure 17. Green Belt Project in Myanmar
Source: Maung Aye, Win, 2023



Figure 18. Mangrove Planting in Myanmar
Source: Source: Maung Aye, Win, 2023

In the context of mangrove management, Myanmar also implements Nature-based Mangrove Restoration, Integrated Coastal Management, and some collaboration efforts. The collaboration efforts are implemented in Protected Area Management (for primary mangroves and biodiversity conservation), Mangrove Restoration (for degraded mangrove areas and newly accreted lands), Research, Capacity Building, Community Forestry and Rural Development, and Public Awareness and Community Extension.

Philippines

Philippines has a great experience in large scale rehabilitation of mangrove ecosystem management, through the National Greening Program as a massive reforestation program by the government that seeks to plant 1.5 billion trees on 1.5 million hectares of land within 6 (six) years from 2011 to 2016.

In 2015, the Government issues EO No. 193, expanding the coverage of the NGP to cover all remaining unproductive, denuded, and degraded forests with its period of implementation also extended from 2016 to 2028.



Figure 19. The restoration area at Aringay, LA Union, Philippines

There are plenty of large grasses and weeds in the area at Aringay, LA Union, previously. In 1990, the Philippines is experienced an earthquake at 7 intensity level.



Figure 20. The Coastal area that experienced typhoon along the shore with a high tide

The Philippines National Greening Program started in 2011, with the establishment of plantations, and involvement of thousands of communities that called local folks. After the greening program, the mountains are improved, the coastal are restored, and the weather is getting better. When the typhoon comes, the mangroves act as a barrier. The area also become a tourism area where the communities happy to meet the tourists. The National Greening Program has proved that it can reduce floods. Through the program, Multi-Purpose cooperative was formed among all relevant stakeholders.



Figure 21. Mangroves at the coastal area of Philippines

The program also increased involvement of Youth, where they can have activities at the forest and mangroves area, and it can enhance their awareness on the importance of the forest and the mangroves. The Youth also conduct an information campaign Program, enhancing all parties involvement in the climate change mitigation and adaptation effort.



Figure 22. Farmers activities for the forest and mangrove rehabilitation



Figure 23. Youth and child activities at the forest and the mangroves area

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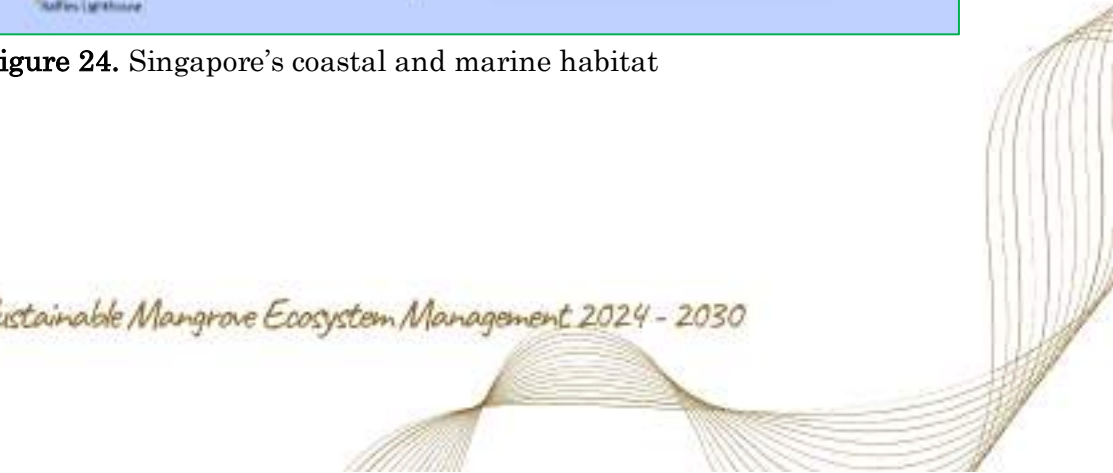



Figure 24. Singapore's coastal and marine habitat



Singapore's first ASEAN Heritage Park, the Sungei Buloh Wetland Reserve (SBWR), is a legally gazetted nature reserve for the conservation of 130 hectares of mangrove forests, mudflats, ponds, and its associated fauna. To enhance protection of the Reserve, strengthen ecological connectivity across habitats, and provide new opportunities for research and education, a variety of complementary wetland habitats surrounding the Reserve is also conserved as the Sungei Buloh Nature Park Network (NParks, 2021). However, mangroves in Singapore remain susceptible to environmental threats such as rising sea levels and erosion. To further protect these vulnerable mangroves, Singapore adopts hybrid eco-engineering interventions that prevent mangroves from being eroded, as well as coastal protection designs and structures that aim to promote mangrove establishment and accrete sediment (Tan et al., 2022; Yang et al., 2013; Friess, 2017). The National Parks Board also collaborates with researchers to better understand the impacts of climate change on mangroves and develop solutions to improve long-term climate resilience.

This comprehensive map depicts the extent of Singapore's diverse and spatially heterogeneous coastal and marine habitats including mangroves, forming an important reference point for multiple applications. Amid constrained land availability, knowing the spatial, extent, distribution, and temporal dynamics of key habitats is essential to guide land-use planning decisions, effective conservation and restoration, as well as quantification and maximization of ecosystem services derived from coastal habitats (Tan et al., 2022).

Thailand

In Thailand, there are mangrove forests along the coastal areas. They play a major role in the ecosystem. They also protect the coastal environment by reducing the ion and the striking of heavy waves and strong winds along the coast. Moreover, mangrove forests have numerous benefits for the local communities of the coastal areas. Therefore, they play an important role not only for humans but also for the biological systems.

Mangrove areas significantly declined during 1961-2007 because of the invasion. The main reason of the invasion was primarily to over exploit the resources for the production of mining, charcoal. Later, shrimp farming became the main cause of invasion. The government of Thailand promoted semi-intensive and intensive shrimp production. That policy rapidly reached to the coastal areas. Consequently, Thailand became the third largest exporter of seafood around the world and also one of the major shrimps producing countries of the world.

As a result, the mangrove had declined as well as impaired the mangrove ecosystem also deteriorated which the loss of areas for mangrove forests accounted for 50-60% during 1961-1996. According to the data from Department of Marine and Coastal Resources (DMCR) under the Ministry of Natural Resources and Environment (MNRE), the mangrove plantation areas across the whole country have decreased dramatically from 1961 to 1996. In 2000, the mangrove forest areas increased about 1.5 times within four years. And then, the coverage of mangrove forest area has increased steadily.

From the satellite images interpretation in 2023, Thailand can maintain the primary mangrove forest cover at 275,200 ha across the country which are mainly distributed in 23 provinces along the 3,151 km of two coastal zones of southern Thailand. Among the mangrove forests, composition of other resources can be classified into 23,869 ha of coral reefs, 25,700 ha of seagrass, 7,543 of beach forests, and 5,942 of peat swamps. Up to the present, DMCR has set up its policy to maintain the 0.27 m ha of protected mangrove forests while rehabilitating 48,000 ha of degraded mangrove forest that used to be deteriorated by human activities.

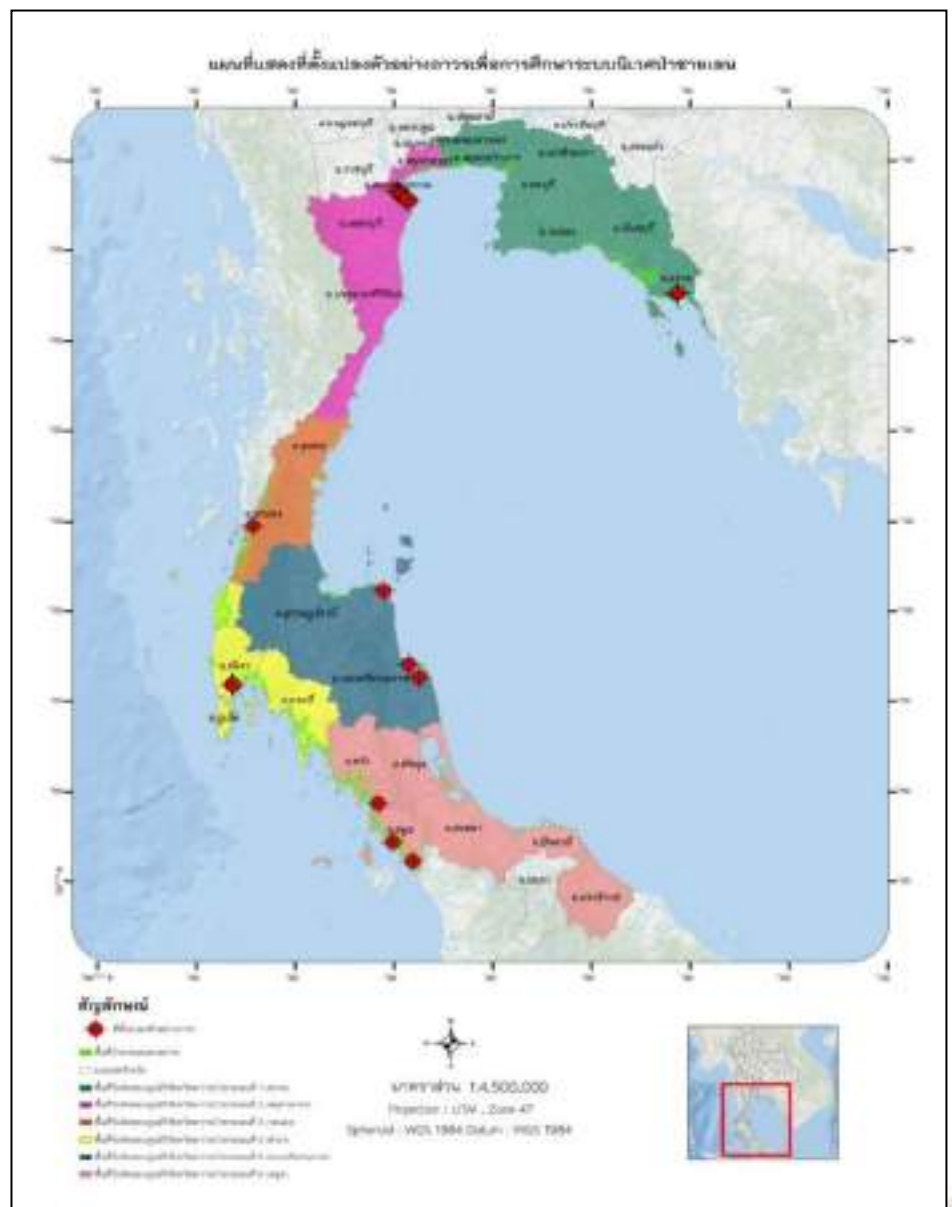


Figure 25. Distribution of Mangrove Forests in Thailand

Moreover, carbon credit offsetting program has launched under Thailand Voluntary Emission Reduction (T - VER) of 10-year plan (2022-2031). Meanwhile, DMCR has promoted the economic mangrove tree species to be planted within the private lands which is now 49 farmers has joined the program covering approximately 95.5 ha.



Figure 26. Thailand's mangrove ecosystem

To solve the problem of degraded of mangrove resource, the Government of Thailand has set up the policy on mangrove and coastal ecosystem management. The Cabinet Resolution approved the policy for the Enhancement and Conservation of Environmental Quality submitted by the National Environmental Board on November 26, 1996. The main purpose of that policy is to maintain the mangrove conservation areas not less than 0.16 million hectares and also for the conservation and rehabilitation of all coastal resources. Also, the DMCR act was enacted in 2015 to ensure the sustainable management of mangrove forest in Thailand. According to the DMCR, there are 0.27 million hectares of protected mangrove areas. The effective control and management would be performed to maintain the environment which can affect the coastal areas. At the present, Thailand by the DMCR supports the community based natural resources management which is considered to be a sustainable way in conserving the local natural resources.



Figur 27. Media to support mangrove forest conservation

The implementation of the community-based natural conservation (CBNC) can prevent the negative impacts on the ecosystem surrounding the affected areas caused by human activities and make a strong authority to the local community. Regarding the main fundamental rule of CBNC, local people who have the knowledge about the environment and ecological management are preferred to participate through the whole management process of problem identification, setting up the objectives to make the alternative plan, making planning decisions, implementation, and outcome monitoring. Regarding with this, community-based resource management was firstly practiced in Thailand about 15 years ago in terms of an alternative way for economic, state-oriented and scientific forestry. It is also bottom-up organizations and the government sector motivated various stakeholders to involve in the natural resources management at both national and community levels.



Figure 28. Mangrove restoration in Thailand

So far, the local communities become more aware of the conservation and utilization of mangroves. The participation of stakeholders through the conservation process becomes more acceptable. As soon as the local communities become aware of the causes of mangrove forests degradation and the various advantages of mangrove rehabilitation as well, they become willing to participate in the coastal ecosystem conservation process. According to the record, DMCR has supported the establishment of Mangrove Forests for Community Project which has 98 communities joined the program covering 25,766 ha in 10 provinces. Moreover, the government sectors (DMCR) established a system of learning centers by collaborating with local communities and others. This learning center focuses on educating the local communities about the role of mangroves and provides the technical information about rehabilitation and conservation. To understand the needs of the local communities, DMCR and the Thai network held the annual meeting regularly. However, there are still challenges in maintaining the ecosystem along coastal areas such as waste water discharge and accumulation of heavy metals. Meanwhile, the impacts from climate change to human and ecosystems should also be concerned.

Vietnam

Viet Nam has a coastline of more than 3,260 km, located in 28 coastal provinces and cities with a population accounting for 30% of the country's population. This area, due to the impact of climate change, is often exposed to many risks and damage from rain, wind, storms, floods, and saltwater intrusion; People's lives, especially the poor and vulnerable, face many difficulties.

The total coastal forest area: 162,000 ha, following different forest types:

- (i) Special use forest: 11,000 ha
- (ii) Protection forest: 89,000 ha
- (iii) Production forest: 62,000 ha



Figure 29. Common distributed mangrove species in Vietnam

Common distributed mangrove species in Vietnam are *Rhizophora*, *Bruguiera*, *Kandelia*, and *Sonneratia*. The biodiversity consists of 517 species of floating plants; 468 species of zooplankton; 450 species of benthic animals; 516 fish species; 77 species of migratory birds; 28 species of animals; and 54 species of reptiles.



Figure 30. Mangrove species and fauna in Vietnam

Mangrove restoration in Vietnam from 2015 to 2022 consists of 22,390 ha new planting, and 4 million scattered trees.



Figure 31. Mangrove restoration in Vietnam

Agro-forestry- fishery production and livelihood activities involve Forest co-managers: Dong Rui (Quang Ninh); Xuan Thuy Nam Dinh); Au Tho B (Soc Trang); and Dat Mui, Tam Giang (Ca Mau). The model of agro-forestry-fishery is a combination of beekeeping, chicken feeding, sea ducks, shrimps, crabs, fish in mangrove forests, supporting net making for local people, etc., that are implemented in Nam Dinh, Thanh Hoa, Quang Nam, Quang provinces Ngai, Ca Mau. Eco-shrimp farming is implemented in mangroves in Ca Mau Province.



Figure 32. Agro-forestry- fishery production and livelihood activities in Vietnam

IV. Strategic Issues

Concerning the condition and dynamics of the mangrove ecosystem in the ASEAN Region, strategic issues of mangrove ecosystem management in the ASEAN Region can be formulated as below:



1. Scattered data, information, knowledge, skills, and experiences of mangrove ecosystem management and its technical measures



2. Condition that shows less of awareness, understanding, and capacity of certain stakeholders on mangrove ecosystem management



3. Differences of view, interests, and understanding among stakeholders, in and among AMS, concerning the sustainability of the effort to achieve the local, national, regional, and global goals

Figure 33. Strategic issues of mangrove ecosystem management in the ASEAN Region

The data and information in the issue can be defined as information on existing and potential mangrove ecosystems, considering biophysics and socio-economic conditions, and noting the expected goals regarding sustainability and prosperity.

The condition that shows less awareness, understanding, and capacity of certain stakeholders on mangrove ecosystem management can be defined as the degradation of the mangrove ecosystem and the decrease of the socio-economic condition at the field level. It also can be defined as less information on and missed management and governance of the mangrove ecosystem.

The differences of view, interests, and understanding among stakeholders concerning the sustainability of the effort for better future conditions emphasize the need for the same vision and intensive dialogue to achieve it, especially to face the common and global challenges, among others regarding climate change, biodiversity, ecosystem restoration; and community prosperity. Based on the strategic issues, we can determine the needs for sustainable mangrove ecosystem management as below:



Figure 34. The needs for sustainable mangrove ecosystem management

The need for sustainable mangrove ecosystem management in the ASEAN Region will be elaborated in a clear strategy considering relevant global and regional frameworks and scientific-based management.

V. The Relevant Global and Regional Framework

Global Framework

Enhancing efforts of mangrove ecosystem management is in line with some UN Agendas, Resolutions, and Actions: (1) UN General Assembly Resolution No. 70/1 the year 2015 entitled “Transforming Our World: the 2030 Agenda for Sustainable Development” regarding Goals No. 2, 13, and targets 14.2 and 15.5; (2) UN General Assembly Resolution No. 71/257 the year 2016 on “Oceans and the Law of the Sea”, regarding the vital role played by mangroves in providing ecosystem services that offer a range of benefits, including sustainable livelihoods, food security, biodiversity conservation, and coastal protection; (3) The outcome document of the United Nations Conference on Sustainable Development entitled “The future we want”, in which Heads of State and Government and high-level representatives recognized the significant vulnerability of mangroves to the impact of climate change, ocean acidification, overfishing, destructive fishing practices, and pollution; (4) Paris Agreement as a legally binding International Treaty on Climate Change; (5) The UNEA Resolution No. UNEP/EA/4/RES.12 the year 2019 on “Sustainable Management for Global Health of Mangroves”; and (6) an International Day for the Conservation of the Mangrove Ecosystem that has been proclaimed by the United Nations Educational, Scientific and Cultural Organization.

The effort is also in line with some global targets: (1) the Convention on Wetlands of International Importance, especially as Waterfowl Habitat which represents a policy framework for conserving and managing coastal wetlands, including mangroves and other coastal ecosystems; (2) the Aichi Biodiversity Targets that are relevant to and benefit from the conservation of mangrove ecosystems, including for resilience and food security; and (3) the Kunming-Montreal Global Biodiversity Framework in its target 2 and 3, to ensure that by 2030 at least 30 percent of areas of degraded terrestrial inland water, and marine and coastal ecosystems are under effective restoration and conserved.



Regional Framework

In the ASEAN Region, the effort for mangrove ecosystem management is in line with some ASEAN frameworks: (1) ASEAN Strategic Plans for Forestry Cooperation; (2) the ASEAN Outlook on the Indo-Pacific (AOIP) in particular to climate change and disaster risk reduction and management, with the AOIP principles that encourage ASEAN centrality, inclusivity and good governance as part of improving Mangrove Ecosystem Management in the region; and (3) ASEAN Leaders' Declaration on the Blue Economy and the ASEAN Blue Economy Framework in particular on Blue Strategy and Blue Conservation Management in restore degraded marine ecosystems.

Concerning the vast area of mangroves in ASEAN as well as the important value of mangroves at the global level, ASEAN collaboration in the context of mangrove ecosystem management is critical. Therefore, the Indonesian Government initiated the formation of the ASEAN Mangrove Network (AMNET), which is designed to improve the network and communication tools among ASEAN member countries to promote and share good practices and lessons learned, to enhance mangrove governance, to improve community awareness and empowerment, and to develop database and information systems regarding mangrove ecosystem management.

To address the condition, conservation of the mangrove ecosystems and rehabilitation of degraded mangrove ecosystems have been conducted by several agencies in the countries of the ASEAN region. Government and non-government organizations as well as the private sector have made significant efforts towards mangrove ecosystem conservation and restoration. Goal, target, and strategy, as well as management and governance of the effort, can differ between countries, depending on the responsible proximate drivers.



VI. Scientific-based Management

There are scientific concepts including approaches, instruments, and guidance for mangrove ecosystem management, that have been established by scientific institutions and have been adopted at the global level. Implementation of these scientific concepts has to be adjusted noting the unique or specific condition and situation of each country.

Ecosystem-based Approach

The concept of an 'ecosystem-based approach' builds on the ecosystem approach. According to the Convention on Biological Diversity (CBD), "the ecosystem approach is a strategy for the integrated management of land, water and living resources that equitably promotes conservation and sustainable use" and which aspires to maintain the natural structure and functioning of ecosystems.

Ecosystem-based approaches address the crucial links between climate change, biodiversity, and sustainable resource management and thus provide multiple benefits. Implementing such approaches can contribute to both the reduction of greenhouse gas emissions and the enhancement of sinks, as well as improve biodiversity conservation, livelihood opportunities, and health and recreational benefits.

Ecosystem-based adaptation

Ecosystem-based adaptation is a strategy for adapting to climate change that harnesses nature-based solutions and ecosystem services.

Ecosystem-based approaches to climate change adaptation

Ecosystem-based approaches to adaptation (EBA) are defined as the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people adapt to the adverse effects of climate change; these approaches may include sustainable management, conservation, and restoration of ecosystems, as part of an overall adaptation strategy that takes into account the multiple social, economic and cultural co-benefits for local communities.

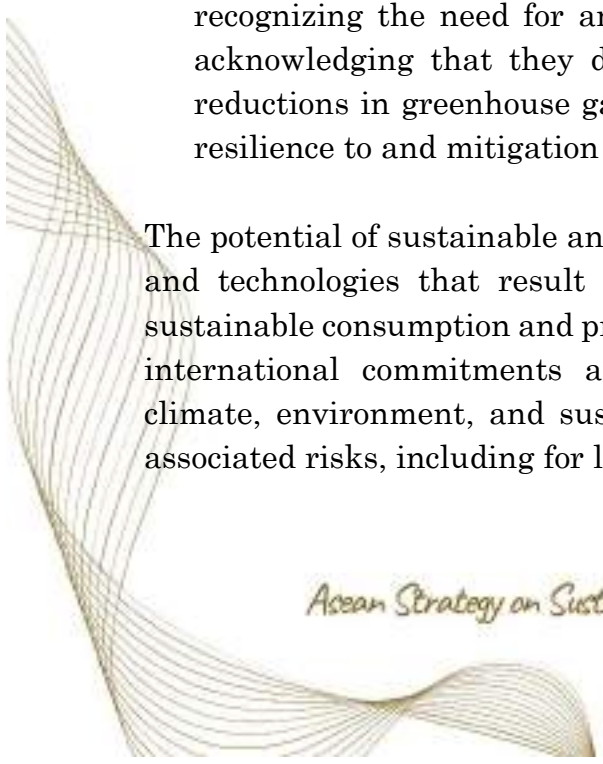


Nature-based Solutions

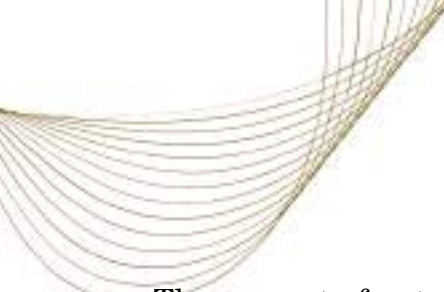
Based on the UNEA Resolution on Nature-based solutions to support Sustainable Development, nature-based solutions are actions to protect, conserve, restore, sustainably use, and manage natural or modified terrestrial, freshwater, coastal, and marine ecosystems that address social, economic, and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services, resilience, and biodiversity benefits.

Nature-based solutions:

- a. Respect social and environmental safeguards, in line with the three “Rio Conventions” (the Convention on Biological Diversity, the United Nations Convention to Combat Desertification, and the United Nations Framework Convention on Climate Change), including such safeguards for local communities and Indigenous peoples;
- b. Can be implemented in accordance with local, national, and regional circumstances, consistent with the 2030 Agenda for Sustainable Development, and can be managed adaptively;
- c. Are among the actions that play an essential role in the overall global effort to achieve the Sustainable Development Goals, including effectively and efficiently addressing major social, economic, and environmental challenges, such as biodiversity loss, climate change, land degradation, desertification, food security, disaster risks, urban development, water availability, poverty eradication, inequality, and unemployment, as well as social development, sustainable economic development, human health and a broad range of ecosystem services;
- d. Can help to stimulate sustainable innovation and scientific research; Recognizes that nature-based solutions may contribute significantly to climate action while recognizing the need for analysis of their effects, including in the long term, and acknowledging that they do not replace the need for rapid, deep and sustained reductions in greenhouse gas emissions, but can improve action for adaptation and resilience to and mitigation of climate change and its impact;



The potential of sustainable and environmentally sound bio-based products, innovation, and technologies that result from nature-based solutions, when they contribute to sustainable consumption and production and are beneficial to nature and consistent with international commitments and relevant multilateral agreements on biodiversity, climate, environment, and sustainable development, while cognizant of the potential associated risks, including for local communities and indigenous peoples.



The concept of nature-based solutions is cognizant of and in harmony with the concept of ecosystem-based approaches identified under the Convention on Biological Diversity and other management and conservation approaches carried out under existing national policy and legislative frameworks and established under relevant multilateral environmental agreements.

Climate Change Mitigation and Adaptation

Climate change adaptation means the process of adjustment to actual or expected climate and its effects, to moderate harm or exploit beneficial opportunities.

Climate change mitigation means any effort to reduce the risks of climate change by reducing GHG emissions from various sources and increasing carbon sequestration/strengthening of carbon stock from various sources of emissions.


Carbon sequestration and stock: Carbon sequestration is the process in which carbon from the land, sea, and sky is stored in the carbon pools of specific habitats, such as above-ground biomass, roots, and soil.

Landscape-based Approach

From a landscape perspective, the definition of a mangrove landscape refers to the definition of a landscape as a socio-ecological system consisting of a mosaic of natural and human-modified ecosystems, with characteristic configurations of topography, vegetation, land use, and settlement that are influenced by ecological, historical, economic, environmental processes, local culture, and activities. The mixture of land cover and land use types forms the landscape composition.

Managing mangroves using a landscape approach requires spatial arrangement by considering types of land use and land cover, management based on existing regulations, socio-economic factors, and the presence of stakeholders. This spatial arrangement is usually referred to as the function of the mangrove ecosystem, which characterizes the division of functions of the mangrove ecosystem into protection and cultivation.

Structuring the function of the mangrove ecosystem is a fundamental that guides steps in protecting and managing the mangrove ecosystem. The practice of structuring mangrove ecosystem functions can also be referred to as structuring mangrove ecosystem zones in a single mangrove landscape.



The government of Indonesia presented an approach for identifying the landscape of mangroves, namely, the Mangrove Landscape Unit (MLU) as a Mangrove Ecosystem Protection and Management Unit. The MLUs are located downstream of a particular river basin/sub-watershed area which is spatially determined by a particular land system and the influence of land and sea interactions which form substrate and salinity conditions suitable for mangrove habitat along with interacting socio-economic systems that influence it.


Boundaries of the Mangrove Landscape Unit are determined by geomorphological conditions in which several ecological types of mangroves reflect more micro-environmental conditions, along with socio-economic systems that interact with the mangrove ecosystem. Spatially, MLU is separated by large rivers, geomorphological factors, or other iconic boundaries. In general, in one MLU there is one type of mangrove based on its geomorphology (delta, estuarine, river estuary, or Island) with several mosaics of ecological types of mangroves (river-dominated, tide-dominated, and basin-dominated mangrove).

Considering that one MLU has a different combination of geomorphological factors, the mosaic of ecological types, and socio-economic conditions, mangrove management and rehabilitation are specific to the local landscape. Hence, the Management of mangrove landscape units is holistic by considering ecological, economic, and social factors. Planning for rehabilitation and utilization of mangroves must take into account the unified profile of the mangrove landscape which includes mangrove ecological zones, disturbance, degradation, environmental limiting factors, and optimum potential of mangroves as well as stakeholder aspirations.

Community-based approach

Community-based approach emphasizes local communities' involvement in accomplishing the vital activities of resource identification, priority development, choice, and adaptation of appropriate technologies for formulating and implementing sustainable management practices.

The uniqueness of mangroves as an ecosystem and consequently due to the related socio-economic as well as governance implications. These implications include the valuation of coastal protective and erosion-resistant functions, competition with commercial aquacultural practices, disputes regarding transnational boundaries, the need for high initial capital investments, and low economic returns.



Management of mangrove resources traditionally encompasses a wide spectrum of social components like the level of community participation, the performance of women, shaping of social space, social justice, and rights, politics of poverty and exclusion, utilization and reproduction of social capital, quality of life, presence of various forms of social norms and cleavages based on religion, class and ethnicity. Moreover, the uniqueness of mangrove habitats as ecotone zones has given rise to diverse patterns of cultural as well as aesthetic traits and identities for coastal communities throughout the tropics.

VII. Strategy

The strategy for ASEAN Regional's mangrove ecosystem management is detailed in Goal, Target, and Strategy, as below:

GOAL

Sustainably managed and conserved mangrove ecosystems in ASEAN Region, to achieve mangroves' ecosystem health and coastal resilience, and to contribute to the global agenda/commitment

EXPECTED OUTCOME

The expected outcome is:

1. Enhanced coastal resilience
2. Restored ecosystem and sustained biodiversity
3. Improved community livelihood and prosperity
4. Increased carbon sequestration and stock
5. Strengthened position of ASEAN in facing common and global challenges related to mangrove ecosystem management

TARGET OUTPUT

The target output is:

1. Developed ASEAN mangrove ecosystem profile
2. Implemented and shared best practices of conservation, protection, restoration, and sustainable use of mangroves ecosystem in ASEAN Region
3. Enhanced mangrove ecosystem governance in each AMS
4. Maintained and rehabilitated mangrove areas in each AMS
5. Enhanced understanding and harmonized effort among AMS in facing common and global challenges related to mangrove ecosystem management

STRATEGY

The strategy to achieve the target is:

- 1** Mapping and assessing mangrove ecosystems in ASEAN Region
- 2** Promoting the urgency of and enhancing capacity for conservation, protection, restoration, and sustainable use of mangrove ecosystems in ASEAN Region
- 3** Strengthening governance as well as establishing and implementing appropriate policy related to mangrove ecosystem management in each AMS
- 4** Implementing appropriate technical interventions of conservation, protection, restoration, and sustainable use of mangrove ecosystem in each AMS
- 5** Enabling understanding among AMS in facing common and global challenges related to mangrove ecosystem management

Figure 35. The strategy to achieve the target

In implementing the Strategy, there are certain focus areas and scheme of activities, as below:

FOCUS AREA

The focus area of the cooperation is:

1. Data inventory, mapping, and assessment
2. Protection and Conservation
3. Restoration and Rehabilitation
4. Sustainable Use and Community Livelihoods
5. Community awareness and engagement
6. Biodiversity preservation
7. Climate Change Mitigation
8. Coastal Resilience and Climate Change Adaptation
9. Integrated Coastal Management and Land Use Planning
10. Handling unsustainable use of mangroves and illegal trading of unsustainable mangrove products
11. Policy and Regulation for legal certainty, compliance, and law enforcement

SCHEME OF ACTIVITIES

The scheme of activities is:

1. Sharing knowledge and experiences
2. Developing regional indicators of mangrove ecosystem health
3. Developing models of mangrove ecosystem management
4. Developing a platform as an information hub
5. Training
6. Joint research
7. Joint monitoring and reporting
8. Joint publishing of periodic ASEAN Mangrove Profile
9. Developing and implementing the strategy in each AMS
10. Policy dialogue in and among AMS

ACTION PLAN

Based on the focus area and the scheme of activities, the Strategy is elaborated into action plans as below:

Table 3. Strategy 1

Strategy 1. Mapping and assessing mangrove ecosystems in ASEAN Region	
Action Plan:	
1.	Sharing knowledge and experiences on inventory, mapping, and assessment, including measuring mangrove ecosystem health or degradation
2.	Developing regional indicators on mangrove ecosystem health
3.	Training on inventory, mapping, and assessment of mangrove ecosystem
4.	Joint monitoring and reporting
5.	Developing and implementing the inventory, mapping, and assessment in each AMS
6.	Joint publishing periodic Profile of ASEAN mangrove ecosystem

Table 4. Strategy 2

Strategy 2	
Promoting the urgency, managing knowledge, and enhancing capacity for conservation, protection, restoration, and sustainable use of mangrove ecosystems in ASEAN Region	
Action Plan:	
1.	Enhancing community awareness, campaigning, and engaging all relevant stakeholders including the local community on the urgency of mangrove ecosystem conservation, protection, restoration, and sustainable use.
2.	Applying appropriate scientific-based management, sharing knowledge, experiences, and best practices, and establishing technical guidelines on conservation, protection, restoration, and sustainable use of mangrove ecosystem.
3.	Developing models of mangrove ecosystem management
4.	Developing a platform as an information hub
5.	Organizing training on conservation, protection, restoration, and sustainable use of mangrove ecosystems as well as biodiversity preservation, climate change mitigation and adaptation, coastal resilience, integrated coastal management, and mangrove ecosystem-related land use planning.

Table 5. Strategy 3

Strategy 3 Strengthening governance as well as establishing and implementing appropriate policy related to mangrove ecosystem management in each AMS	
Action Plan:	
1.	Sharing knowledge, experiences, and best practices on appropriate policy, institutional arrangement, approaches, and implementation for conservation, protection, restoration, and sustainable use of mangrove ecosystem, as well as for legal certainty, compliance, and law enforcement.
2.	Sharing knowledge, experiences, and best practices for preparing a management plan for mangrove ecosystem, including target setting, roles sharing among stakeholders, internalizing the plan into the development plan, sectoral plan, spatial plan, zoning regulation, permits, incentives-disincentives, and penalties.
3.	Ensuring social and environmental safeguard, i.e., through environmental assessment, the implementation of Grievance Redress Mechanism (GRM), public consultation, and understanding and acceptance of the local community and other relevant stakeholders to the policy and plan that will be implemented.
4.	Enhancing capacity of relevant stakeholders including the local community to be involved in planning, implementation, monitoring and evaluating the policy and its implementation, as well as reporting field conditions and threats.
5	Sharing knowledge, experiences, and best practices for identifying and handling crucial cases in mangrove ecosystem management, i.e., socio-economic and tenurial issues.
6	Preparing scheme and methods for incorporating program-related mangrove ecosystem management into the framework of the relevant global agenda, in particular Nationally Determined Contribution (NDC) of climate change convention, biodiversity convention, wetlands convention, and the UN decade on ecosystem restoration.

Table 6. Strategy 4

Strategy 4 Implementing appropriate technical interventions and technology in conservation, protection, restoration, and sustainable use of mangrove ecosystems in each AMS	
Action Plan:	
1.	Identifying the critical area to be conserved, protected, and restored, and to be ensured the sustainable use of the mangrove ecosystems, based on bio-physical conditions such as tidal, salinity, mud, and substrates for suitable habitat, and biodiversity; and socio-economic conditions such as land states, socio-economic function, and history of the land use and the land cover; vulnerability; and ecosystem services.
2.	Identifying biophysics characteristics and conditions such as habitat zone, sedimentation, sea level, sea wave, and other oceanographic dynamics; and socio-economic characteristics and conditions, i.e., local culture, local knowledge, and livelihood, to be referred to and taken into account in determining and deciding appropriate interventions.
3.	Identifying and applying the appropriate, best practicable, and environmentally friendly technical or technological interventions needed including for preparing macro-meso and site-plans; bio-physics and socio-economic pre-conditions; technical arrangement such as planting pattern and civil engineering support needs; seeds and nursery for mangrove rehabilitation; hydrological treatment; sea level adjustment; sea wave control; pests and diseases control; online monitoring; and “Smart Nursery”.
4.	Ensuring the accompaniment of experts or field instructors in the implementation of the technical interventions.
5.	Involving and enhancing capacity of local community including local champions, traditional figures, and village leaders as well as women and youth in the planning, implementation, monitoring, and evaluation of the program/activities, through facilitating community discussions, field school, information and education center and platform, and sharing learning and spirit among communities, with the presence of the local leadership.
7.	Explore opportunities to enhance socio-economic benefits for the local community, including through engaging other stakeholders in the effort, i.e., through the scheme of environmentally friendly sylvo-fishery, eco-tourism, food derivative products as well as for packaging and marketing of the product including promoting, branding, and off-taking.
8.	Ensuring periodic monitoring and evaluation of the field conditions, and the performance of conservation, protection, restoration, and sustainable use of mangrove ecosystems.
9.	Joint research on conservation, protection, restoration, and sustainable use of mangrove ecosystems as well as biodiversity preservation, climate change mitigation and adaptation, coastal resilience, integrated coastal management, and mangrove ecosystem-related land use planning

Table 7. Strategy 5

Strategy 5 Enabling understanding among AMS in facing common and global challenges related to mangrove ecosystem management	
Action Plan:	
1.	Identifying specific and crucial conditions that need understanding and cross-boundary policy related to mangrove ecosystem management, i.e., regarding illegal trading of unsustainable mangrove products or products from unsustainable activities in mangrove ecosystems.
2.	Developing mechanisms for cross-boundary policy dialogue and cooperation on needed understanding among AMS.
3.	Formulating understanding and its appropriate instruments in facing the specific and crucial conditions as well as common and global challenges related to mangrove ecosystem management, particularly through control and enforcement mechanisms, i.e., product certificates and labels, and banning illegal trading.
4.	Integrating and consolidating the needed understanding in the appropriate ASEAN-related Agenda, including through the platform of the ASEAN Mangrove Network
5.	Campaigning and establishing publications on important advancements of the achieved understanding to be complied with by all relevant stakeholders.

VIII. Implementation

Implementation of the strategy will be organized periodically, following the schedule of program planning under the coordination of the ASEAN Working Group on Forest Management (AWGFM). The cooperation programs are planned and evaluated every year, by determining the needs and appropriate focus area, as well as location, time, and organizing country of the activities, in the AWGFM Framework. The year for implementation of strategy is below:

Table 8. Proposed year of implementation of the strategy

No	Strategy	Year						
		2024	2025	2026	2027	2028	2029	2030
1	Mapping and assessing mangrove ecosystems in ASEAN Region	V	V	V	V	V	V	V
2	Promoting the urgency, managing knowledge, and enhancing capacity for conservation, protection, restoration, and sustainable use of mangrove ecosystems in ASEAN Region	V	V	V	V	V	V	V
3	Strengthening governance as well as establishing and implementing appropriate policy related to mangrove ecosystem management in each AMS		V	V	V	V	V	V
4	Implementing appropriate technical interventions of conservation, protection, restoration, and sustainable use of mangrove ecosystem in each AMS	V	V	V	V	V	V	V
5	Enabling understanding among AMS in facing common and global challenges related to mangrove ecosystem management		V	V	V	V	V	V

Table 9. Proposed year of the target output achievement

No	Target	Year						
		2024	2025	2026	2027	2028	2029	2030
1	Developed ASEAN mangrove ecosystem profile			1 st Profile			2 nd Profile	
2	Implemented and shared best practices of conservation, protection, restoration, and sustainable use of mangroves ecosystem in ASEAN Region	Information hub established						
3	Enhanced mangrove ecosystem governance in each AMS		25%	50%	75%		100%	
4	Maintained and rehabilitated mangrove areas in each AMS			V	V	V	V	V
5	Enhanced understanding and harmonized effort among AMS in facing common and global challenges related to mangrove ecosystem management			V	V	V	V	V

Table 10. Proposed year of the expected outcome achievement

No	Target	Year						
		2024	2025	2026	2027	2028	2029	2030
1	Enhanced coastal resilience					V	V	V
2	Restored ecosystem and sustained biodiversity					V	V	V
3	Improved community livelihood and prosperity					V	V	V
4	Increased carbon sequestration and stock					V	V	V
5	Strengthened position of ASEAN in facing common and global challenges related to mangrove ecosystem management					V	V	V

References

- , 2021. Roadmap of Mangrove Rehabilitation in Indonesia 2021-2030. KLHK and BRGM. KLHK
- , 2023. Landscape Management Unit. KLHK
- , 2023. *The World's Mangrove 2000-2020*. Rome. Food and Agriculture Organization of The United Nations.
- Arifanti, Virni Budi, Kauffman, John Boone, et. al. 2023. Contributions of mangrove conservation and restoration to climate change mitigation in Indonesia. Wiley – Global Change Biology.
- Datta, Debajit, et.al. 2012. *Community-based mangrove management: A review on status and sustainability*. Department of Agricultural and Food Engineering, Indian Institute of Technology. Elsevier.
- Friess DA (2017) Mangrove rehabilitation along urban coastlines: a Singapore case study. *Regional Studies in Marine Science* **16**, 279 – 89.
- Hamdan O. & Muhamad Afizzul M. 2020. Extents and Distribution of Mangroves in Malaysia. Pp. 1-42 in Hamdan O., Tariq Mubarak H. & Ismail P. (Eds.) Status of Mangroves in Malaysia. FRIM Special Publication No. 50, Institut Penyelidikan Perhutanan Malaysia. Kepong.
- Hilton MJ, Manning SS (1995) Conversion of coastal habitats in Singapore: indications of unsustainable development. *Environmental Conservation* **22** (4), 307 – 22.
- Honculada-Primavera, J. 2000. Mangroves of Southeast Asia. In J. H. Primavera, L. M. B. Garcia, M. T. Castaños, & M. B. Surtida (Eds.), *Mangrove-Friendly Aquaculture: Proceedings of the Workshop on Mangrove-Friendly Aquaculture* organized by the SEAFDEC Aquaculture Department, January 11-15, 1999, Iloilo City, Philippines (pp. 1-12). Tigbauan, Iloilo, Philippines: Southeast Asian Fisheries Development Center, Aquaculture Department.

Keizrul, A., Tan, K. S. & Ghazali, N. H. M. 2005. No more in the comfort zone – Malaysia’s response to the December 2004 Tsunami. Paper presented at International Hydrography and Oceanography Conference and Exhibition, 3 -5 July 2005, Kuala Lumpur. Forestry Department Peninsular Malaysia. (2004). Matang Mangroves A Century of Sustainable Management. Kuala Lumpur (pp. 112).

Kementerian n Sumber Asli dan Alam Sekitar Malaysia (NRE). 2016. *Garis Panduan Penyediaan Rancangan Pengurusan Hutan Paya Laut untuk Negeri-negeri di Malaysia*. Putrajaya (pp. 236).

Maung Aye, Win. 2023. Presentation materials at the Inception Workshop of the ASEAN Mangrove Network, 8 August 2023.


McOwen, Chris, et.al. 2023. “Mangrove Forest Change – What does it mean for nature, people and the climate?”. WCMC. UNEP.

Mohamed Zin, Y. & Nor Lokman, M. N. F. 2021. A Working Plan for the Matang Mangrove Forest Reserve, Perak: The Second 10-Year Period (2020-2029) of the Third Rotation. State Forestry Department of Perak. Ipoh (pp. 6).

National Parks Board (2022, May 12) Mangroves. *Coastal and Marine Ecosystems*. <https://www.nparks.gov.sg/biodiversity/our-ecosystems/coastal-and-marine/mangroves> on 14 May 2024.

National Parks Board (2020, Aug 19) New Sungei Buloh Nature Park Network to expand Singapore’s natural capital along our northern coasts as part of efforts to make Singapore a City in Nature. <https://www.nparks.gov.sg/news/2020/8/new-sungei-buloh-nature-park-network-to-expand-singapore%E2%80%99s-natural-capital-along-our-northern-coasts-as-part-of-efforts-to-make-singapore-a-city-in-nature> on 24 May 2024

National Parks Board (2018, Oct 7) Mandai Mangrove and Mudflat will be conserved as a Nature Park. <https://www.nparks.gov.sg/news/2018/10/mandai-mangrove-and-mudflat-will-be-conserved-as-a-nature-park> on 24 May 2024

- 
- Primavera, J.H., RS. Sadaba, M.J.H.L. Lebata and J.P. Altamirano. 2004. Handbook of Mangroves in the Philippines – Panay. SEAFDEC Aquaculture Department. Iloilo, Philippines.
- Richards, Daniel R., Friess, Daniel A., et.al. 2015. “*Rates and drivers of mangrove deforestation in Southeast Asia, 2000–2012*”. Department of Geography, National University of Singapore. PNAS.
- Shaharuddin, M. I., Azahar, M., Razani, U., Kamaruzzaman, A. B., Lim, K. L., Suhaili, R., Jalil, M. S. and Latiff, A. 2005. Forest Biodiversity Series 4: Sustainable Management of Matang Mangroves: 100 Years and Beyond. Forestry Department Peninsular Malaysia. Kuala Lumpur (pp 91-101).
- Tan JYH, Tham JKQ, Aayush P, Umair R, Ang HP, Nguyen NTH, Yee ATK, Leong BPI, Drummond S, Tun KPP (2022) Remote sensing mapping of the regeneration of coastal natural habitats in Singapore: Implications for marine conservation in tropical cities. *Singapore Journal of Tropical Geography* 44 (1), 130 – 148
- Yang S, Lim RLF, Sheue C-R, Yong JWH (2013) The current status of mangrove forests in Singapore. In Leong TM, Ho HC (eds) *Proceedings of Nature Society, Singapore’s Conference on ‘Nature Conservation for a Sustainable Singapore’*, 99 – 120. Nature Society, Singapore.