1. Introduction

1.1 Aims of National Report

1.1.1 Inputs to the SCS-GOT TDA

The South China Sea (SCS) is a global center of shallow water tropical marine biodiversity and is one of the 64 Large Marine Ecosystems (LME) that supports unique habitats and ecosystems that are amongst the most biologically diverse shallow-water marine ecosystems globally. Large marine ecosystems are regions of ocean space of 200,00 km^2 or greater that encompasses the coastal areas from river basins and estuaries to the outer margins of a continental shelf or the seaward extent of a predominant coastal current. It is defined by ecological criteria including bathymetry, hydrography, productivity and trophically-linked populations (Duda and Sherman, 2002). The LME concept is for an ecosystem-based management approach focused on productivity, fish and fisheries, pollution and ecosystem health, socioeconomics, climate and governance.

As an LME, the SCS is central to defining environmental sustainability and food security in the region. However, the richness and productivity of the SCS and associated environments like coastal communities are seriously threatened by pollution, overharvest, climate change, and habitat modification, resulting in high habitat loss rates and impairment of living resources' regenerative capacities. According to studies, the decadal rates of loss of coastal habitats from the SCS are high and increasing. In fact, each decade, around 30 percent of seagrass, 16 percent of mangrove, and 16 percent of live coral cover (Felix et al., 2025) is lost from this basin due to pressures associated with unsustainable patterns of use by the 270 million people that reside on the SCS's coast. Therefore, it is inarguable that the socio-economic impacts of environmental deterioration are significant for the economies of this region.

Recognizing that strategic actions are urgently needed to arrest the degradation of the environment of this marine basin, the countries of the region sought the assistance of United Nations Environment Programme (UNEP) and the Global Environment Facility (GEF) in preparing a Transboundary Diagnostic Analysis (TDA) in 2000 of the issues and problems and their societal root causes as the basis for the development of a Strategic Action Programme (SAP), which was adopted at the inter-governmental level in 2008, representing the agreed common vision among the participating countries on targets and actions for reversing environmental degradation trends in the SCS. The SAP established a series of objectives and priority-costed actions for coastal habitats, land-based pollution management, and the over-exploitation of fish stocks in the SCS.

The TDA is a key component of the SAP for the marine and coastal environment of the South China Sea and Gulf of Thailand LMEs, serving as the scientific and technical foundation for identifying and understanding the root causes of environmental issues that transcend national borders. In contrast to the TDA-SAP Version 1.0 in 2000, which primarily focuses on status assessments, the TDA-SAP Version 2 for 2026 introduces a strategic shift toward forward-looking risk scenario assessments (Figure 1.1). This new version places greater emphasis on addressing the three (3) interlinked planetary crises namely climate change, nutrient and plastic pollution, and biodiversity loss. The revised framework aims to enhance the region's resilience by integrating these global environmental challenges into transboundary diagnostic and strategic action planning. For the Philippines, ensuring the accuracy and completeness

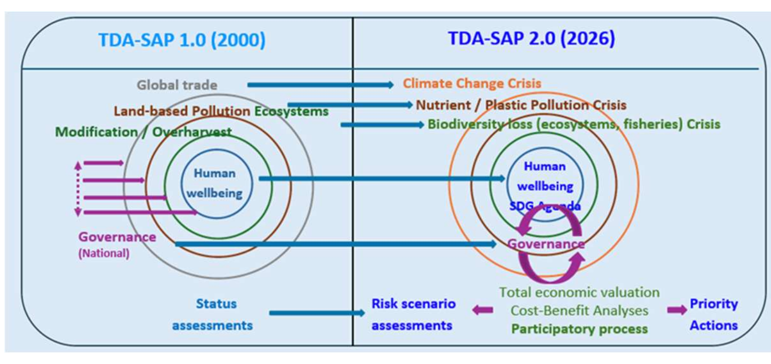

Figure 1.1. Composition of TDA-SAP 1.0 vs the updated 2026 TDA-SAP 2.0)

of its TDA inputs is essential to reflect local conditions, national priorities, and emerging environmental challenges within the broader regional context.

The participating countries of the region made a commitment and prepared the SAP. This commitment was further reinforced in 2016, when the six (6) countries in the region namely Cambodia, China, Indonesia, Philippines, Thailand and Vietnam signed a special Memorandum of Understanding (MoU), committing to cooperate with one another to implement the SAP. For the Philippines, the MoU was signed in 2016 by Atty. Jonas R. Leones, Undersecretary for Environment and International Environmental Affairs, for and on behalf of the then Secretary of the Department of Environment and Natural Resources, H.E. Ramon J.P. Paje.

This commitment provided a clear signal to the international community to support the financing of the SAP through various projects, including the project titled "*Implementing the Strategic Action Programme for the South China Sea and Gulf of Thailand (SCS SAP Project).*" Later on, the project was financed and adopted by the GEF on November 03, 2016 and was implemented by the UNEP. The United Nations Office for Project Services (UNOPS), on the other hand, executed the project in partnership with the Ministries responsible for the environment in Cambodia, China, Indonesia, Thailand, and Vietnam. Meanwhile, for the Philippines, the one currently undertaking the SCS-SAP project is the Society for the Conservation of Philippine Wetlands, Inc (SCPW). The SCPW signed the Grant Service Agreement with UNOPS in November 2024 and since then has embarked on mobilization and full implementation of the project. The project has recently secured security clearance from the National Task Force for the West Philippine Sea (NTF-WPS). In response, the Department of Environment and Natural Resources (DENR) has issued a memorandum directing its concerned offices to extend support to the project's overall objective. That is, to assist the governments of the participating countries in meeting the targets of the approved SAP 2008 through the provision of technical assistance as required in implementing national activities in support of the SAP; and the provision of strong regional co-ordination of the process of the SAP implementation for the marine and coastal environments of the SCS and Gulf of Thailand (GOT).

The Project Team was formed composed of consultants and technical staff with extensive and strong backgrounds on ecosystem management. The team frequently met online and in-person and gathered, reviewed and discussed various environmental reports focusing on the above-cited fields. They agreed to incorporate additional information on pollution hotspots, sensitive habitats, and some national frameworks and international initiatives that address governance.

Each consultant is tasked to lead the assessment and drafting of specific components of the Philippine TDA Report. These components include (i) Socio-economics and Climate, covering demographic trends, economic drivers and activities, and climate- and environment-related threats; (ii) Pollution, focusing on pollution sources and magnitude, nutrient loading, plastic waste, and other land-based transboundary pollution issues affecting the South China Sea; (iii) Ecosystems, which is subdivided into Coastal Wetlands, Coral Reefs, Seagrasses, and Mangroves, addressing biodiversity hotspots and sensitive areas, endemic, endangered, and threatened species, conservation priorities, as well as the valuation of economic losses; (iv) Fish, fisheries and aquaculture, concentrating on fisheries and ecosystem health indicators, including its management and conservation efforts; and (v) Governance, that explores economic and policy drivers, institutional setting and frameworks, legal and policy setting, and governance performance and effectiveness. Accordingly, each consultant is responsible for their assigned component, integrating scientific considerations, which were harmonized into the consolidated National TDA for submission to the regional process.

Through this coordinated approach, the Project Team ensures that all thematic areas are comprehensively addressed given available data, establishing a cohesive and evidence-based Philippine TDA Report that reflects both national priorities and the shared vision for the sustainable management of the LMEs in the SCS and GOT LMEs.

1.1.2 Analysis to Help National Reporting to SDG and other National Commitments

While the emphasis of this project is on supporting the participating countries to meet the targets of the SCS SAP, which must be considered globally significant, the project has also envisioned to contribute to the attainment of the global targets such as the Sustainable Development Goals (SDG), Agenda 2030 and the targets established by the Convention on Biological Diversity (CBD) under the Kunming-Montreal Global Biodiversity Framework (KMGBF). It is noted that alignment of SAP actions with CBD targets was a key consideration in SAP formulation. After all, the design of the results framework for the SAP project focuses as well in aligning outcomes with the KMGBF.

Importantly, the project seeks to contribute towards the achievement of the Sustainable Development Goals: 1, 6, 12, 13, 14, and 15.

Recognizing the urgency of achieving these goals given the identified threats, the countries bordering the SCS requested the assistance of the United Nations Environment Program (UNEP) and the Global Environment Facility (GEF) to prepare a Transboundary Diagnostic Analysis (TDA) as the scientific basis for a Strategic Action Program (SAP). The first regional TDA-SAP cycle culminated in the intergovernmental adoption of the SAP in 2008, setting objectives and priority actions to:

1. Conserve and restore critical coastal habitats
2. Manage land-based sources of pollution, and
3. Reduce the over-exploitation of fish stocks.

In contrast to the TDA-SAP Version 1.0 finalized in 2000, which largely concentrated on status assessments of coastal and marine resources, the forthcoming TDA-SAP Version 2 (2026) represents a strategic evolution. It introduces forward-looking risk scenario assessments (Figure 1) that allow countries to anticipate and prepare for emerging threats rather than only responding to current conditions. This second version highlights the need to confront the three interlinked planetary crises—climate change, nutrient and plastic pollution, and biodiversity loss—by embedding these global challenges directly into transboundary diagnostic and strategic action planning. For the Philippines, this means ensuring that its national TDA inputs are both accurate and comprehensive, so that local realities, national priorities, and evolving environmental issues are effectively reflected within the broader regional framework.

Overall, efforts will be made to align the agreed reporting systems with national reporting requirements to various international conventions and processes.

1.2 Major Water Related Environmental Problems

The Philippine coastal waters in the SCS-LME face multiple pressures that threaten the integrity of marine and coastal ecosystems. Land-based pollution, including nutrient loading, plastic waste, and other transboundary contaminants, degrades water quality and leads to eutrophication, which negatively affects seagrass beds and wetlands through smothering and reduced light penetration (Orth et al., 2006; Short et al., 2011). Coral reefs also suffer from sedimentation and nutrient enrichment, which encourage algal overgrowth and weaken reef resilience (Fabricius, 2005; Hughes et al., 2017).

Climate change and rising sea surface temperatures intensify these impacts. Warmer waters trigger coral bleaching and harmful algal blooms (HAB) when combined with nutrient loading (Hoegh-Guldberg et al., 2007; Peñaflor et al., 2009), while also reducing seagrass productivity and causing large-scale die-offs (Waycott et al., 2009). Mangroves are increasingly vulnerable to sea-level rise, saltwater intrusion, and coastal erosion (Alongi, 2015; Primavera et al., 2019), while wetlands face shifts in salinity that threaten their ecological functions (Finlayson et al., 2017). Ocean acidification further weakens coral skeletons and limits the growth of calcifying organisms, thereby diminishing reef structures that provide habitat for fish (Kleypas et al., 2006; Kroeker et al., 2013). Seagrasses are also affected, as changes in carbonate chemistry alter their productivity and associated biodiversity (Campbell & Fourqurean, 2014).

Extreme weather events such as stronger typhoons cause direct physical damage across ecosystems—breaking coral branches, uprooting seagrass meadows, eroding mangrove shorelines, and flooding wetlands (Villanoy & Yñiguez, 2024; Licuanan et al., 2019). Meanwhile, other natural hazards such as earthquakes and tsunamis destabilize seabeds, trigger submarine landslides, and generate powerful waves that can bury reefs and seagrass beds, displace marine life, and alter coastal landscapes (Satake, 2015; Imamura, 2018).

1.3 Biogeophysical Setting

1.3.1 Geomorphology and Geological History

The geomorphology of the Philippine Seas in SCS-LME is shaped by its tectonic and oceanographic setting within the Philippine archipelago, which comprises about 40% of the country's Exclusive Economic Zone (EEZ) (VLIZ 2022, 2023; PD 1596, 1978; NGA 2004 as cited in Villanoy & Yñiguez, 2024). It features continental shelves, deep basins, reefs, and atolls—particularly around the Kalayaan Island Group (KIG) and western Palawan—formed through tectonic processes, reef accretion, and sedimentation. The Philippine Seas in SCS-LME evolved through seafloor spreading that began around 55–50 Ma and ceased by ~30 Ma, leaving behind extinct spreading centers such as the Central Basin Spreading Center and crustal features like the Benham and Gagua Rises (Taylor & Hayes 1980; Deschamps & Lallemand 2002; Li et al. 2021). Its semi-enclosed setting drives counterclockwise circulation that redistributes sediments and nutrients, while subduction and tectonic reorientations continue to shape its margins (Villanoy & Yñiguez, 2024). Seasonal monsoons and increasing typhoon frequency further influence erosion, sediment transport, and productivity, illustrating the dynamic geological and geomorphological history of the Philippine Seas in SCS-LME (Villanoy & Yñiguez, 2024).

1.3.2 Climatology, Present and Projected

According to the Modified Coronas Classification System (MCCS) of PAGASA, Philippine climate can be classified into four (4) types (Figure 1.2). The Philippine western seaboard predominantly exhibits a Type 1 climate, characterized by distinct wet and dry seasons—dry period from November to April and wet season for the rest of the year, with peak rainfall from June to September.

Figure 1.2. Modified Coronas Classification System (PAGASA)

The Department of Science and Technology – Philippine Council for Agriculture and Aquatic Resource and Research Development (PCAARRD) also provided a complimentary classification system of the Philippine climate (Figure 1.3) through the Remote Sensing Information for Living Environments and Nationwide Tools for Sentinel Ecosystems in our Archipelagic Seas Program for Climate Change (RESILIENT SEAS Program, 2009-2012). It divides the seas surrounding the Philippine archipelago into 11 distinct clusters (David, 2012), each characterized by climatic and oceanographic conditions resulting from complex land-sea interactions in the coasts (e.g., precipitation, sea surface temperature, sea surface height, etc.) (PEMSEA, 2019).

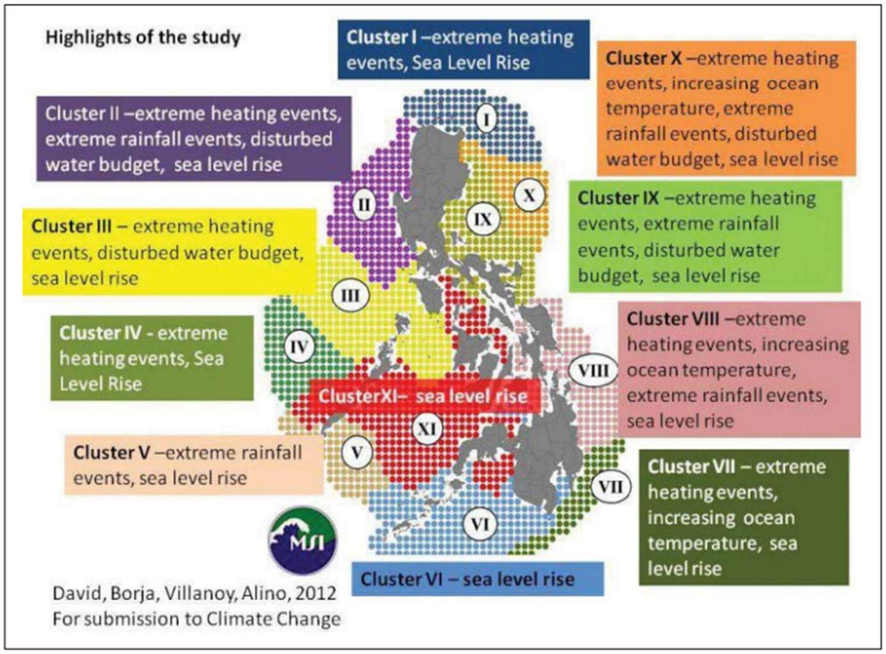

Figure 1.3. Climate Typologies in the Philippines (David, 2012 as cited by PEMSEA in the *National State of the Coasts*, 2019)

The country also experiences two (2) main monsoons: the stronger and more consistent northeast monsoon (*amihan*) which occurs from November to March, and the comparatively weaker and less predictable southwest monsoon (*habagat*) which prevails from June to September (Villanoy & Yñiguez, 2024). While the Type 1 climate is heavily influenced by the *habagat* (Villarin et. al., 2016) the strong winds and cooler temperature associated with the *amihan* plays a significant role in enhancing primary productivity in the Philippine waters facing the SCS-LME. This is driven by wind jets funneled through the straits within the archipelago, generating localized upwelling zones—particularly along the west coast of Palawan—which may further enhance water column productivity (Villanoy & Yñiguez, 2024).

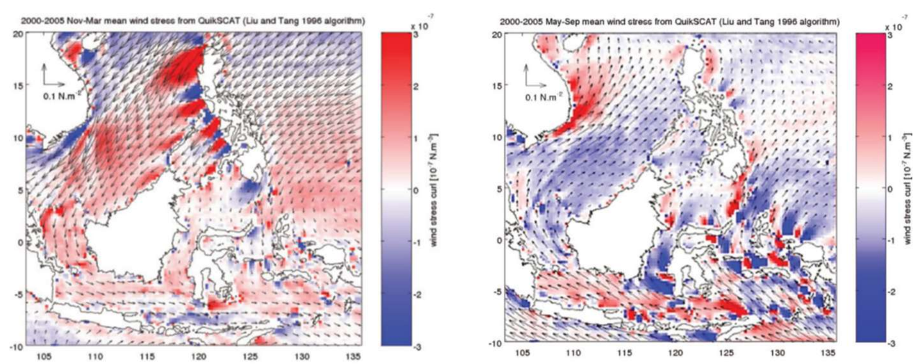

Figure 1.4. Wind Stress and Wind Stress Curl during *Amihan* (left) and *Habagat* (right) seasons

Positive wind stress curl areas (winds turning to the left) are associated with upwelling, and negative wind stress curl (winds turning to the right) areas with downwelling (Villanoy & Yñiguez, 2024).

To support climate adaptation and mitigation planning, PAGASA developed baseline (1981-2020) and projected (2021-2050) climate data for temperature and rainfall. Climate projections under various scenarios were generated using models from Coupled Model Intercomparison Project (CMIP) of the World Research Programme (IPCC, 2013b as cited in Villarin et al., 2016).

Temperature

The last 30 years (1981-2020) show that increasing temperatures have been observed in most parts of the country while some areas particularly in western Ilocos Region, eastern portion of Rizal province, and southern islands of Luzon experienced a slight decrease in temperature. Using these baseline data, projections for surface area temperature show that the country will experience significantly warmer climate towards the end of 21st century (2021-2050), ranging from 2.6ºC up to 4.4ºC increase from the average temperature and was seen highest for the month of May (DOST-PAGASA, 2024).

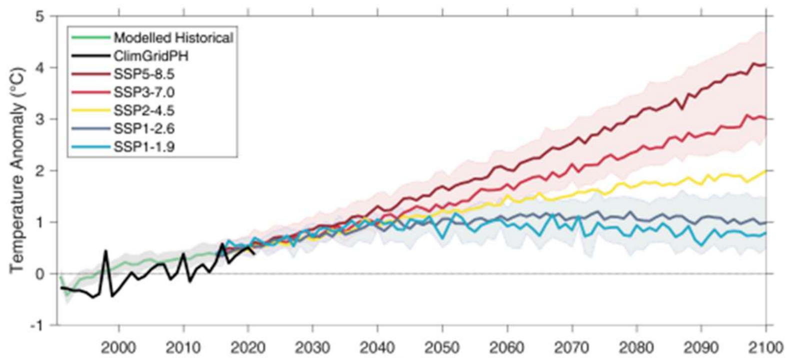

Figure 1.5. Time series of the annual mean temperature anomalies in the Philippines *(DOST-PAGASA CMIP 6-BASED Climate Change Projections in the Philippines Report, 2024).*

Rainfall

From the baseline period of 1981-2010, observed trend in rainfall revealed an increasing level in majority of the country particularly Luzon and Visayas. In December, increasing rainfall was observed in Luzon and Visayas and moves to Mindanao in January, coinciding with the northeast monsoon or *amihan* season. However, from July to October, western areas facing the SCS-LME experience heavy rainfalls due to the southwest monsoon or *habagat* season. Rainfall projections for 2021-2050 show a decrease in rainfall level in most parts of Luzon particularly from January to May but may experience about 5-10% increase in rainfall from June to December (except for the southern portions of Luzon and most parts of Visayas in August, and most parts of Visayas and Mindanao in September, where a potential decrease in rainfall is projected (DOST-PAGASA, 2024).

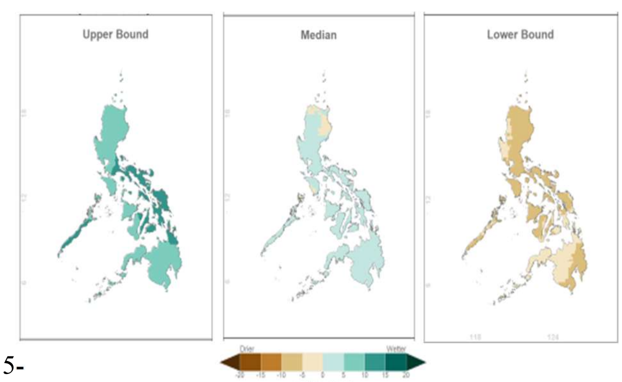

Figure 1.6. Range of projected changes in annual rainfall over the Philippines for 2021-2050 using baseline period 1981-2020 *(DOST PAGASA CMIP 6-BASED Climate Change Projections in the Philippines Report, 2024).*

The varying climatic conditions exert considerable impacts on the marine ecosystems. During wet seasons in June to September, increased precipitation contributes to greater surface runoff, leading to elevated nutrient loading, sedimentation, and coastal pollution (Gomez et al., 2016). Seagrass beds, which support nurseries for fish species and other invertebrates may be affected by sediment loading (Fortes, 2018). Surface run-off increases organic matter in the marine ecosystems leading to hypoxic conditions in coastal waters (Zhang, 2022). Meanwhile, the dry and hot seasons usually from March to May is associated with rising sea surface temperature (SST) which can trigger coral bleaching events (Licuanan et al., 2019). Elevated SST and ocean acidification also reduces calcification rates of corals, further threatening reef resilience (Fabricius et al., 2011). Moreover, climate-driven changes in temperature, salinity, and nutrient availability influence fish spawning cycles and migration patterns, ultimately affecting fisheries productivity (Barut et al., 2004).

Due to its geographical location, the Philippines is also highly susceptible to tropical cyclones (PAGASA, n.d.). Approximately 19 to 20 tropical cyclones enter the Philippine Area of Responsibility (PAR) per year (Cayanan et al., 2011 as cited in Villarin et al., 2016). Intense typhoons can damage mangroves forests which are natural buffers against storm surges thereby compromising their ability to support vulnerable marine life (Primavera & Esteban, 2008).

1.3.3 Biogeography Endemic and Unique Marine Species

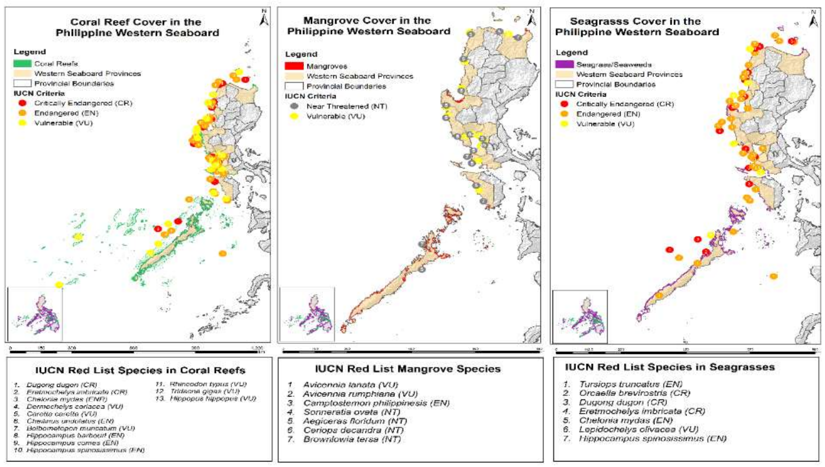

Figure 1.7. IUCN Red List Species of Endemic and Unique Marine Species in the Philippine Western Seaboard

The mangroves, seagrass and wetlands at Philippine waters at SCS-LME are home to a number of threatened mammals and reptiles species.

1.4 Assessment Methodology

1.4.1 Conceptual Framework

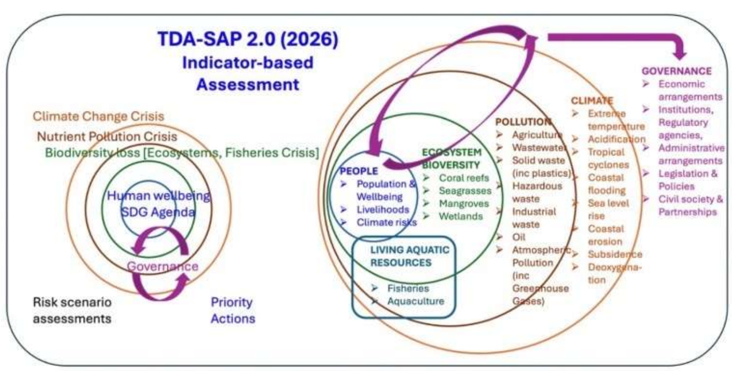

Figure 1.8. TDA-SAP 2.0 (2026) Indicator-based Assessment

The TDA SAP 2.0 (2026) is an indicator-based assessment. It is something that is metric and it indicates whether the status is good or bad. It also indicates whether the risk is high of low. In this TDA SAP 2.0, not everything is of metric indicator. In the case of governance, it also has qualitative descriptor of the state of governance relative to the major environmental issue. As shown in Figure 1.8, there are six components, namely:

1) People
2) Ecosystem Diversity: coral reefs, seagrasses, mangroves, and wetlands
3) Pollution
4) Fisheries or living aquatic resources
5) Impact of climate which affects all of the components – the people and ecosystems
6) Governance

The TDA SAP 2.0 intends to help governance informed not just on climate but the impact of climate on people and ecosystems and help governance be more attuned to the environmental crises that climate is imposing on people and ecosystems.

1.4.2 Subnational Geographic Divisions Used in the Analysis

This analysis uses provinces as the subnational geographic units, allowing localized variations to be captured and providing clearer insights for accurate interpretation and targeted recommendations.

Figure 1.9. depicts the political boundaries of the provinces along the Philippine western seaboard which face the SCS-LME, namely: Ilocos Norte, Ilocos Sur, La Union, and Pangasinan of Region I (Ilocos Region), Batanes and Cagayan of Region II (Cagayan Valley), Zambales, Bataan, Pampanga, and Bulacan of Region III (Central Luzon), the National Capital Region (NCR) which include 16 cities, Cavite and Batangas of Region IV-A (CALABARZON), and Occidental Mindoro and Palawan of Region IV-B (MIMAROPA). Understanding of the spatial dynamics and geopolitical considerations within the country facilitates a more comprehensive analysis of the socio-economic drivers, coastal and marine resource use, livelihoods, and governance frameworks relevant to the SCS-LME.

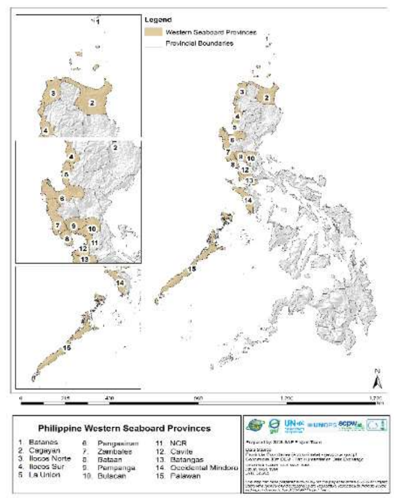

Figure 1.9. Political Boundaries of the Philippine Western Seaboard Provinces

1.4.3 List of Indicators by Components

Tables 1.1-1.5 below present only the indicators up to the second level. For the complete list of indicators per component, please refer to **Annex 1.A**.

A. Socioeconomics and Climate-related Threats – Assesses the vulnerability of coastal communities and livelihoods to socioeconomic pressures and climate change impacts

Table 1.1. List of Indicators for Socio-Economic and Climate

Socio-Economics and Climate Indicators	Components
Demographics	
SE1-1. Subnational Population	Number of Female Households
	Number of Male Households
	Total Households
	Total Population
	Growth Rate
SE1-2. Areas of Subnational First Level Administrative Region	Total Land Area (sq km)
SE1-3. Subnational Populations as % of National Population	% to Philippine Population
SE1-4. Subnational Region Areas as % of National Area	% to Philippines' Total Land Area (sq km)
SE1-5. Annual Population Changes	% Annual Change in the Population
SE1-6. Population Densities	Population Density (people/ sq km)

Socio-Economics and Climate Indicators	Components
SE1-10 Urbanization Rate	
SE1-11 Built Up Surface	Total Floor Area of Construction (sq km)
Human Well-Being	
SE2.1 Poverty	Poverty Incidence Among Families (%)
SE2.2 Contemporary Human Development Index (HDI)	Level of Literacy (Illiterate, Low Literate, Basic Literate) HDI Value and Classification

B. **Pollution** – Evaluates the sources, levels, and effects of land- and sea-based pollution on coastal and marine environments

Table 1.2. List of indicators for Pollution

Pollution Category	Parameter	Indicator
P-1. Marine and coastal water quality	PO1-1. Nutrient Pollution PO1-2. Organic Pollution PO1-3. Coliform PO1-4. Heavy Metals PO1-5. Water Quality PO1-6. Contaminants of Emerging PO1-7. Concerns (CEC)	 Nitrate, Phosphate, Ammonia BOD, DO Fecal, Total Coliform Cadmium, Chromium, Lead, Mercury TSS Microplastics
P-2. Aquaculture / mariculture pollution	PO2-1. Fish Kill Events PO2-2. Shellfish Advisories	 Harmful Algal Blooms (HABs)

C. **Ecosystems** – Examines the status, trends, and resilience of critical marine and coastal ecosystems and their services.

Table 1.3. List of Indicators for Ecosystems

Properties and Variables	Data & Information needed
Mangroves And Wetlands	
MW-1.1 Geographic information	
MW-1.1. Name of area	Name of locality (coastal areas, estuaries, lagoon, …)
MW-1.2. Co-ordinates	Latitude & Longitude central position of areas <50 Ha; GPS Boundary or number (min 4) of paired co-ordinates for larger areas; end points for linear strips.
MW-1.3. Total area	(Units Km^2 or Ha)
MW-1.4. Areas of mangrove forest	(Units Km^2 or Ha)
MW-1.5. Area of tidal flats	(Units Km^2 or Ha)
MW-1.6. Area of seagrass beds	(Units Km^2 or Ha)
MW-2. Social & use information	
MW-2.1. Ownership	Description: Federal, State, Community, private
MW-2.2. Management regime	Description: Land-use planning, Institutional framework, stakeholder co-ordination, forestry practices, restoration replanting, stakeholder investment, fishery practices.
MW-2.3. Current use	Description: Commercial, subsistence
MW-2.4. Potential use	Alternative livelihoods
MW-2.5. Significance/ national importance	Use designation in national/state master plans
MW-2.6. Protection status	Protection category (MPA, National Park…), total area, mangrove area, tidal flats area, seagrass area in hectare,
Coral Reefs And Seagrasses	

Properties and Variables	Data & Information needed
CS-1. Geographic Information	
CS-1.1. Name of area	Name of locality (islands, bay…)
CS-1.2. Co-ordinates	Latitude & Longitude central position of areas, GPS Boundary or number (min 4) of paired co-ordinates for larger areas; end points for linear strips.
CS-1.3. Area of coral reefs	Units Km2 or Ha
CS-1.4. Area of seagrass beds	Units Km2 or Ha
CS-1.5. Reef type	Fringing (mainland & island), barrier, atoll, patch, other
CS-2. Environmental state information	
CS-2.1. Present status	Live coral cover, dead coral cover, algae, abiotic (%) Seagrass cover (%)
CS-2.2. Present threats	• Sedimentation • Destructive fishing (no. of cases, both bombing & poisoning, reported per year • Pollution (no. population & distance to the sources of pollutants) • Crown of Thorns (COT), years, infestation (density of COT, no. of cases, and infested areas) • Bleaching (2010, 2014-2017, 2019, 2024, others (% bleaching of live coral, % of mortality) • Others
CS-2.3. Trends of change	Increase or decrease of live coral cover and/or seagrass cover & density
CS-2.4. Future threats	Development plan & distance to the coral reef and/or seagrass area

D. Fish, Fisheries, and Aquaculture – Monitors the sustainability, productivity, and impacts of wild fisheries and aquaculture practices.

Table 1.4. List of Indicators for Fisheries

Indicator/Parameter	Units
FS-1. Annual Catch	Metric Tons
FS-2. Catch Value	USD

E. Governance – Reviews the effectiveness of policies, institutions, and cooperative mechanisms in managing marine and coastal resources.

Table 1.5. List of Indicators for Governance

Indicators	Components
GO-1. Economic Arrangements	GO-1.1. Political and Economic Drivers GO-1.2. National Budgetary Allocations GO-1.3. Investments (National, International) GO-1.4. Provincial Investment Profile GO-1.5. Sustainable Financing Initiatives
GO-2. Institutional Setting	GO-2.1. Institutions, Regulatory Agencies, and Administrative Arrangements

1.4.4 Assessing Risks to Ecosystems, People and Livelihoods, including those that are Related to Climate Warming, as Bases for Integrated Governance

The Philippine waters within the SCS-LME are subject to an increasing convergence of environment and socio-economic risks, both localized and transboundary in nature. Key drivers such as pollution, habitat degradation, and overfishing (cited in Chapter 7.3 of this report) collectively undermine the ecological integrity and sustainability of marine and coastal resources in the country. These stressors are further magnified by climate change impacts of rising sea surface temperatures (SST), ocean acidification (Fabricius et al., 2011), and sea level rise. Collectively, this worsens existing vulnerabilities and introduces new systemic risks to ecosystems, communities, and marine-dependent livelihoods (UNEP, 2019; PEMSEA, 2018). A comprehensive assessment of such interconnected risks is crucial for integrated and evidence-based governance frameworks for the country's marine and coastal ecosystems.

Ecosystems

Critical coastal ecosystems such as mangroves, seagrass beds, coral reefs, and wetlands provide essential ecosystem services including shoreline protection, fish nursery functions, water filtration, and carbon sequestration (McLeod et al., 2010; Barbier et al., 2011). These services play a crucial role in enhancing climate resiliency and adaptive capacity especially of coastal communities. However, the continued degradation of these ecosystems, driven primarily by anthropogenic pressures including land and water use change, reclamation, destructive practices, and pollution (cited in Chapter 7.3 of this report), poses significant threat to their functionality.

Furthermore, climate-induced stressors such as ocean warming, coral bleaching, and sea-level rise add to these existing pressures leading to substantial decline in habitat suitability and driving shifts in species distribution (Hughes et al., 2017). In this assessment, key areas such as Manila Bay, Lingayen Gulf, Batangas Bay and the Verde Island Passage, and Palawan have been identified as critical ecosystem hotspots where high biodiversity overlaps with commercial, industrial and tourism-driven pressures (Licuanan et al, 2019; cited in Chapters 3 and 4 of this report) raising both their risk and biodiversity significance and further highlighting the need for integrated management strategies.

Socio-Economic and Climate Vulnerabilities

Densely populated urban areas particularly Metro Manila in the National Capital Region (NCR) and adjacent provinces exhibit the highest exposure to climate-induced hazards such as flooding, storm surge, and sea level rise (ADB, 2021; cited in Chapter 2 of this report). These areas are also burdened by significant socio-economic and infrastructural vulnerabilities i.e., lack of disaster-resilient and climate-adaptive structures, pollution overload, and encroachment of informal settlement families (ISF) in hazard-prone areas which cumulatively increase their vulnerability to adverse climate-related events (World Bank, 2022).

On the other hand, while remote provinces such as Batanes are less exposed to hazards, their limited adaptive capacities—measured by lower incomes, high poverty indices, limited technology and infrastructure, and insufficient policy and institutional mechanisms—directly contribute to their increased vulnerabilities and overall risk (Yusuf & Francisco, 2009). Both scenarios, although contrasting, underpin the role of climate warming as a "risk amplifier"—intensifying the frequency and magnitude of extreme weather events and disproportionately affecting the marginalized and vulnerable sectors (IPCC, 2023).

Livelihood Risk

Fisheries in the Philippines remain to be a primary livelihood particularly in small-scale coastal communities. However, the sector continues to suffer from overfishing, habitat loss, and illegal, unreported, and unregulated (IUU) fishing (cited in Chapter 5 of this report) particularly in Fisheries Management Areas 5 (Palawan and Occidental Mindoro) and 6 (Ilocos Norte, Ilocos Sur, La Union, Pangasinan, Bataan, Bulacan, Pampanga, Zambales, Batangas, Cavite, Occidental Mindoro) in this assessment. Degradation of mangroves, coral reefs, and fish spawning grounds directly affects fish productivity in addition to ocean warming which alters migration patterns and composition of fish species (DA-BFAR, 2020; Barange et al., 2018).

Without effective adaptive management, climate change will seriously threaten food security and livelihood stability of marine-dependent households. Therefore, climate change adaptation must be mainstreamed into policy measures, ensuring that these efforts complement and reinforce existing governance systems for sustainable fisheries and coastal resource use (Barange et al., 2018).

Risk-Based Integrated Governance

Globally pressing environmental challenges stem from complex socio-economic systems that transcend political, institutional, and governance areas. The fragmented structure of our existing governance frameworks is poorly equipped to manage cross-cutting issues, resulting in overlapping risks both at local and regional scales (PEMSEA, 2019; UNEP, 2019).

Hence, addressing the complex and interconnected nature of our country's social, economic, and environmental problems require systemic reform of institutional mechanisms. Governance frameworks must be data-driven, multi-level—linking local and national actions—and cross-sectoral, incorporating socio-economic dimensions with the three (3) interlinked planetary crises of climate change, nutrient and plastic pollution, and biodiversity loss (United Nations Framework Convention on Climate Change, n.d.). Furthermore, our governance frameworks should also adopt risk-based approaches that recognize the interaction between these drivers and the intensifying impacts of climate change. Such transformation is critical for minimizing socio-economic vulnerabilities and reducing ecological stress in our marine ecosystems (Raworth 2012; O'Neill et al. 2018 as cited in GEO-6 by UNEP, 2019; PEMSEA, 2019).

Chapter 1 References

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Chapter 1 Annexes

Annex 1.A. List of Indicators by Component

Annex 1A.1. List of Indicators for Socio-Economic and Climate (Continuation)

Socio-Economics and Climate Indicators	Components
Blue Economy	
SE3.1. Subnational Regional GDP by Economic Sector (Agriculture, Manufacturing, Services)	Agriculture, Forestry, and Fisheries Value Added at Current Price Manufacturing Value Added at Current Price: • Manufacturing • Mining and Quarrying • Electricity, Steam, Water, and Waste Management • Construction Services Value Added at Current Price • Wholesale and Retail Trade, Repair of Motor Vehicles and Motorcycles • Transportation and Storage • Accommodation and Food Service Activities • Information and Communication • Financial and Insurance Activities • Real Estate and Ownership of Dwellings • Professional and Business Services • Public Administration & Defense and Compulsory Social Activities • Education • Human Health and Social Work Activities • Other Services
Climate-Related Threats	
SE4-1. Number of Tropical Cyclones and Typhoons	
SE4-2. Number of Deaths Because of Tropical Cyclones and Typhoons	
SE4-3 Possible Total Damage Due to Hazards and Disasters (Exposed Population, Exposed Capital in USD)	Storm Surge • Typhoon Winds • Tsunami • Flooding • Landslide • Earthquake • Liquefaction • Volcanic Eruption • Wildfire • Drought • Other risks (epidemics, conflicts, etc)

Table 1.A.2. List of indicators for Pollution (Continuation)

Pollution Category	Parameter	Indicator
P-3. Wastewater and industrial	PO3-1. Wastewater PO3-2. Treatment Facility PO3-3. Pollution Load	Generated, Collected and Treated Nitrate, Phosphate, BOD, COD, TSS, Fecal Coliform

Pollution Category	Parameter	Indicator
P-4. Agricultural runoff	PO4-1. Fertilizer Use PO4-2. Pesticide Use PO4-3. Nutrient Load	N, P, K Fertilizer Nitrate, Phosphorus
P-5. Solid waste	PO5-1. Projected Generation PO5-2. Disposal Facilities PO5-3. Top Plastic-Emitting Rivers in the Philippines	Illegal Dumps, Sanitary Landfill, MRFs
P-6. Hazardous waste	PO6-1. Hazardous Waste PO6-2. Types of Hazardous Waste PO6-3. Treatment Facility	Generated, Collected and Treated Waste with Cyanide, Acid Wastes, Alkali Wastes, Waste with Inorganic Chemicals, Reactive Chemical Wastes, Inks/Dyes/Pigments/ Paint/Latex/Adhesives/ Organic Sludge, Waste Organic Solvent, Organic Wastes, Oil, Containers, Immobilized/Stabilized Wastes, Organic Chemicals, Miscellaneous Wastes
P-7. Oil pollution	PO7-1. Oil Spill	Major Incidents, Volume
P-8. Atmospheric pollution	PO8-1. Wet Deposition PO8-2. Dry Deposition	Sulfate, Nitrate Sulfate (Particulate-bound), Nitrate (Particulate-bound)

Table 1.A.3. List of indicators for Ecosystems (Continuation)

Properties and Variables	Data & Information needed
Mangroves And Wetlands	
MW-3. Biological data	
MW-3.1. Present status	Vegetation Canopy Cover, Seagrass cover (% area)
MW-3.2. Natural/Managed	Proportions of total area natural and replanted
MW-3.3. Mangrove diversity	(True) Mangrove tree species Density (no ha^{-1})
MW-3.4. Seagrass diversity	Number of Seagrass species
MW-3.5. Migrating species	Species of mammals, birds
MW-3.6. SCS Endemic species	List species and abundance
MW-3.7. Endangered or threatened species (IUCN criteria)	List species and abundance if data available
MW-3.8. Source & sink of larvae	Location & types (breeding/nursery grounds of fishery species), density of larvae
MW-4. Stress-pressure information	
MW-4.1. Intrinsic/internal sources of change	• Resident human population • Natural e.g. frequency of typhoon throws, change in allochthonous sediment inputs, marine based flooding, erosion
MW-4.2. Extrinsic/external sources of change	Changes in catchment basin e.g. dam construction, water diversion etc.
MW-4.3. Rates of change, historical review	Rates of loss of cover and/or species over the period 2010-2024
MW-4.4. Social and economic drivers of change in environmental state	Description, quantitatively, if possible, e.g. population growth, immigration, income/livelihood, demand/ consumption, management regime)
MW-5. Economic valuation (based on Barbier, E.B. 1997)	
MW-5.1. Values of direct use	Timber, charcoal, living marine resource extraction
MW-5.2. Values of indirect use	Carbon sequestration, ecotourism, nursery areas for shrimps
MW-5.3. Values from environmental services	Coastal protection, sediment stabilization, water quality enhancement, contaminant sink, reduction of wave energy & erosion
MW-5.4. Value of investment	Restoration, replanting

Properties and Variables	Data & Information needed
MW-5.5. Values of potential (commercial) sustainable use	
MW-5.6. Total Economic Value	Local currency total (year?)
Coral Reefs And Seagrasses	
CS-3. Social & use information	
CS-3.1. Ownership	Description: Federal, State, Community, private, common property
CS-3.2. Management regime	Description: Land-use planning and coastal zoning, Institutional framework, stakeholder co-ordination, restoration, stakeholder investment, fishery practices
CS-3.3. Current use	Description: Commercial, subsistence, fishing ground, tourism and/or MPA
CS-3.4. Traditional use	Description of
CS-3.5. Potential use	Tourism and MPA (sustainable use)
CS-3.6. Significance/national importance	Use designation in national/state master plans
CS-3.7. Protection status	Protection category (MPA, National Park…), total area, coral reef area, seagrass area in hectare
CS-4. Biological data	
CS-4.1. Species diversity	• No. of species and coverage of hard corals • No. of species and coverage of soft corals • No. of species and coverage of seagrasses
CS-4.2. SCS Endemic species	List species and abundance
CS-4.3. Endangered or threatened species (IUCN criteria)	List species and abundance
CS-4.4. Source & sink of larvae	Location & types (breeding/nursery grounds of fishery species), density of larvae
CS-4.5. Migratory species	List species and abundance
CS-5. Economic valuation (based on Barbier, E.B. 1997)	
CS-5.1. Extractive	Reef related fish landing (mt/$$) Subsistence fishery (no. of fishers dependent on reef – mt/$) Commercially (live fish and fish landing – mt/$)
CS-5.2. Non extractive (tourism)	No. of visitors. ($ generated) No. of people involved in industry (income generated) – no. of chalets/hotels operators - no. ferry/boats operator - no. guide/agents Environment services Education Others
CS-5.3. Total Economic Value	Local currency total (year)

Table 1.A.4. List of indicators for Fisheries (Continuation)

Indicator/Parameter	Units
FS-3. Species Population Size	Number of Individuals
FS-4. Biomass	Kg/km^2 (Tons/area)
FS-5. Stock Status Plots	%
FS-6. Fishing Effort	Number of Vessels or Hours Fished
FS-7. Catch per unit effort (CPUEs)	Kg per hour of trawling Kg/ 1000 hooks of Long Line
FS-8. Subsidies	USD or local currency
FS-9. Primary Production Required (PPR)	$mgC \cdot day^{-1} \cdot m^{-2}$
FS-10. Marine Trophic Index	Level 1 - 5
FS-11. Fishing-in-Balance Index (FIB)	= 0; = More than 0; = Less than 0
FS-12. Catch from Bottom Impacting Gear	Percentage (%)
FS-13. Change in Catch Potential under environmental temperature change	Percentage (%)
FS-14. Aquaculture Products	Metric Tons
FS-15. Aquaculture values	USD

Table 1.A.5. List of indicators for Governance (Continuation)

Indicators	Components
GO-3. Legislation and Policies	GO-3.1. International Legal/Policy Frameworks & Forums • United Nations Convention on the Law of The Sea (UNCLOS) • Fisheries Related Instruments • Biodiversity Related Instruments • Pollution Related Instruments • Climate Change Related Instruments GO-3.2. Regional Legal/Policy Frameworks & Forums GO-3.3. National and Subnational Legislation and Policies GO-3.4. Current Development Plans, Policies
GO-4. Civil Society, Stakeholders and Partnerships	GO-4.1. Key NGOs and Special Interest Groups GO-4.2. Trade Associations and Business Groups GO-4.3. Co-Management, Traditional Systems and Customary Rights GO-4.4. Decentralized Governance, Coastal Governance (Formal, Informal)