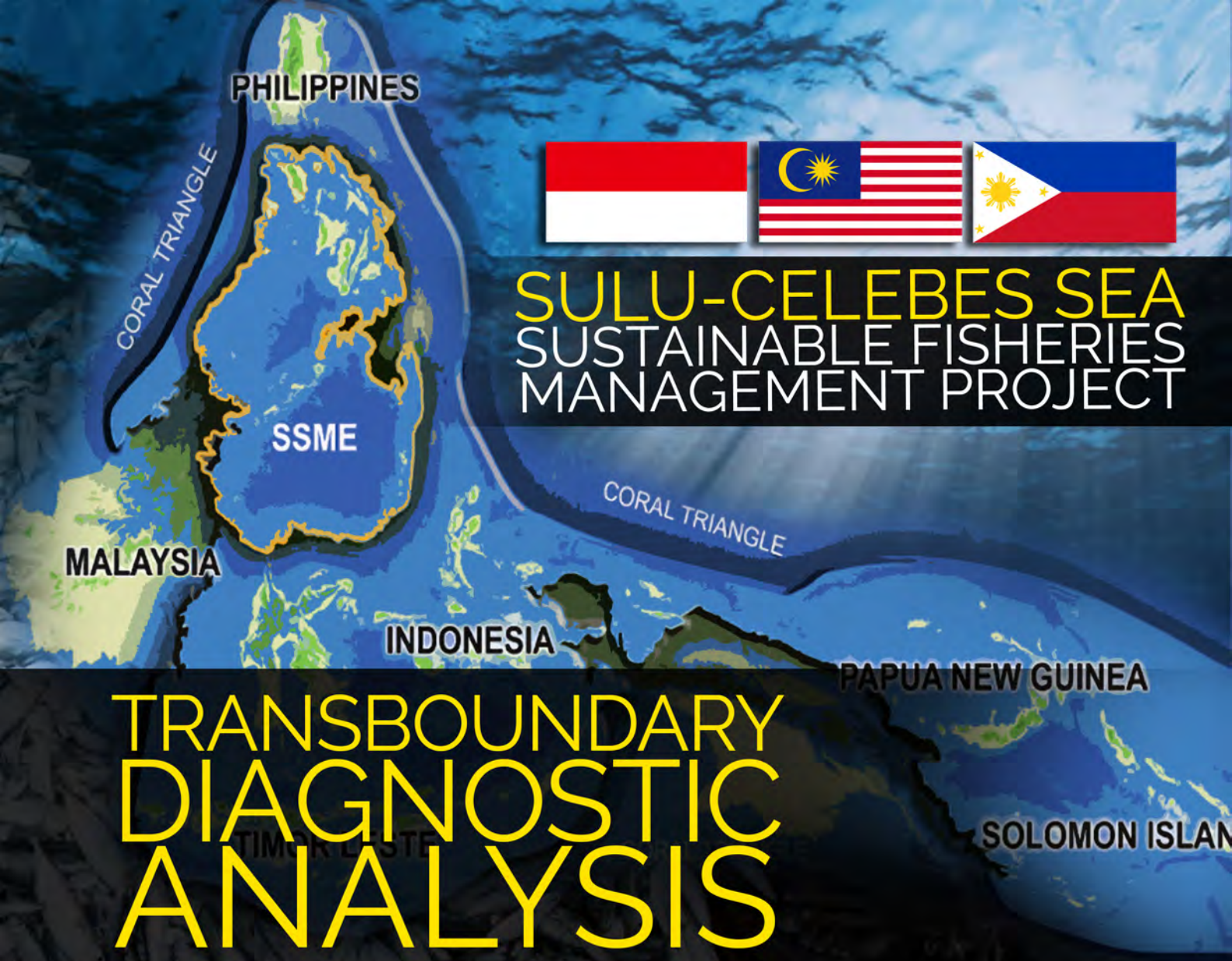

SULU-CELEBES SEA SUSTAINABLE FISHERIES MANAGEMENT PROJECT

TRANSBOUNDARY DIAGNOSTIC ANALYSIS

TDA

TRANSBOUNDARY DIAGNOSTIC ANALYSIS

SULU-CELEBES SEA SUSTAINABLE
FISHERIES MANAGEMENT PROJECT
2014

REPORT ON THE TRANSBOUNDARY DIAGNOSTIC ANALYSIS OF THE

SULU-CELEBES (SULAWESI) LARGE MARINE ECOSYSTEM

Executive Summary

The Sulu-Celebes (Sulawesi) Sea Large Marine Ecosystem (SCS LME) is a tropical body of water that gives life support to Indonesians, Malaysians, Filipinos, and the rest of the world. The SCS LME has the highest marine biodiversity among the oceans[1]. It is at the apex of the famous coral triangle – the area where the number of corals, fishes, molluscs, mangrove plants, seagrass species, and algae are highest in the world. This high diversity of marine organisms provides resiliency against natural and anthropogenic stresses.

The high biodiversity of the SCS LME provide a wide array of ecosystem services. The stocks of marine fishes in mangrove forests, coral reefs, bays, and pelagic waters are the natural resources exploited by coastal and offshore fisheries to provide food **(provisioning service)**. The seafood benefits the people living around the SCS LME and exported fishery products benefit the world. The economic value of this service is contributes a conservative value of about 5-7% of the countries' (Indonesia, Malaysia, Philippines) gross domestic product (GDP). The SCS LME is a small (1,000 km^2) twin-basin but with depths reaching 5,000 m. It has the potential to store large quantities of carbon, which is important in regulating climate, and removing pollutants in the water **(regulating service)**. The mangrove forests (e.g., East Sabah and Palawan), peat-swamps (East Kalimantan), and seagrass beds (e.g., in Semporna, Kudat, Cagayancillo) regulate sedimentation into coastal waters and coral reefs. The peat-swamps store and regulate freshwater flowing into coastal waters. Mangrove forests and coral reefs protect coastlines from being eroded and human settlements from being washed-over by surges during storms and typhoons **(regulating service)**. The regulating services of these ecosystems are rarely given monetary values (but it is increasingly needed for decision-making) but costs of replacing these services are better known, e.g., a sea-wall is PhP 1 million/100 m (2010 prices).

The SCS LME is also home to unique groups of people. The Badjau is a nomadic people in the maritime waters of Southeast Asia although some members have learned to settle on islands and the coasts of Mindanao, East Sabah, East Kalimantan, Sulawesi Island and other areas. The Badjau

[1] Carpenter and Springer 2005

in Semporna, Sabah always hold a parade on the sea (*lepa-lepa*) with colourful sails like the *vintas* of Zamboanga attesting to the bond between these people and the sea **(cultural service)**. The Tubbataha Reef that lies in the heart of the Sulu Sea is among the World Heritage Sites of UNESCO, and also judged as one of the Wetlands of International Importance by the Ramsar Convention. The extraordinary sites of biodiversity and beauty are attractions that tourists from the region and around world are interested to visit and enjoy and are willing to pay for its conservation.

The SCS LME has oceanographic features that are the subject of studies by scientists of Indonesia, Malaysia, the Philippines and other countries[2].

The stakeholders of Indonesia, Malaysia, and the Philippines, in recognition of the importance of the large marine ecosystem, ratified the Sulu-Sulawesi Marine Ecoregion Conservation Plan (SSME ECP) in 2006 and subsequently formed the three-country governance structure - the Trinational Committee for the SSME and its three Sub-committees on Charismatic and Threatened Species, Marine Protected Areas and Networks, and Sustainable Fisheries. The Sub-committees prepared in 2008 the Action Plans for implementation by the countries to achieve the vision and the ten objectives of the SSME ECP. The Action Plans of the Sub-committees were reviewed, the impacts of climate change considered and added, and the estimates of costs of implementation were prepared in 2010. The *Comprehensive Action Plan of the Sulu-Sulawesi Marine Ecoregion, A Priority Seascape of the Coral Triangle Initiative* was published and launched in October 2011.

The trinational management of the SCS LME is a partnership facilitated by the World Wide Fund for Nature – (WWF) Philippines and supported by Conservation International Philippines (CI-P). The Global Environment Facility (GEF) continues to support the implementation of the SSME ECP, particularly in Action Plan of the Sub-committee on Sustainable Fisheries. The Sulu-Celebes Sea Sustainable Fisheries Management Project (SCS SFM) is funded under the Coral Triangle Program, International Waters Focal Area, of the Global Environment Facility (GEF).

The GEF International Waters Focal Area focuses and supports the sustainable development of nations and the agenda of the governments to achieve this by facilitating and investing for sustained management of large marine ecosystem. The GEF provides grants in the building of the foundation for ecosystem-based management and sustainable development by: prioritizing environmental problems and finding their root-causes in a Transboundary Diagnostic Analysis (TDA); formulating a Strategic Action Program (SAP) that addresses the root-causes of the problems and applies a monitoring and evaluation of management effectiveness (in the concept of adaptive management, integrated coastal management, and co-management between resource managers and resource users). The GEF supports also the implementation of the SAP that uses management tools that have been demonstrated to be effective (in sites, which can be replicated and scaled-up in the large marine ecosystem).

The Sub-committee on Sustainable Fisheries, under its Action Plan, submitted in 2007 a proposal to the GEF International Waters Focal Area, with the support of CI-Philippines and the endorsement

[2] For example: Jones, I. S. F. 2002. Primary production in the Sulu Sea. Proc. Indian Acad. Sciences – Earth and Planetary Sciences 111:209-213; Gordon, A. L., Z. D. Tessler, and C. Villanoy. 2011. Dual overflows in to the deep Sulu Sea. Geophysical Res. Letters 38 L 18606, 6 pp. doi:10.1029/2011GL048878.

of the Trinational Committee of SSME. The United Nations Development Programme (UNDP) approved the SCS SFM Project in 2010, with the UNDP as the implementing Agency and United Nations Office for Project Services (UNOPS) as the Executing Agency. The SCS SFM Project has the following components:

Component 1 – Conduct of the Transboundary Diagnostic Analysis

Component 2 – Formulation of the Strategic Action Programme

Component 3 – Institutional Strengthening

Component 4 – Demonstration Site

Component 5 – Knowledge Management

This report covers the Transboundary Diagnostic Analysis.

The Transboundary Diagnostic Analysis is for the identification and the prioritization of transboundary environmental problems and the analysis of its root causes. A similar activity was conducted in 2002 in the Sulu-Celebes Sea LME under the GEF/UNEP/Global International Waters Assessment (GIWA) Project. The GIWA for the SCS LME drew results from the biodiversity and socio-economic assessments under the SSME Biodiversity Visioning, facilitated by WWF Ecoregional Conservation Program[3]. The prioritized transboundary problems were:

1 - Unsustainable Exploitation of Fish

2 - Habitat Loss and Community Modification

3 – Marine Pollution

4 – Freshwater Shortage

5 – Climate Change

The ecological and socio-economic impacts of these problems, projected to 2020, will be severe unless interventions are put in place.

The TDA in the SCS SFM Project is to up-date the GEF/UNEP/GIWA findings and to analyse the root-causes of all the transboundary problems (TP) and serve as the bases for the formulation of the SAP. The TDA followed the process promoted by the GEF[4], which includes the following steps: The TDA process that was used in the SCS LME consists of the following steps: (1) identification of the geographical scale of the physical boundary and time scale, (2) identification of TPs relevant within the bounds of the identified geographic and temporal scales, (3) prioritization of the TPs; (4) secondary research and validation; (5) Finalization of the priority TPs, and (6) Casual Chain Analysis.

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[3] SSME ECP

[4] IW:LEARN; The NOAA also has a 5-modular approach (http://www.noaa.gov.us)

The SCS SFM Project has pre-selected CI-Philippines to facilitate the conduct of the TDA of the SCS LME. The CI-Philippines formed a team and engaged Technical Task Teams (TTT) for Indonesia, Malaysia, and the Philippines. The TTT is composed of four (4) experts in the following fields: fisheries, environment, socio-economics, and legal, institutions and governance. These teams and the National Coordinating Units (NCU) of the respective countries conducted the TDA in the Sulu-Celebes Large Marine Ecosystem (SCS LME). The technical staff of the Project Management Office (PMO) provided technical guidance in the whole process. Two regional workshops were conducted in 2011: the 1st Regional Workshop was conducted for the spatial and temporal scoping of the TDA and the identification and preliminary prioritization of the transboundary problems; and the 2nd Regional Workshop was for the finalization of the priority transboundary problems and the identification of the root causes (causal-chain-analysis). The national workshops validated the data and information collected by the TTTs and generated additional data and sources from the stakeholders.

The TDA results are summarized, as follows:

Scope – The spatial boundary for the analysis is expanded to include the watersheds surrounding the SCS LME because of the impacts of the activities in the watershed that transcend into the marine ecosystem. The inclusion of the watershed makes the analysis complete and scientifically sound. It is also consistent with the Global Program of Action for the Protection of the Marine Environment from Land-based Activities (GPA), to which Indonesia, Malaysia, and the Philippines are signatories. The temporal scope of the analysis includes all available data and the impacts are projected to 2020, and aligned to the commitments of the countries to the Convention on Biological Diversity.

Transboundary Problems

1 – Unsustainable Exploitation of Fish

Fisheries in the SCS countries are probably among the most diverse in the entire coral triangle. The aggregate marine capture fisheries production in the SCS countries during the last decade was more than $53x10^6$ tons, which is a 10-fold increase from the 1950s. Small pelagics are a consistent sizeable contribution to the total marine fisheries landings (>30%). However, fish stocks have declined evident also from the declining catch per unit effort (CPUE). Aquaculture (inland and marine) has helped buffer the fisheries production, which has seen a rapid development over the past 20 years although this is mostly production on aquatic plants. Total aquaculture production in the last decade for Indonesia and the Philippines amounted to more than US$18 million and US$10 million, respectively. Malaysia is not yet very active in the aquaculture industry with only about US$1 million total production over the past 10 years. The rapid growth of the aquaculture industry in the region has also led to the decimation of coastal ecosystems like mangroves and seagrass beds. The industry is also beset with pollution problems, causing it to self-destruct and impact coastal waters in terms of fishkills.

2 – Habitat Loss and Community Modification

The SCS LME has a combined area of at least 124,000 square kilometers of mangroves, seagrass beds, and coral reefs. Among the three countries, Indonesia has the most extensive coral reef (39,538 km^2, and also the most diverse with >550 coral species) and mangrove ecosystems (~20,000 km^2) while Philippines has the greatest extent of seagrass cover (~27,000 km^2). The coral reef ecosystems of SCS is an integral part of the most biodiverse coral triangle and provides an annual potential finfish yield of 675,380 metric tons to >40 million people. However, most coral reefs of the SCS LME have coral cover below 50% and vast expanses of mangroves have been converted to aquaculture ponds. Seagrasses are least studied but nonetheless suffer from degradation and destruction from coastal development. Marine protected areas are the advocated tool to protect biodiversity and improve fisheries productivity in the coastal zone. For coral reefs alone, the destruction of one square kilometer entails economic losses from fisheries, ecotourism and shoreline protection of some US$137,000-1,200,000 over a 25-year period.

3 – Climate Change

The IPCC has shown a global trend of increasing temperatures and rising sea level (1.8-3.1 mm/yr from 1961-1993, which is 18-59 cm at the end of the 21st century) since the mid-1800. Frequency of extreme events in terms of rainfall and drought has also increased including changes in wind patterns. Large scale shifts in ocean circulation will have its impacts on productivity, fisheries, and carbon dioxide uptake. These changes will put 20-30% of species under increased risk of extinction. The considerable number people in the SCS (>40 million) dependent on marine fisheries and the contribution of the fisheries sector to the GDP give a perspective on the potential impact of climate change to the economy and to the welfare of the people.

4 - Marine Pollution

Sedimentation is one of the highest forms of pollution on earth. About 1 billion tons of sediment from the Philippines and 29 rivers from Borneo and Sulawesi Islands, discharge 4.2 x 109 mt sediment or 20 to 25% of the global sediment export. In the coastal zone, coral reefs usually succumb to sedimentation while mangroves and seagrasses are less affected. Other pollution problems include solid waste, chemical contamination and oil spills, and eutrophication leading to harmful algal blooms and concomitant fish kills in coastal areas and aquaculture farms.

5 – Freshwater Shortage

Freshwater sources of the SSME areas in Indonesia, Malaysia and the Philippine mainly come from rivers, lakes, ground basins and even rain. Impacts of human activities in the watersheds and drainage basins, exacerbated by climate change, will compromise freshwater availability and its intended use. Dry spells from El Nino events, for example, limited the water availability and interrupted power generation in hydroelectric dams in Mindanao (Philippine part of SCS LME). Economic production in this locality was considerably reduced. Health related concerns are also expected to arise with lack or shortage of freshwater and this is projected to be severe in the future.

6 –Alien and Invasive Species

Increasing mobility through trade, business travel, migration, tourism and human interaction are among the key drivers in spreading alien species. It is estimated that around 10,000 species are being carried in ballast water around the globe. Alien species can be invasive and repress or exclude native species and disrupt ecosystems especially when they carry pathogens or are pathogenic themselves. There is a dearth of studies that assess the quantitative ecological and socio-economic impacts of invasive alien species and even the specific resilience of ecosystems especially in the SCS. Meanwhile, some alien species in certain situations may be beneficial if they become a new resource, especially as food items (e.g., tilapia). From the economics perspective, alien species contribute substantially to the aquaculture production of Southeast Asian countries (e.g., >8% of Indonesia's aquaculture production).

The results of the TDA analysis are slightly different from the results of the GIWA in 2002. Climate Change is ranked 3rd from the 5th and last position. Marine Pollution is found to have lesser impact than Climate Change (#3). Alien and invasive species was not in the earlier assessment but is now considered a problem.

The results of the causal-chain-analysis for the **unsustainable exploitation of marine resources**, **habitat destruction and community modification**, **marine pollution, freshwater shortage,** and **invasive alien species** are presented in mindmaps. The "impact-analysis" was prepared for **climate change** since the root-cause of this environmental problem is high carbon emission from industrial countries and beyond the jurisdiction of the governments.

The root-causes of the transboundary problems are socio-economic and governance in nature. These are summarized in the table below:

Transboundary problem	Root causes		
	Governance	Sociological	Socioeconomic
1. Unsustainable exploitation of fish	• Lack of political will due to existing/prevailing economic model system which does not account the real economic value of the sector • Weak regulation of regional illegal, unreported, unregulated (IUU) • Low priority of fisheries and the marine environment in national planning • Inconsistencies in government laws or regulations	• Poverty	• Poverty • Increasing demand for small pelagic fishes for food, fish bait, fish-meal, and feeds for aquaculture
2. Habitat loss and community modification	• Poor or lack of urban, agri-industrial, tourism, and poor land-use planning • Unregulated industrial development	• Lack of awareness of the importance of habitats and communities	

	• Poor management, lack of policy on water management • Poor or lack of enforcement of regulations		
3. Marine pollution	• Lack of political will and weak enforcement and monitoring (for chemical pollution) • Weak land-use planning coupled with weak governance (for suspended solids and solid waste)		• Lack of funding (Indonesia, Philippines) for solid waste pollution
4. Climate change		[Ecological] • Increase in frequency and intensity of typhoons • Increase in frequency and volume of rainfall • Sea-level rise • Ocean acidification • Increase in sea-surface temperature	• Loss of properties (houses, infrastructure, vessel), livelihoods, and lives • Fluctuating prices or high (local) market price of fishery products • Poor fishermen trapped in the vicious cycle of poverty • Increase unemployment • Increase in irresponsible fishing practices • Displacement of human populations • Increase in morbidity • Poor welfare conditions • High investment costs in technology and capacity • Increase in poverty incidence • (+) With the potential retreat of mangroves landward, there is also a potential expansion of seagrass beds and coral reefs and their related fisheries

The SCS LME has an existing SSME Ecoregion Conservation Plan under the governance of the Trinational Committee and Sub-committees. The Sub-committee on Sustainable Fisheries needs strengthening to address the root causes of the transboundary problems, particularly on the overexploitation of marine resources, especially of shared stocks, and the application of ecosystem approach to fisheries management in the SSME. The Governments of Indonesia, Malaysia, and the Philippines are signatories to international conventions (e.g., Convention on Biological Diversity, United Nations Convention on the Law of the Sea; Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea, of 10 December 1982, relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks; FAO Code of Conduct for Responsible Fisheries (the FAO Code of Conduct); Convention on the

Prevention of Marine Pollution by Dumping of Wastes and other Matter; Convention on Persistent Organic Pollutants (POPs); regional agreement and cooperation (Treaty of Amity and Cooperation in Southeast Asia; Brunei-Indonesia-Malaysia-Philippines East Asia Growth Area), and initiatives (e.g., Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security; Sustainable Development and Climate Change Adaptation in the Seas of East Asia Region) that address all the transboundary problems. The governments of Indonesia, Malaysia, and the Philippines also have signed on the United Nations Framework Convention on Climate Change (UNFCCC). National legislations, for the most part, are in place but require appropriate regulations and enforcement to address the issues that result to transboundary environmental problems.

A dynamic synergy between and among the three Sub-committees of the SSME (Threatened, Charismatic and Migratory Species, Marine Protected Areas and Networks, and Sustainable Fisheries) should be developed and maintained. This could be achieved by designing, implementing and monitoring projects that will compel the three` Sub-Committees to address their respective thematic issues, i.e., fisheries, MPAs and MPA Networks and threatened species in a complementary and synergistic fashion. The SSME is strategically positioned to demonstrate this synergy and complementation by building on existing plans and strategies, e.g., MPA Network for Sea Turtles which could simultaneously address fisheries by-catch issues involving threatened sea turtles. The synergy among the Sub-committees is important in implementing the ecosystem approach to fisheries management – a management framework that requires the co-management of ecosystems, using protected areas, for endangered and commercially-important species for the sustainability of fisheries.

National agencies, economic sectors, civic societies, and the general population are the stakeholders of the SCS LME. They are interested and willing to participate in the sustainable fisheries management of the SCS LME through: information and access-sharing; provision of inputs to activities; and involvement in activities. The stakeholders are amenable to communicate through the internet, newsletters, and periodic meetings to participate and receive information on the progress activities. The success of this endeavour is to their overall wellbeing.

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ACRONYMS AND ABBREVIATIONS

Acronyms	
AMFR	Agency for Marine and Fisheries Research (Indonesia)
APEC	Asia-Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nations
ASEAN-WEN	Association of Southeast Asian Wildlife Enforcement Network
ASP	Amnesic Shellfish Poisoning
BFAR	Bureau of Fisheries and Aquatic Resources (Philippines)
BIMP-EAGA	Brunei, Indonesia, Malaysia, Philippines - East Asia Growth Area
BT	Butyltin
CAP	Comprehensive Actions Plans
CBD	Convention on Biological Diversity
CCA	Causal Chain Analysis
CI-P	Conservation International-Philippines
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
COREMAP	Coral Reef Rehabilitation and Management Program
CTI-RPOA	Coral Triangle Initiative-Regional Plan of Action
DENR	Department of Environment and Natural Resources (Philippines)
DoF	Department of Fisheries (Malaysia)
DPSIR	Driver-Pressure-State-Impact-Response
DSP	Diarrhetic Shellfish Poisoning
ECP	Ecoregion Conservation Plan
EIS	Environmental Impact Score
ENSO	El Niño Southern Oscillation
FAD	Fish Aggregating Device
FAO	Food and Agriculture Organization of the United Nations
FRI	Fisheries Research Institute (Malaysia)
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIWA	Global International Waters Assessment
GVA	Gross Value Added
HAB	Harmful Algal Bloom
HDI	Human Development Index
IEC	Information, Education and Communication
IHHNV	Infectious hypodermal and hematopoietic necrosis virus
IMP	Indonesia, Malaysia and the Philippines
IPCC	Intergovernmental Panel on Climate Change
I-SCS	Indonesian part of the SCS LME
ITF	Indonesian Throughflow
IUU	Illegal, Unreported and Unregulated (fishing)
LGU	Local Government Units
M-SCS	Malaysian part of the SCS LME
NCU	National Coordination Units
NEC	North Equatorial Current
NFRDI	National Fisheries Research and Development Institute (Philippines)
NGO	Non-Government Organization
NPW	North Pacific Water
PES	Payment for Environment Services

PMO	Project Management Office
P-SCS	Philippine part of the SCS LME
PSSA	Particularly sensitive sea areas
RCFMC	Research Center for Fisheries Management and Conservation
SAP	Strategic Action Program
SCS LME	Sulu-Celebes Sea Large Marine Ecosystem
SCS-SFMP	Sulu-Celebes Sea Sustainable Fisheries Management Project
SEAFDEC	Southeast Asian Fisheries Development Center
SLR	Sea level rise
SSME	Sulu-Sulawesi Marine Ecoregion
SST	Sea Surface Temperature
TDA	Transboundary Diagnostic Analysis
TP	Transboundary Problem
TTT	Technical Task Team
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNOPS	United Nations Office for Project Services
WNPSM	Western North Pacific Summer Monsoon

Abbreviations	
Cd	cadmium
Chl-a	chlorophyll a
Cr	chromium
Cu	copper
E coli	*Escherichia coli* (the bacterium indicator of fecal coliform)
g cm^{-1} kyr^{-1}	grams per centimeter per kiloyear
g C m^{-2} yr^{-1}	grams of carbon per square meter per year
ha	hectare
km	kilometer
m	meter
mg m^{-2}	milligrams per square meter
mg L^{-1}	milligrams per liter
ml ml^{-1} O_2	milliliters per milliliter of oxygen
MPN $100ml^{-1}$	most probable number per 100 milliliters
NH_3	ammonia
NO_2^- or NO_2	nitrite
NO_3^- or NO_3	nitrate
Pb	lead
pH	acidity or alkalinity of liquids ranging from 0 (strong acid) to 14 (strong base), and pure water is pH 7
PO_4^{3-} or PO_4	phosphate
psu	practical salinity units
SiO_4 or SiO_4^{-4}	silicate
sp	species (singular)
spp	species (plural)
µg L^{-1}	microgram per liter
µM	micromolar
Zn	zinc

GLOSSARY

Capture of undersized pelagic fish - qualifier to include undersized small pelagic fishes and juvenile tuna to address the issue of inclusion of tuna in small pelagic fisheries

Fish aggregating device (FAD) - term agreed to refer to any device used to catch fish in lieu of the Malaysian term peranti pengumpul ikan

frequency of impact - measure of persistence of impact

geographical scaling - spatial extent to consider in inferring impacts of transboundary problems, taking into account sources of pollution, locations of socio-economic centers

illegal migrants - children born in SCS who are undocumented

Increase in surface temperature - term referring to a specific change in sea surface temperature (in lieu of 'change in sea surface temperature), in relation to climate change, to emphasize a negative effect

long-term - time scale covering five to twenty years (agreed for this document)

Loss of freshwater source - term referring to loss of watershed area causing freshwater shortage due to development activities

ridge-to-reef - an ecosystem-based approach to conservation which includes managing large marine ecosystems and terrestrial habitats in a single integrated management framework

Sea level rise - term referring to a specific change in sea level (in lieu of 'change in sea level'), in relation to climate change, to emphasize a negative effect

short-term - time scale covering less than three years (agreed for this document)

stakeholders - sectors of society (individual or group) that have interest, involvement and contribution to an environment in terms of benefits, issues and management

stateless people - sea gypsies with no documents and is now under the UN Convention

Technical Task Team - a team of experts in different fields (fisheries, environment, socio-economic and policy and governance), for each country, tasked to undertake a Transboundary Diagnostic Analysis of the SCS LME

temporal scaling - number of years into the future to consider in inferring impacts of transboundary problems

transboundary problem – a) any form of anthropogenic degradation in the natural state of a water body that concerns more than one country; b) an environmental problem originating in, or contributed by, one country and affecting (or impacting) another; c) the impact may be damage to the natural environment and/or damage to human welfare.

Underemployment - full potentials of the labor force is not optimized; level of income derived from such employment is lower than what is commensurate to the worker's capabilities and abilities.

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THE SULU-CELEBES SEA LARGE MARINE ECOSYSTEM (SCS LME)

1.1. Introduction

The Sulu-Celebes Sea Large Marine Ecosystem (SCS LME) is composed of the Sulu Sea and Celebes (Sulawesi) Sea that is separated by a chain of islands called the Sulu archipelago. This ecosystem is important to Indonesians, Malaysians, Filipinos, and to the world. It is at the apex of the Coral Triangle (Figure 1.1) – an ecoregion that has the highest marine biodiversity among the oceans (see also Section 1.2). The high marine biodiversity of the SCS LME provides a wide array of ecosystem services like provisioning, regulating, cultural and supporting services and also provides resiliency against threats like climate change.

The stakeholders of Indonesia, Malaysia and Philippines, in recognition of the importance of the large marine ecosystem, ratified the Sulu-Sulawesi Marine Ecoregion (SSME) Conservation Plan in 2006 and subsequently formed the trinational governance structure — the Trinational Committee for the SSME and the Sub-committee on Charismatic and Threatened Species, Sub-committee on Marine Protected Area and Networks, and the Sub-committee on Sustainable Fisheries. In 2008, the Sub-committees prepared the Action Plans for the countries' implementation to achieve the vision and the ten objectives of the SSME ECP. In 2010, climate change impacts were considered and added to the Action Plans of the Sub-committees. The *Comprehensive Action Plan of the Sulu-Sulawesi Marine Ecoregion, A Priority Seascape of the Coral Triangle Initiative* was then published and launched in October 2011. Under its Action Plan of 2006-2010, the Sub-committee on Sustainable Fisheries, with the support of Conservation International – Philippines (CI Philippines) and the endorsement of the Trinational Committee of SSME, submitted a proposal to the Global Environment Facility (GEF) International Waters Focal Area in 2007.

The GEF International Waters Focal Area focuses and supports the sustainable development of nations and the agenda of the governments. They achieve this by facilitating and investing for the sustained management of large marine ecosystems, which led to the approval of the Sulu-Celebes Sea Sustainable Fisheries Management Project in 2010 (with the UNDP as the implementing Agency and UNOPS as the Executing Agency). The GEF provides grants in the building of the foundation for ecosystem-based management and sustainable development by: (1) prioritizing environmental problems and finding their root-causes in a Transboundary Diagnostic Analysis (TDA) methodology; and (2) formulating a Strategic Action Program (SAP) that addresses the root-causes of the problems and applies a monitoring and evaluation of management effectiveness. The GEF also supports the implementation of the SAP that uses management tools that have been demonstrated to be effective, and can be replicated and scaled-up to the large marine ecosystem.

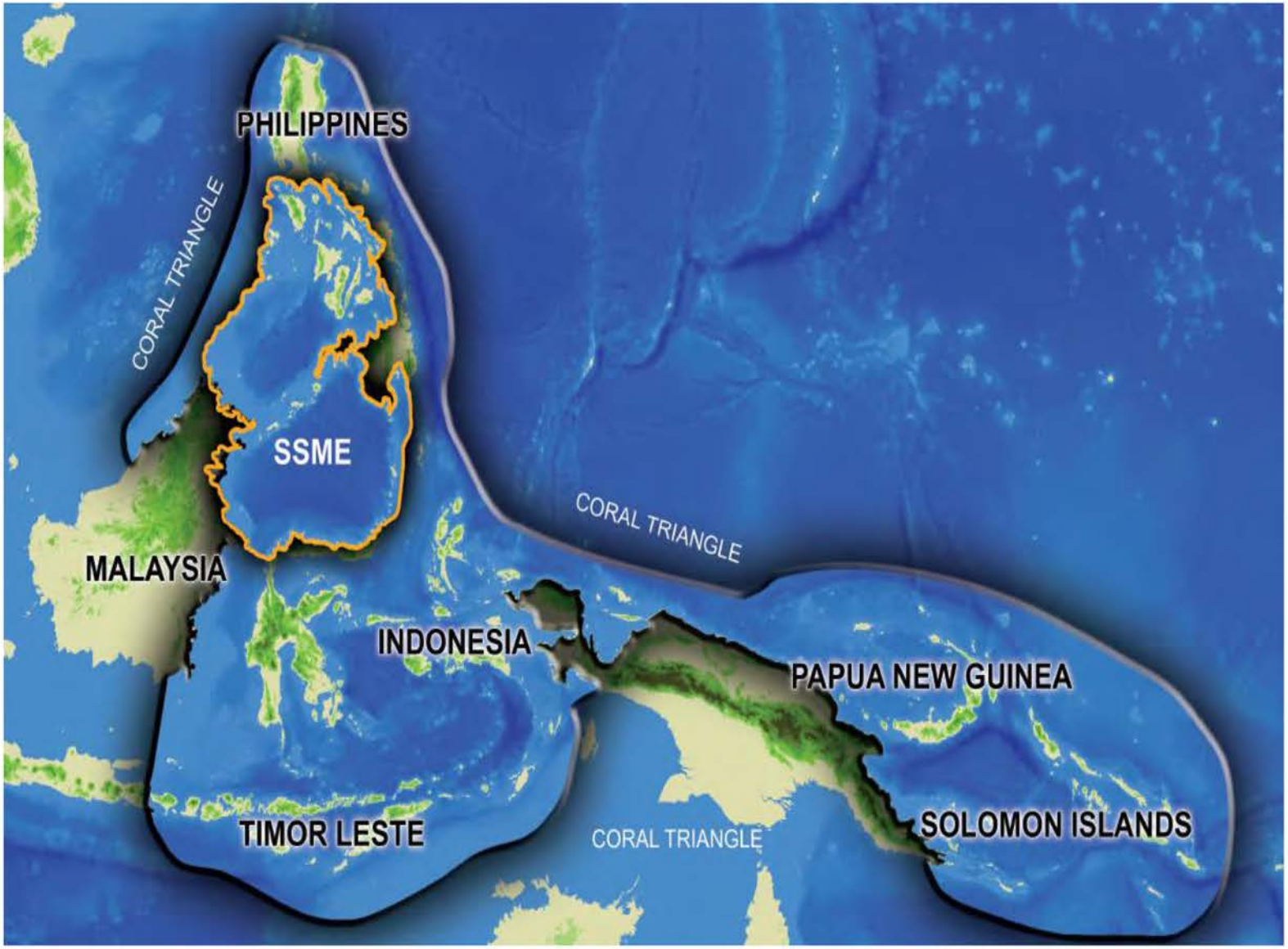

Figure 1.1. The SCS LME (SSME) within the Coral Triangle.

The approved Sulu-Celebes Sea Small-Pelagic Fisheries Management (SCS SFM) Project of 2010 has the following components:

Component 1 – Conduct of the TDA for the SCS LME
Component 2 – Formulation of regional, national, and institutional reforms for improved fisheries management (= Strategic Action Program for the LME)
Component 3 – Introduction of institutional reforms to catalyze implementation of policies on reducing overfishing and improving fisheries management in the SCS LME and strengthening of fisheries laws and policies ("Institutional Strengthening")
Component 4 – Demonstration of best fisheries management practices in critical sites in the SCS LME ("Demonstration Site")
Component 5 – Knowledge Management and replication of lessons learned

This report is for component 1 – the Transboundary Diagnostic Analysis (TDA). The TDA is for the identification and the prioritization of transboundary environmental problems and the analysis of their root causes. A similar activity for the SCS LME was conducted in 2002 under the GEF/UNEP/Global International Waters Assessment (GIWA) Project. The present undertaking is to update the GEF/UNEP/GIWA findings and to analyze the root-causes of all the transboundary problems (TPs) that will serve as the bases for the formulation of the Strategic Action Program (SAP). The TDA methodology followed the process promoted by the GEF[1], which includes the following steps: (1) identification of the geographical scale of the physical boundary and the time scale, (2) identification of TPs relevant within the bounds of the identified geographic and temporal scales, (3) prioritization of the TPs, (4) secondary research and validation, (5) finalization of the priority TPs, and (6) Casual Chain Analysis.

The SCS SFM Project has pre-selected CI-Philippines to facilitate the conduct of the TDA of the SCS LME. CI-Philippines formed a team and engaged Technical Task Teams (TTT) for Indonesia, Malaysia and Philippines. The TTT is composed of four (4) experts in the following fields: fisheries, environment, socio-economics, and legal, institutions and governance. These teams and the National Coordinating Units (NCU) of the respective countries conducted the TDA of the SCS LME while the technical staff of the Project Management Office (PMO) provided technical guidance in the whole process. Two regional workshops were conducted in 2011: the 1st Regional Workshop was conducted for the spatial and temporal scoping of the TDA and for the identification and preliminary prioritization of the TPs and the 2nd Regional Workshop was for the finalization of the priority TPs and for the identification of the root causes (Causal Chain Analysis). The national workshops validated the data and information collected by the TTTs and generated additional data and sources from the stakeholders.

This TDA is an updated assessment of the SCS LME with the engagement of the TTTs in each country. The present analyses included the watersheds in the scope of the analysis, more recent secondary data and information, especially from 2002 to 2011, and further inputs from the research of consultants on the environment and socio-economics. Findings were presented and validated by the stakeholders where mind-mapping was also used to show

[1] IW:LEARN; The NOAA also has a 5-modular approach (http://www.noaa.gov.us)

the causal-links of the TPs to their immediate causes and root-causes. This is the first foundation, a compendium of scientific information, for the conservation of the biodiversity and marine resources of the Sulu-Celebes (Sulawesi) Sea Large Marine Ecosystem.

1.2. Global and Regional Significance of the Sulu-Celebes Sea Large Marine Ecosystem

The SCS LME just sits above the equator and includes waters of Indonesia, Malaysia and Philippines. It forms part of a system called the Maritime Continent with very complex topography which gives rise to the largest and warmest body of ocean globally. This is a significant source of energy that influences the entire global circulation system (Neale and Slingo 2003).

Also known as the Sulu-Sulawesi Marine Ecoregion (SSME), the area is of vast ecological and economic importance, featuring productive ecosystems such as coral reefs, seagrass beds and mangrove forests. It is within the most biodiverse marine region of the world – the Coral Triangle (Hoeksema 2007) – and includes more than 500 species of corals (Veron et al. 2009), 400 species of algae, 16 species of seagrass, 1000 species of reef fishes (Carpenter and Springer 2005), including living fossils such as the coelacanth, 5 of the world's 7 species of marine turtles, and endangered marine mammals such as the dugong, whales and dolphins.[2]

The area serves as an important source of food and livelihood for over 40 million people. Many engaged in subsistence fishing while others in commercial fishing such as coral trade, reef fisheries and live fish trade. Its seas are crucial spawning grounds for shrimps and other commercially important fish species like the yellow fin, skip jack, and big eye tuna. It is also a popular tourist destination and a living laboratory for research and educational purposes.[3]

Aside from the marine resources that significantly contribute to the capture fisheries industry and food security in the region, there are also aquaculture and mariculture activities in the ecoregion as well as activities related to offshore oil and mineral resources exploitation. It also provides important corridors to the Pacific and Indian oceans and to inter-island shipping passages. It serves as a major shipping route for oil tankers and other large vessels carrying other products (APEC 2008). Furthermore, it is an important navigational route between the East and West. Navigational routes also link many cultural activities in various parts of the ecoregion.

This ecoregion has been identified as one of the top 200 ecoregions in the world for conservation and sustainable use (Spalding et al. 2007). This is fitting because of the heavy impact of human population who depend largely on its resources while the poor governance system contributes to the continuing resource depletion and ecosystem degradation (De Vantier et al. 2004). This geopolitical area also has porous borders so that transmigration, piracy, poaching and political instability make trilateral arrangements very

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[2,4] www.panda.org

challenging. Recently, the region has also been called the Sulu-Sulawesi Seascape, the first priority seascape recognized under the Coral Triangle Initiative's Regional Plan of Action (RPoA).

1.3. Biophysical Characteristics

The Sulu and Celebes Seas are located in Southeast Asia and sit just above the equator with bounds between latitudes 0-15°N and longitudes 115-129°E. They also form part of the system called the Maritime Continent, characterized by islands, peninsulas and shallow seas. The location and complex topography of the area give rise to the largest and warmest body of ocean known as the tropical warm pool. This is a significant source of energy that influences the entire global circulation system (Neale and Slingo 2003).

1.3.1. Meteorological and climatological features

1.3.1.1. Monsoonal regimes

Generally, monsoon is the term "applied to tropical and subtropical seasonal reversals in both the atmospheric circulation and associated precipitation... and the extremes are often best characterized as "wet" and "dry" seasons rather than summer and winter (Trenberth et al. 2000)."

Several regional monsoon systems are recognized that are embedded in a more global monsoon system. Dominant regional monsoon systems with clear wind reversals are the Asian-Australian and the African monsoons. In the tropical sectors of these monsoons, the rain belt follows the sun as it crosses the equator and reverses back (Trenberth et al. 2000).

Because of the latitudinal breadth, different monsoons have varying influence on each of the Sulu and Celebes Seas. The Asian Monsoon is more pronounced in the Sulu Sea while the Celebes Sea is more influenced by the Australian monsoon system. This is not surprising since the center of Sulu Sea is nearer mainland Asia while Celebes Sea is nearer the Australian continent.

1.3.1.2. General wind patterns relative to monsoon seasons

Figure 1.3-1 by Chang and co-workers (2005) gives the general wind pattern governing the Sulu and Celebes Seas over the two monsoon seasons. This analysis was made using satellite data (QuickSCAT) over the period January 1999 to December 2002. Winds near the sea surface were derived over the domain with a 25km x 25km resolution.

Winds generally come from the northeast during the boreal winter months of December, January and February (black vectors) and then reverses during the boreal summer months of June, July and August (red vectors). In the Sulu Sea, winter winds are stronger (8 m s^{-1}) but in the Celebes Sea, both monsoon winds appear to have similar strengths at about 4 m s^{-1} (Wyrtki 1961). See also Annex 1.3-1(a-c).

1.3.1.3. Rainfall patterns

The macro view of the Asian monsoon rainy season includes two phases. The first occurs in May over the South China Sea which is actually a rainband that extends from the Arabian Sea to the Bay of Bengal and all the way to the subtropical Western North Pacific. The second phase occurs in June as this rainband progresses northwestward to initiate the continental Indian rainy season, the Chinese *mei-yu*, and the Japanese *baiu* (Figure 1.3-2). This large rainband can also be seen as three separate components, namely, the Indian Summer Monsoon (ISM), the Western North Pacific Summer Monsoon (WNPSM), and the East Asian Summer Monsoon (EASM). This was the pattern arrived at by Wang and LinHo (2002) after utilizing 20 years (1979-1998) of rainfall dataset together with satellite measurements. The analysis covered Sulu Sea, which is under the WNPSM and also called the tropical monsoon (together with the ISM; EASM is a subtropical monsoon). In this region, the summer monsoon rains start in mid-May and peak late in June and then subside after mid-September. The May-September summer monsoon rains average about 8-11 mm day^{-1} (240-330 mm $month^{-1}$) where winds in this regime are westerlies that reverse to winter easterlies (Wang and LinHo 2002).

Southern Philippines (Mindanao), the Celebes Sea and Borneo are all outside the domain of the Asian monsoon system described by Wang and LinHo (2002).

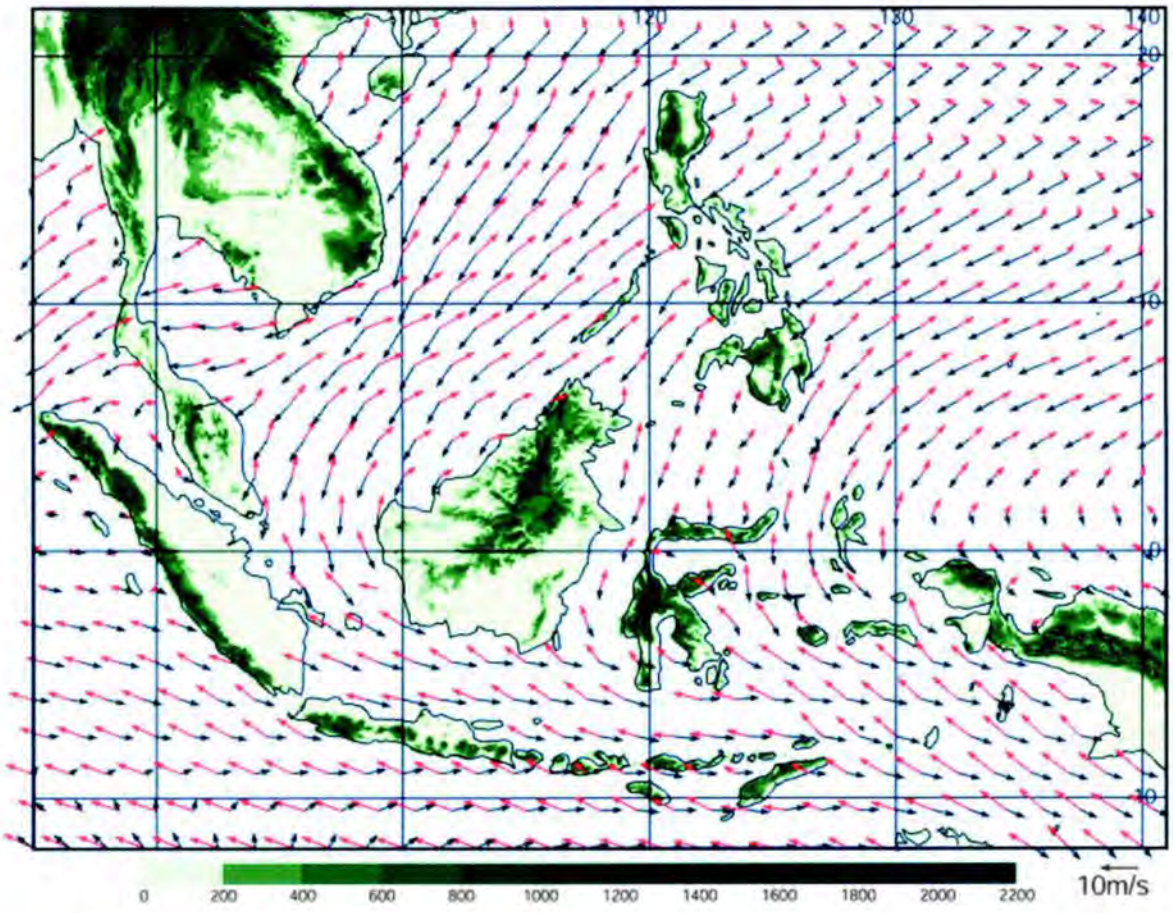


Figure 1.3-1. Mean winds for January (black, winter monsoon) and July (red, summer monsoon) over the SCS LME. Topography of the region is also given (scale bar in meters) (Chang et al. 2005).

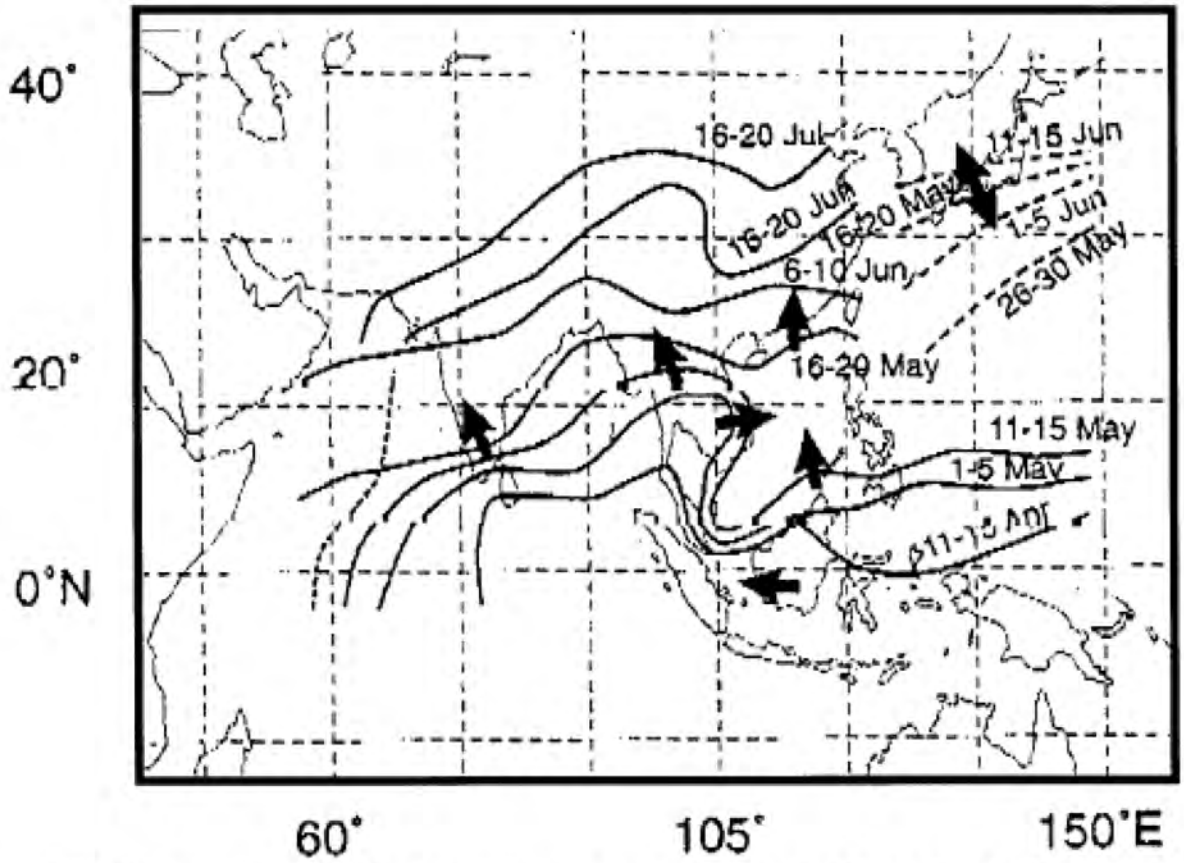


Figure 1.3-2. The onset dates of the Asian summer monsoon (Lau and Yang 1997 in Chang et al. 2005).

Earlier, Wyrtki (1961) had a similar description for the Sulu Sea, which experiences rain starting from May onwards to November with peaks in June and November that reach to 200 mm. The rains result in the drop of surface salinity from about 34.5 ppt in April to 33 ppt in October.

In the Celebes Sea, rainfall throughout the year is about 150 mm month^{-1} (Wyrtki 1961). This area falls under a rainfall regime (three in all of Indonesia) where more rain is experienced from November to March, which is during the northwest Australian monsoon (Aldrian and Susanto 2003, see also Hamada and co-workers 2002). Low salinities of 33.5 ppt coincide with peak rainfall in January and rains are relatively small between July and October due to the drier air of the southeast Australian monsoon (Wyrtki 1961).

Basically, the rainy seasons between Sulu and Celebes Seas are opposite, i.e., heavy rains are experienced from June to August in the Sulu Sea but are the drier months in Celebes Sea. Celebes Sea experiences peak rains around January, the time which is drier in the Sulu Sea (Figure 1.3-3).

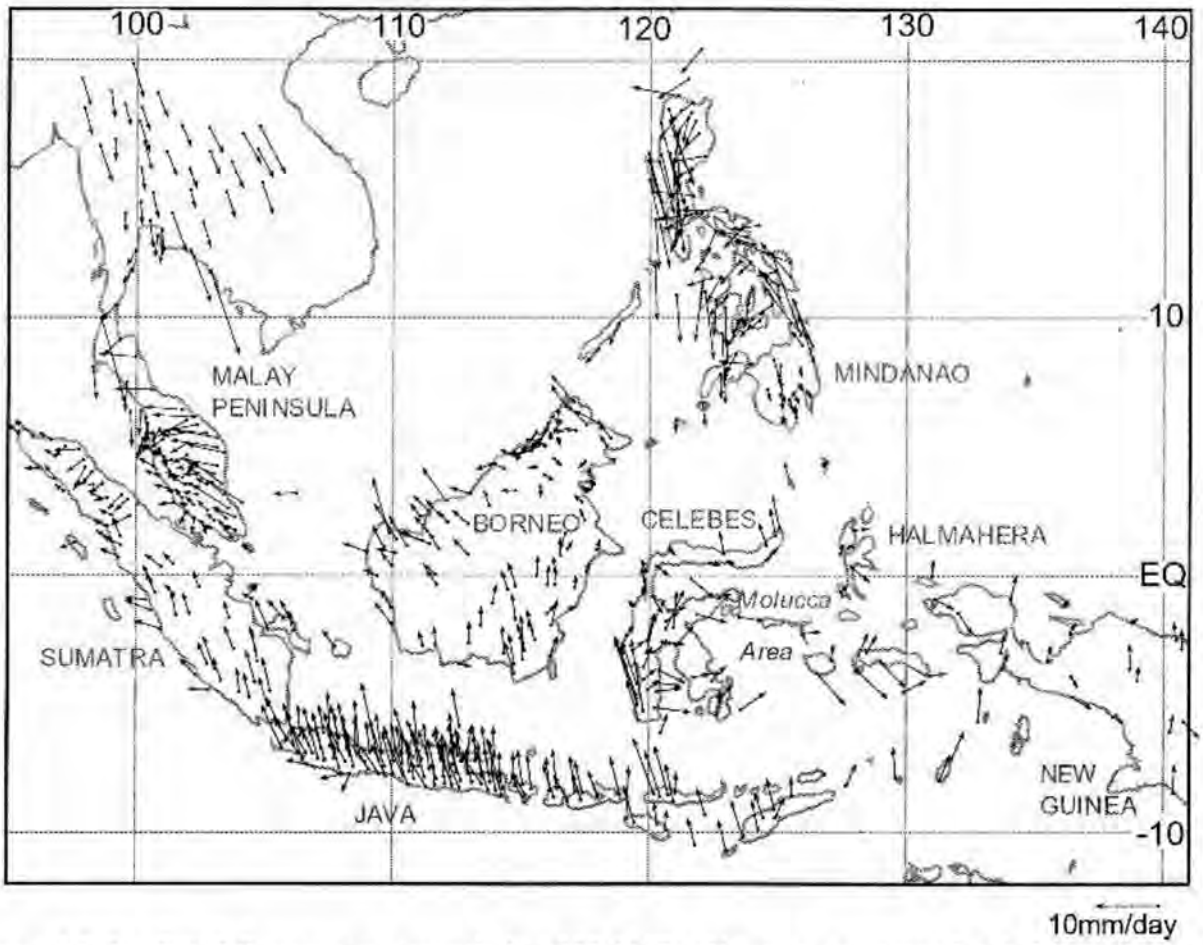


Figure 1.3-3. Rainfall patterns around the SCS LME. Vectors are annual rainfall cycle with a northward arrow indicating maximum rainfall in January. Eastward, southward, and westward arrows indicate April, July, and October, respectively (Chang et al. 2005).

1.3.1.4. Temperature patterns

A baseline structure of hydrographic features (temperature, salinity, dissolved oxygen and nutrients in the form of nitrates, phosphates and silicates) of waters surrounding the Philippines that include Sulu Sea and Celebes Sea is given by Udarbe-Walker et al. (2002). Temperature (and salinity) characteristics of both Sulu and Celebes Seas are similar up to the sill depth of 250m. Below this, the Celebes Sea water temperature drops to ~4°C at the ocean floor while the Sulu Sea maintains the water temperature at ~10°C from the mesopelagic (see Gordon et al. 2011) to the bottom (Matsuura et al. 2010). The warmer Sulu Sea temperature profile is attributed to shallower waters penetrating it from the West Philippine Sea through the Mindoro Strait that has a sill depth of only about 400m whereas deeper waters penetrate into the Celebes Sea from the Pacific over a sill that is 1400m deep (Udarbe-Walker et al. 2002).

Surface water temperatures in the Sulu and Celebes Seas experience fluctuations with the reversal of monsoons. February to May are the months that heating takes place in the Sulu Sea but surface water temperatures only become warm (at least 28°C) starting May to November. On the other hand, considerable heating appears to take place in the Celebes Sea (surface waters mostly over 28°C) but the heat is absorbed by the deep homogenous layer (~100m) and carried away by strong currents (Wyrtki 1961).

1.3.1.5. ENSO events

The El Niño Southern Oscillation (ENSO) is a large scale climate phenomenon occurring every 4-7 years. Its onset is recognized when sea surface temperatures (SST) are either above or below (called an anomaly) the normal value for three consecutive months. The long term average value of the SST is considered the normal value.

SST monitoring in the Pacific Ocean is done in specific regions and labeled Niño 1+2 (0-10°South and 90°West-80°West), Niño 3 (5°North-5°South and 150°West-90°West), Niño 4 (5°North-5°South and 160°East-150°West), and Niño 3.4 (5°North-5°South and 170-120°West). Niño 3.4 is a special region of interest among researchers as this is where major changes occur when an El Niño develops. See figure below:

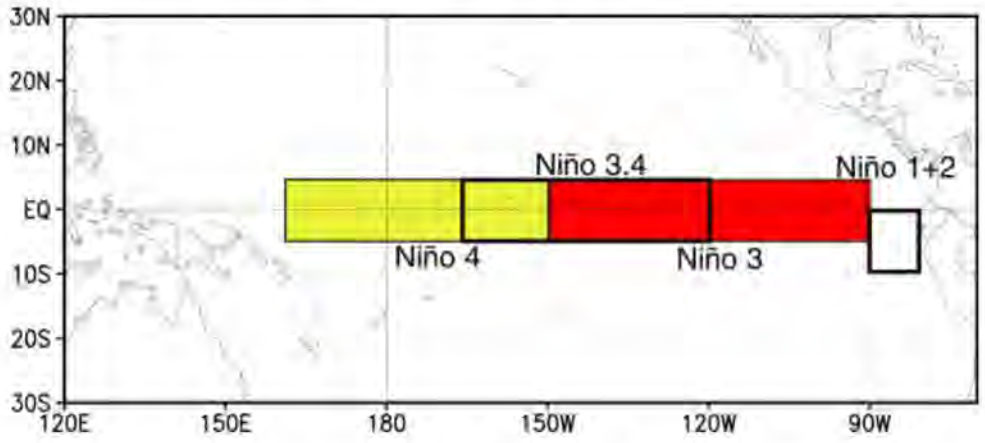


Figure 1.3-4. El Niño regions in the Pacific (http://www.cpc.ncep.noaa.gov/).

El Niño happens when the easterly trade winds weaken or even reverses and piles up warm water in the eastern Pacific (towards Nino 1+2). La Niña, on the other hand, is when the easterly winds become stronger and piles up warm water in the western Pacific (far into Nino 4). Rainfall then becomes more intense where this warm water pool piles up.

Episodes of El Niño and La Niña are usually protracted, occurring for several months to about a year for El Niño but is usually longer for La Niña (1-3 years) (Figure 1.3-5). ENSO significantly affects the circulation of the oceans and atmosphere. The piling of water at the western boundary of the Pacific during La Niña will result to larger volume transports in the ITF (England and Huang 2005), which could be expected for the internal seas of the Philippines as well (see Hurlburt et al. 2011). La Niña also brings more rains to the West Pacific, adding more to the monsoon rains. However, more typhoons are generated during strong El Niño than strong La Niña conditions (Wang and Zhang 2002).

1.3.2. Oceanographic features

1.3.2.1. Global currents (NEC, Indonesian throughflow, Mindanao current)

Physical description of the Sulu and Celebes seas is given by Johnson et al. (2006). Briefly, the basins are believed to have formed independently; both reach more than 5000m in depth (Nishida and Nishikawa 2011) and are separated by a sill in the Sulu archipelago at about 250m depth (the Sibutu Passage).

Recent modeling studies (Hurlburt et al. 2011) show that the Sulu Sea (SS) is fed by the North Pacific Water (NPW) that enters the West Philippine Sea (also called South China

Sea/WPS) via the Luzon Strait (see also Centurioni et al. 2004) and through the Mindoro Strait. The sill depth here is ~450m so that subsurface water or intermediate water can penetrate the SS. Subsurface water ventilation of the SS is in the timescale of 150-450 years, which is considered short by Horikawa and co-workers (2006).

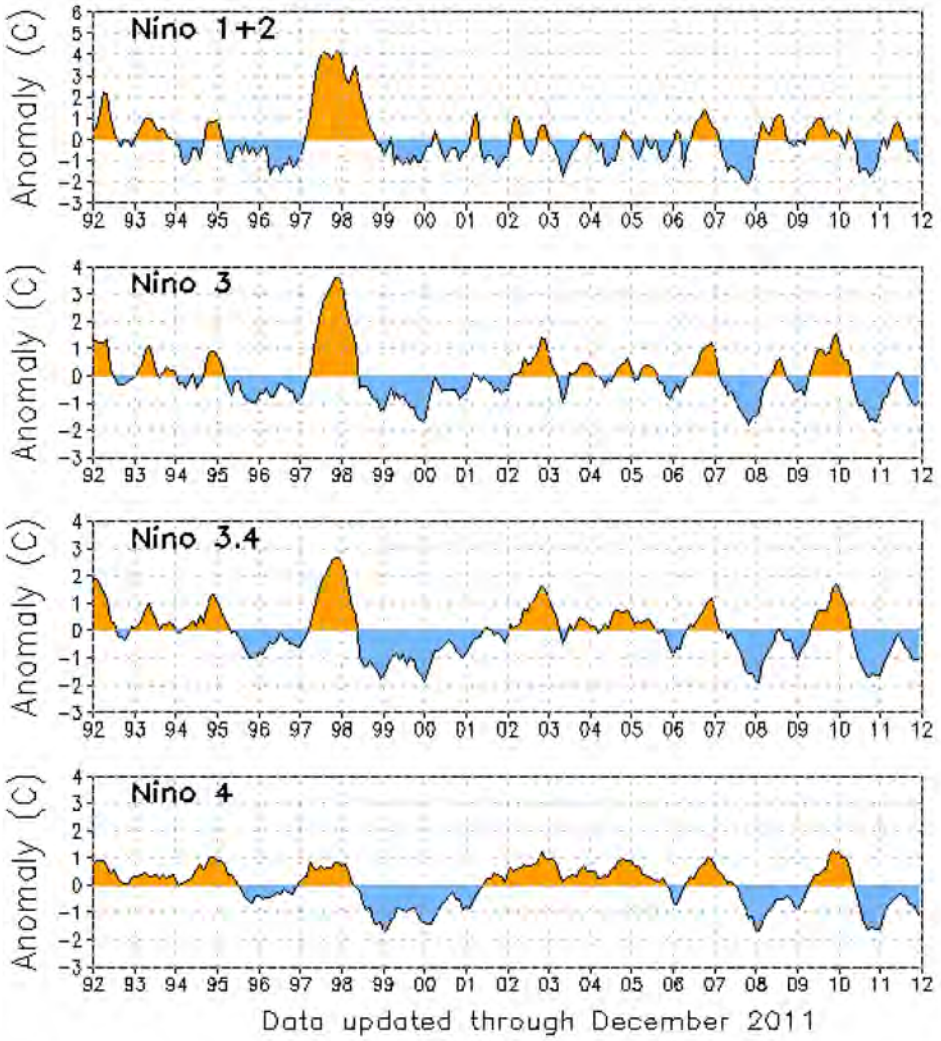


Figure 1.3-5. Sea surface temperature anomalies (°C) from 1992 to 2011. Positive anomalies are El Nino events (shaded in orange with strongest signal in 1997-1998) while negative anomalies indicate La Niña events (shaded in blue) (http://www.cpc.ncep.noaa.gov/).

Pacific water also enters the SS in a more direct route via the Surigao Strait through the Bohol Sea. The sill depth here is only ~230m near Dipolog so only shallow NPW enters the SS. The Sulu Sea basin drains into the WPS through Balabac Strait (although Lermusiaux and co-workers [2011] describe an inflow from WPS into the SS here) but mainly into the Celebes Sea through the Sibutu Passage (~250m sill depth) and openings of the Sulu Archipelago (Figure 1.3-6).

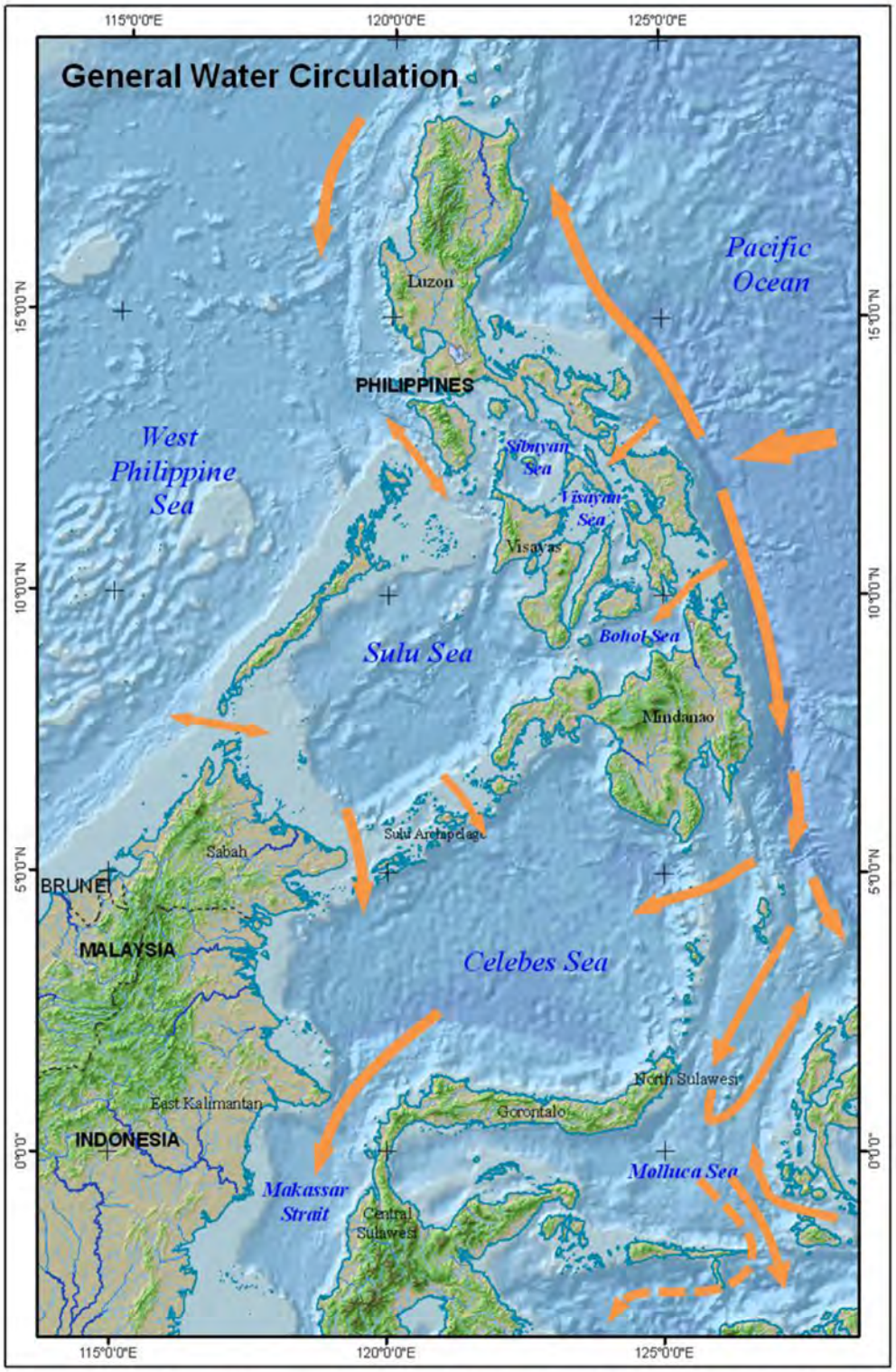


Figure 1.3-6. General water circulation pattern around the SCS LME. See text for details.

The southbound bifurcation of the NPW that forms the Mindanao current feeds directly into the Celebes Sea. Periodic incursion of Celebes Sea water, particularly deep water, into the SS is tidal in nature (Lermusiaux et al. 2011).

Celebes Sea contributes to the Indonesian Throughflow (ITF) through the Makassar Strait although the ITF is mainly generated by the Pacific Ocean directly through the deep gaps between the Philippines and New Guinea. The Mindanao Current formed by the NPW also makes its way through the Maluku Sea while the Equatorial Pacific Water enters through

the Halmahera Sea. The Torres Strait between New Guinea and Australia is very shallow (~10 m) and is not a significant passage contributing to the formation of the ITF. Also, the NPW that enters Luzon Strait and reaches the Indonesian seas through the WPS and SS adds little to the ITF (Gordon 2005).

The different routes of the ITF flow further south through three passages (Timor Passage, Ombai Strait, and the Lombok Strait) and finally converge as the waters continue westward into the Indian Ocean. See Figure 1.3-6.

1.3.2.2. General ocean circulation patterns relative to monsoon seasons

The general water circulation in the Sulu Sea described earlier can be modified by wind forcing and modulated by the East Asian Monsoon, especially between close islands that form straits (May et al. 2011). Pullen et al. (2011), for example, described a reversal in flow in the Mindoro Strait (water going out to West Philippine Sea) due to strong easterly and northerly wind episodes in January-February 2008. They acknowledged that the strong stratification brought by heavy rains during this observation period (the highest over four decades for the same period) contributed to the strong coupling of the atmosphere and near surface ocean circulation in the study.

In the Indonesian Seas, less saline surface water from the Java Sea is driven into the south of Makassar Strait during the northwest monsoon and generates a pressure gradient northward of the strait that counteracts the seasonal southward winds. The reversal of winds during the southeast monsoon (July to September) forces saline waters to the south of Makassar Strait from the Banda Sea and relieves the northward pressure gradient although the winds this time constrain the surface flow (Gordon 2005). See also Annex 1.3-2(a-c).

1.3.2.3. Tidal regimes

Tides of the Southeast Asian region are driven by the Pacific and Indian Oceans and textured by the complex geography and topography of the area. Tidal forcing due to the sun and moon is important only to the deeper areas of the region. Generally, the Pacific Ocean tides dominate the whole of South China Sea, Philippine Waters and Celebes Sea while the Indian Ocean tides have more influence on the Timor Sea, the Banda Sea and the Sahul Shelf. Both oceans have tidal influence on the boundary regions that include the Molucca Sea, Macassar Strait and the Java Sea although the semi-diurnal component reaches further north (Wyrtki 1961).

While eight tidal constituents were used in the study of Magno (2005) to characterize the tides of the Philippines and nearby regions, Wyrtki (1961) previously claimed that only four tidal constituents are sufficient to describe the tidal pattern of the region (Table 1.3-1).

Table 1.3-1. Tidal constituents used to describe the South China Sea region that covers the southern part of the West Philippine Sea, the Sunda Shelf, Macassar Strait, Malacca Strait, Sulu Sea and Celebes Sea (Wyrtki 1961).

Tide constituent	Description	Period (hours)
M2	Semi-diurnal principal lunar	12.42
S2	Semi-diurnal principal solar	12.00
K1	Diurnal luni-solar	23.93
O1	Diurnal principal lunar	25.82

Semi-diurnal tides

The semi-diurnal tidal wave predominates the east coast of the Philippines (Magno 2005). This enters the South China Sea region through the Luzon Strait with amplitudes of only 20 cm (Wyrtki 1961, Magno 2005). This wave reaches the Sunda Shelf after 6 hours and bifurcates when it reaches the coast of Malaya. The northbound enters the Gulf of Thailand and forms a clockwise rotating amphidromic system (centered at 9°18'N, 103°28'E). Wave amplitudes in this amphidromic region are less than 20 cm (Wyrtki 1961). The southbound bifurcation also forms an amphidromic system but rotates in an anti-clockwise fashion (centered at 0°30'N, 106°30'E) and has asymmetrical co-tidal lines and small wave amplitudes as well.

Another branch of the Pacific Ocean tide enters the South China Sea region via the Celebes Sea with a phase of ~10 hours and amplitude of ~80 cm where it meets the wave from the Indian Ocean north of Macassar Strait and the area east and west of Halmahera. This increases to 139 cm off the coast of Borneo in the Celebes Sea. This wave also enters the Sulu Sea and takes four hours to go through the Sulu archipelago. High tide is practically simultaneous for the entire Sulu Sea and the Philippines with a phase of only two hours and amplitudes of 50-80 cm. The Sulu Sea is apparently little influenced by the semi-diurnal tides of the South China Sea (Wyrtki 1961).

Diurnal tides

Tidal waves of the Pacific reach the Philippines with a phase of six hours and amplitudes of 20-40 cm. Again, the diurnal tide constituents enter the South China Sea mainly through the north of Luzon Strait and the Taiwan Strait. The amplitudes increase gradually upon entering the South China Sea and reach a maximum in the Gulf of Tonkin (216 cm in the northeast corner) where it forms an anti-clockwise rotating amphidromic system. High water reaches the Sunda Shelf with a phase of 13 hours and also bifurcates when it reaches the coast of Malaya. The northbound enters the Gulf of Thailand and forms an anti-clockwise amphidromic system with amplitudes reaching 113 cm in the north of the Gulf. The southbound moves slowly but amplitudes increase to more than 100 cm in the coast of Sumatra and Banka (Wyrtki 1961).

The diurnal wave entering south of the Philippines to the Celebes Sea slows down and high water occurs simultaneously along all coastal areas in the Celebes with a phase of 10 hours and amplitudes of about 30 cm. This wave further slows down when passing the Sulu Archipelago and high water occurs simultaneously in the whole Sulu Sea and the Philippines with a phase of about 13 hours and with almost uniform amplitudes of about 60 cm. The Sulu Sea does not seem to be influenced directly by waves from the Pacific Ocean through the eastern border of the Philippines, or via the South China Sea (Wyrtki 1961).

Overall, the tidal characterization of Southeast Asia is similar between the studies of Wyrtki (1961) and Magno (2005) where a mixed but prevailing semi-diurnal tide is typical of the West Pacific Ocean, Philippine internal waters, Celebes Sea and most of Sulu Sea and a mixed but prevailing diurnal tide in most of the West Philippine Sea (South China Sea). Magno (2005) also found the southwest area of the Sulu Sea as mixed diurnal. Strictly diurnal tides were seen off the northwest coast of the Philippines in the two studies (Figure 1.3-7).

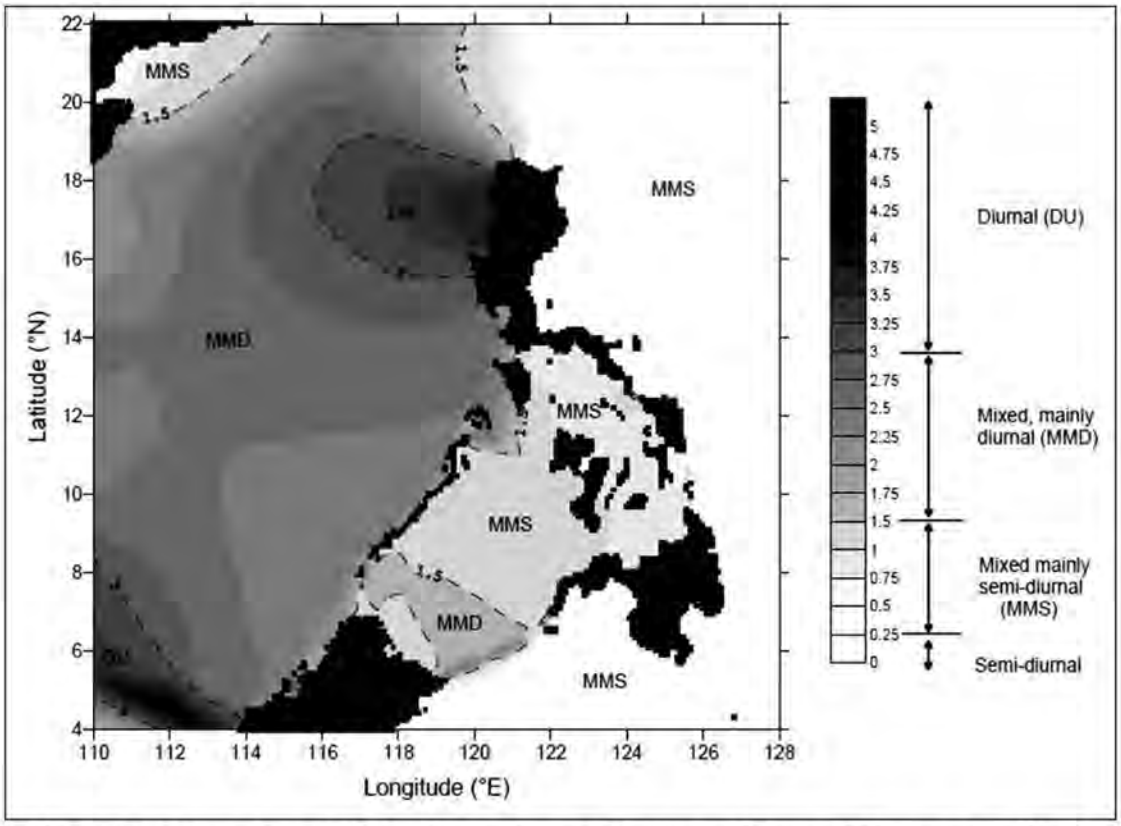


Figure 1.3-7. Tidal characters of Philippine waters and vicinity (Magno 2005, see also Wyrtki 1961).

1.3.2.4. Upwelling systems

Coastal area productivity in the Philippine archipelago may be driven by upwelling due to wind forcing (Villanoy et al. 2011), water circulation that results in cyclonic eddies (Cabrera et al. 2011), or the shoaling of internal waves onto shelf areas (San Diego-McGlone et al. 1999).

May et al. (2011) found an upwelling area in the Verde Island Passage (VIP) during the northeast monsoon season in 2008. The strong wind jet (12-15m s-1) through the passage blowing from east to west favored Ekman transport offshore and upwelling nearshore of northern Mindoro. Upwelling in this situation was confined to the upper 60m of coastal waters. This was supported by observations of cooler coastal waters at 1°C below surrounding water temperatures and satellite imagery data showing elevated values of chlorophyll-a.

Another passage where wind driven upwelling occurs is along the Zamboanga peninsula off Mindanao (Villanoy et al. 2011). Upwelling in this area also coincides with the northeast monsoon and is indicated further by cooler temperatures than surrounding areas, similar to the case of the VIP, and higher observed chlorophyll-a values. The Zamboanga upwelling supports a rich sardine fishery, whose production (~landings) correlates very well with the El Niño Southern Oscillation (ENSO), which is poor during La Niña years and rich during El

Nino years (Villanoy et al. 2011). Presently, no upwelling systems are detected in the Celebes Sea using signatures of chlorophyll and temperature from satellite data, i.e., areas or regions with coincident elevated chlorophyll-a levels and cooler sea surface temperatures (see Annex 1.3-3 and 1.3-4).

Internal waves also present a mechanism for nutrient enrichment of shelf areas (San Diego-McGlone 1999, Liu et al. 2006, Liu et al. 2008, Girton et al. 2011). These subsurface waves are normally generated by the interaction of tides with topography that displaces the pycnocline (section in the water column with a large change in density). These waves can have amplitudes that reach 100m and when they impinge and break on shelf areas, deeper waters that are nutrient rich are mixed with surface waters. Internal waves around the Philippines range from 10m packets (groups) in Butuan and Macajalar Bays, 100m in Samar Sea, 1,000m in Surigao Strait and Sulu Archipelago, and large 10,000m solitary waves in the Sulu Sea (Liu et al. 1985, Jackson et al. 2011). The large solitary waves of the Sulu Sea reach the eastern coast of Palawan island and the Cuyo shelf.

The contribution of tropical cyclones to primary productivity is not easily determined but Lin et al. (2003) were able to estimate the enhancement of chlorophyll-a levels of a typhoon from satellite imagery. Typhoons carry strong winds that enhance vertical mixing and pump nutrient-rich deep waters into the surface. Typhoon Kai-Tak (that occurred from 3-9 July 2000 with maximum sustained winds of 140 kph), for example, that passed over the West Philippine Sea increased the primary production of the basin by two to four percent. Estimated frequency of typhoons passing this region approximately adds up to 30% of primary production per year for the West Philippine Sea according to Lin and co-workers (2003).

1.3.2.5. Eddies

A two layer upwelling area exists near the Dipolog sill (~500m) between the Bohol Sea and the Sulu Sea where the circulation is described as a double estuary type (Cabrera et al. 2011). As Bohol Sea surface water (upper 100m) flows westward into the Sulu Sea, the underlying Sulu Sea waters (100-200m) that flow into the Bohol Sea is driven upwards (upwelling) by entrainment. The deeper cell is driven by the dense Sulu Sea deep water (~400-500m) that spills over the Dipolog sill into the Bohol Sea and displaces water that upwells and exits back to the Sulu Sea at ~250-400m layer.

The shallower overturning of the double estuary circulation in the Bohol Sea results in a cyclonic eddy called the Iligan Bay Eddy. This, by expectation, should result in upwelling and productive waters but was not observed during the study of Cabrera and co-workers (2011) because of strong water column stratification brought about by an overlying freshwater lens (La Niña conditions).

The Iligan Bay Eddy was also detected in circulation models done by Hurlburt and co-workers (2011). Apart from this eddy, the simulation also showed a large gyre (rotating anti-clockwise) south of Sulu Sea while two gyres were seen in the Celebes Sea, a large one rotating clockwise on the lower section and a smaller one rotating anti-clockwise in Moro Gulf near Mindanao.

1.4. Socio-economic Characteristics

1.4.1. Assets-Based Framework in Natural Resource Management

The human being is both the principal steward and the ultimate beneficiary of sustainable development and management of natural resources. In order to better understand the interaction between the human being and resource management, this section anchors its discussion on an assets-based framework in natural resource management (Figure 1.4-1). The framework is used to understand options available to the human populace, the strategies they adopt for survival - including using natural resources – and their vulnerability to adverse events. It is most useful in understanding poverty reduction initiatives that need to be strengthened.

Households or communities have five forms of capital (cluster A in the model), which they can use for livelihoods – human, physical, financial, natural, and social (Ellis 2000, Carney 1998). These assets are complementary and substitutable and their translation into livelihood strategies is mediated by several factors, such as population pressure, calamities, influence of culture, markets, institutions, policies and laws – the household or community's vulnerability context (clusters B, C, D, E). Given the level of the five assets and their interactions, and in the context of the mediating factors, the household or community will choose the "best" livelihood option primarily in the use of these assets, including biodiversity, to attain certain livelihood outcomes. The relationship that the household has with its environment, and by extension its impact on the environment, is mediated by these forms of capital, as well as by institutional and cultural factors. Natural resources used for livelihood (cluster G) affect the livelihood itself and the sustainability of the environment (cluster H).

The natural resource in focus refers to the small pelagic fish stocks. Access to this natural capital is influenced by both the standing social relations and institutions in the area. The analysis of small pelagic fisheries management in the SCS LME needs to consider internal and external factors relative to where the resource is located. The internal context covers human population size and growth trends, migration and other demand side factors. Impacts of small pelagic fishing and processing on livelihood and food security concerns are also examined. Income levels of the residing populace play a crucial role as it determines the population's capacity to manage and pay for expenses in using the resource (referred to as Payment for Environment Services or PES).

1.4.2. Fishers Demographics

1.4.2.1. Population

The human population in the SCS area is more than 66 million in 2010 (Table 1.4-1). The Malaysian-SCS population is 1.48 million comprising about 47% of the total Sabah population. The Philippine-SCS has a total population of 62 million Filipinos (based on 2010 population projections). Assuming that at least 60% of the total population in the P-SCS are in coastal areas (Philippine Coastal Management Guidebook Series No. 1: Coastal Management Orientation and Overview 2001), around 37 million Filipinos live in coastal areas. For the Indonesian-SCS, total population is estimated at 2.73 million or roughly 28% of the entire population of the four provinces (Central Sulawesi, Gorontalo, North Sulawesi and East Kalimantan). Average annual population growth rate (AAPGR) in the entire SCS is estimated at 2.03-2.04% with each country's AAPGR within the said range. The Philippine-SCS is the most densely populated area in the entire SCS (see Annex 1.4 for the population density in the SCS region).

1.4.2.2. Ethnic composition

Diverse ethnic groups comprise the population in SCS and while there are shared cultural elements and historical circumstances, the identities are nonetheless important to be recognized in governance and management plans.

The P-SCS is home to numerous ethnic groups. Major ethnolinguistic groups such as the Tagalog, Ilocano, Ilonggo, Cebuano, and Waray are the dominant population among original and settler communities. At least 35 indigenous peoples are documented (NCIP 2010), including the Ati in the Western and Central Visayas, the Tagbanua and Molbog in Palawan, seacoast dependent Mansaka in Davao Del Norte, Higaonon in Misamis Oriental and Agusan, Subanon in Zamboanga and Misamis Occidental, Sama-Yakan of Sama and Dayak origin in Basilan and Zamboanga, Samal/Sama in Sulu and Tawi-tawi and the Sama Laut in the rest of the smaller Sulu Celebes Sea islands, and Tausug in the Sulu archipelago (Jolo, Indanan, Siasi, Patikul) as well as in Basilan, Zamboanga Del Sur.

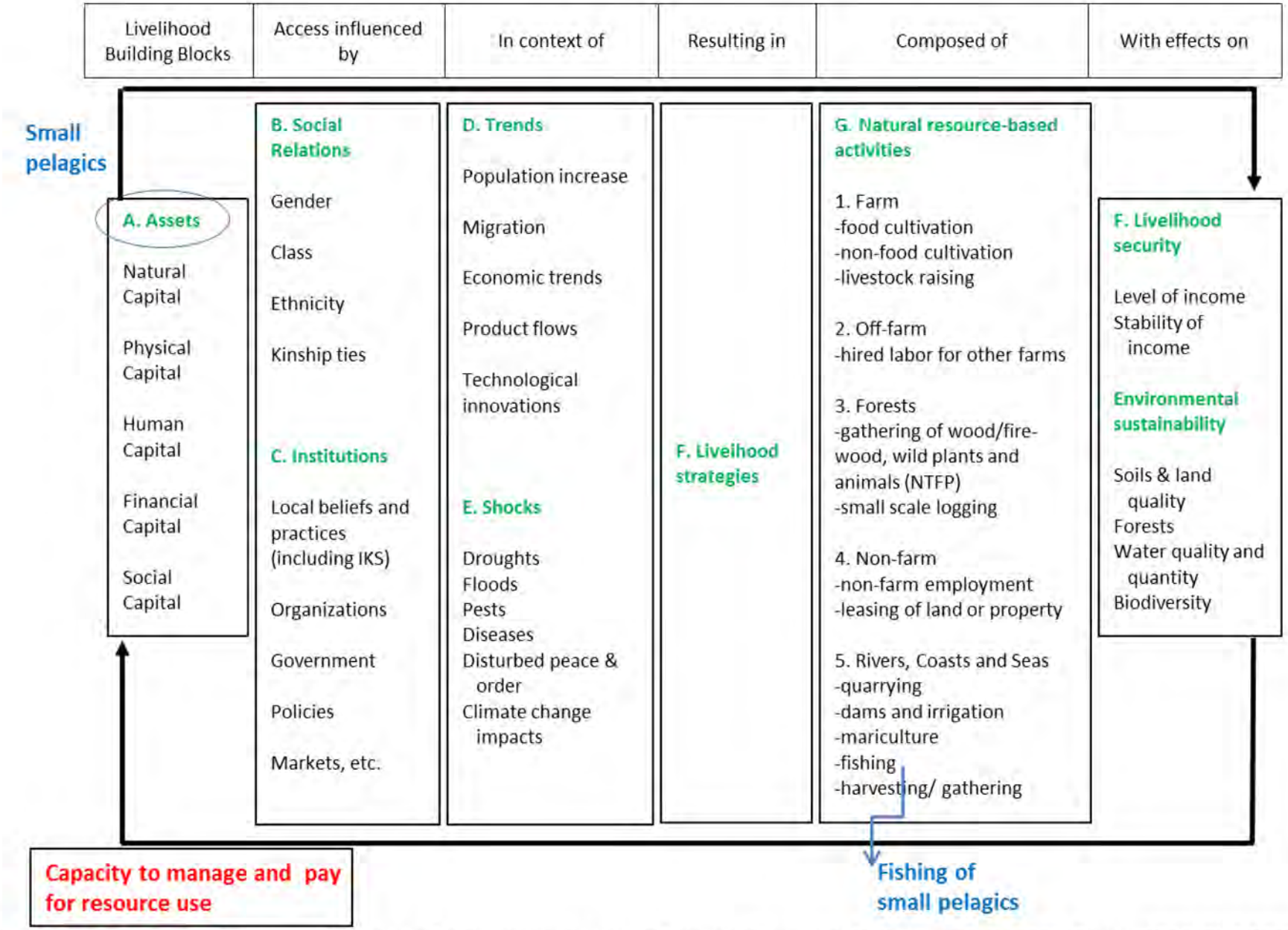


Figure 1.4-1. Assets-based framework in natural resource management (source of framework elements: Ellis 2000, Carney 1998, CI-P 2007).

Table 1.4-1. Population size in the SCS area.

Malaysia (2010*)		Philippines (2010**)		Indonesia (2010***)	
District	Population	Region	Population	Province	Population
Kunak	60,068	IV-A	11,904,100	East Kalimantan	648,553
Sandakan	397,555	IV-B	3,018,000	North Sulawesi	1,654,693
Kudat	83,123	V	5,711,500	Central Sulawesi	324,708
Tawau	396,475	VI	7,578,000	Gorontalo	98,272
Semporna	133,939	VII	7,029,300		
Lahad Datu	199,934	VIII	4,447,500		
Pitas	37,586	IX	3,487,400		
Beluran	106,583	X	4,349,300		
Kota Marudu	65,807	XI	4,362,400		
		XII	4,080,400		
		Caraga	2,549,400		
		ARMM	3,551,800		
Total	1,481,070		62,069,100		2,726,227
AAPGR	2.04%		2.03%		2.03%

*Yearbook of statistics Sabah 2010 is based on population Census conducted in year 2000
** Based on 2010 population projections.
*** Indonesia Technical Report for Socio-economics; Central Bureau Statistic – Indonesia (2011); East Kalimantan Province (2005-2010); North Sulawesi Province (2001-2010); Central Sulawesi Province (2005-2010); Gorontalo Province (2006-2010)
AAPGR – Average Annual Population Growth Rate from 2000-2010.

In the I-SCS, there are about 45 ethnic and sub-ethnic groups living in the surrounding areas. The population of East Kalimantan Province has been dominated by Dayak, Banjar, Bajou, Kutai, Bugis and Java ethnic groups. Central Sulawesi Province has been dominated by the ethnics of Sea-sea, Loinang, Wana, Tolare, Lauje, and Kori Rai. Gorontalo Province has been dominated by Gorontalo, Bone, Bolango, Limboto, and Mongondow ethnic groups whereas Minahasa, Sangihe Talaud, dan Bolaang Mongondow have been the three major ethnic groups of North Sulawesi Province.

About 32 ethnic groups exist in Sabah. Among the prominent ones are the Kadazan-Dusun, Bajau, Malay, Murut, and Bruneian Malay. On the other hand, the Sabah Yearbook of Statistics (2010) cited that the total population by ethnic group and local authority area for Sabah (nine districts for M-SCS) in descending order of numbers are (1) Bumiputera (consisted of Malays, Bajau, Kadazan–Dusun, Chinese, Murut, and others like Bumiputera), and (2) Non-Malaysian citizens (of Philippine and Indonesian origins).

1.4.2.3. Role of gender

Males and females are in about the same proportion in the Philippine SCS (50.5:49.5). While fishers are usually men, the participation of women in the planning and decision-making processes and in the management, monitoring and evaluation of the natural resources cannot be overemphasized. This recognizes and takes into consideration the

differing perspectives and even unique knowledge of men and women both in terms of resource use and conservation.

Among artisanal fishing communities, labor (work) is usually divided along the line of sex rather than socially constructed roles, i.e., gender role. Although men do the fishing, it is the women and their children (child labor is prevalent among coastal and small islands communities) who do the household production, i.e., in fixing fishing gears, processing, retailing fish and determining amount of fish to be shared among relatives and neighbors.

1.4.3. Contribution of Fisheries to Gross Domestic Product (GDP), Employment and other Economic Benefits of the SCS LME

Inclusive of its watersheds, the SCS LME is a huge natural resource base characterized by its marine resources, fertile lands, and rich mineral deposits, among others. With its archipelagic physical orientation, the SCS LME is extremely rich in marine and fishery resources. Given this, the SCS LME also takes pride of its agricultural plantations, manufacturing industries, budding mineral industry, and extensive water transport and logistics industry. The waters of the entire SCS LME region are equally important navigational channels for both domestic and international trade. Striking a balance between these development activities and sustaining the environment, both land and water, is therefore a challenge.

1.4.1. Philippine part of the SCS LME (P-SCS)

In the P-SCS, agriculture, fisheries and forestry (AFF) make up at least 26% of the economy and the share of fisheries to total gross value added (GVA) in agriculture is around 21%. Within the P-SCS, the share of employment in the fisheries industry and other sectors is 5.6%. This figure, based on the National Statistics Coordination Board (NSCB) definition, only refers to proceeds from the sale of raw fishery products (fresh/frozen/chilled). Value adding applied to fishery products under manufacturing is currently around eight percent. General Santos City in SOCCSKSARGEN region is the Philippine's tuna capital while Zamboanga City and Dipolog City in Western Mindanao are the country's sardine capital and bottled sardine capital, respectively. In terms of contribution of the small pelagics to the Philippine economy, the sardine fishing and processing industry alone in Zamboanga City is a PhP3 billion industry generating about 120,000 jobs (75,000 direct and 45,000 indirect). The P-SCS also boasts of its booming tourism in the Tubbataha Reef Natural Park in Palawan while the proposed Philippine Turtle Island Ecotourism Development is estimated to earn at least PhP126 million annually from medium-volume of tourist arrivals (Libosada 2009).

1.4.2. Indonesian part of the SCSLME (I-SCS)

The gross regional domestic product (GRDP) of the four Indonesian provinces in the SCS amounted to 7.62% in 2010 relative to the Gross Domestic Product (GDP) with East Kalimantan contributing the largest (GRDP 6.08% relative to the GDP). The agriculture

sector, which combines fisheries and forestry, contributed significantly to the GRDP with the Province of Central Sulawesi contributing the most (40.03%), followed by the Province of Gorontalo of about 29.65%, and North Sulawesi Province of about 18.30%. In 2009, fisheries production in North Sulawesi was highest and amounted to 211.373 tons compared to only 66.717 tons in Gorontalo, 37.831 tons production in East Kalimantan, and 4.776 tons in Central Sulawesi (TDA Country Report 2011).

1.4.3. Malaysian part of the SCSLME (M-SCS)

Agriculture is Sabah's second most important economic activity, contributing about 24% (as compared to the services sector of 49%) to Sabah's GDP. Fisheries provide employment from the appropriation stage of the supply chain to the processing stage in the downstream industries and exporting sector. In 2010, the total number of Sabahan working full and part time in the fisheries industry, combined with agriculture and forestry, was estimated at around 416,000 out of 1,345.3 million labor force (unemployment rate in Sabah was 5.5%), in which 351,500 are categorized as skilled agricultural and fishery workers. Another study ascertained that about 32% were employed in agriculture, hunting, forestry and fishery in Sabah as of 2004. The trend has been declining from its high share of about 56% back in 1980 (Leete 2008).

The fisheries sector in the nine nine districts in Sabah employed 16,923 individuals or 71% of the total number of fishermen in the state (23,763). Alin (2009a) estimated that specific contributions of fisheries to Sabah's economy from these nine districts, measured in employment multiplier effect, are 1.62 for marine capture and 1.70 for aquaculture. This implies that, for every 10 jobs created directly in the catching sector, over six additional jobs are created elsewhere in the nine economic districts within the supply industries (e.g., down-stream processing, import/exports) while in the aquaculture industry, every 10 jobs support at least seven more jobs in the industry's suppliers. Surprisingly, the employment multiplier effects for fisheries surpassed that of oil palm –a sector claimed to be the engine of growth for the nines M-SCS districts.

The multiplier effect works in both directions. In the expansion of an industry, it creates additional jobs in other sectors; but contraction in the industry will also restrict job opportunities. This means that exogenous shock such as overexploitation of fish, habitat and community modification, pollution and climate change may adversely affect production and employment both in fisheries and in the wider economy.

1.4.4. Fisheries (Small Pelagics) and Its Contribution to Food Security

Although output from fisheries is relatively small compared to agriculture, fisheries is nonetheless extremely important as it relates to food security, absolute poverty and the "greening" of GDP. In 2010, the per capita consumption of fish among Malaysians is 56 kg (as compared to ~33 kg in 1985) and this figure is expected to double for poor people living in SCS areas. Small pelagics are the main source of inexpensive animal protein for lower income groups in the Philippines as well. This lower income group comprises about 70% of

the country's total population. The average consumption of fish among Filipinos is 36 kg person^{-1} yr^{-1}. Moreover, it is estimated that more than 50% of the animal protein intake in the Philippines is obtained from marine fisheries (Philippine Coastal Management Guidebook Series No. 1: Coastal Management Orientation and Overview, 2001).

1.4.5. Determinants of the Population's Capacity to Manage and Pay for Resource Use (Payment for Environmental Services or PES)

1.4.5.1. Human Development Index

The United Nations Human Development Report has formulated the Human Development Index (HDI) as a composite measure of the quality of life of an individual.[4] It is composed of three dimensions, each with corresponding indicators, namely, health (life expectancy at birth), education (mean years of schooling, expected years of schooling), and living standards (Gross National Income or GNP per capita). An HDI value close to one (1) indicates a better quality of life.

HDI for the P-SCS (0.53) has been lagging behind the M-SCS (0.74) and I-SCS (0.73) (see Table 1.4-2). As the HDI gives an overall capacity of the population to manage its resources, the low performance of the three countries, especially P-SCS, will have to be considered in designing the conservation efforts later on for the SCSLME.

Another striking feature of the P-SCS was that it had the top twenty provinces in the country with the lowest HDI in 2003 (Table 1.4-3).

Table 1.4-2. Human Development Index (HDI) in the SCS LME.

Malaysian SCS (2003)		Philippines (2003)		Indonesia (2009)	
District	HDI	Region	HDI	Province	HDI
Kunak		IV-A	0.66	E Kalimantan	No data
Sandakan		IV-B	0.50	N Sulawesi	0.76
Kudat		V	0.52	C Sulawesi	No data
Tawau		VI	0.57	Gorontalo	0.70
Semporna		VII	0.54		
Lahad Datu		VIII	0.49		
Pitas		IX	0.50		
Beluran		X	0.58		
Kota Marudu		XI	0.57		
		XII	0.54		
		Caraga	0.51		
		ARMM	0.38		
Average	0.74		0.53		0.73

Source: UNDP 2007 (for Sabah HDI); Indonesia Country Report for SCS TDA; MEDCo (now Mindanao Development Authority or MinDA) with reference from 2005 Philippine Human Development Report.

[4] http://hdr.undp.org/en/statistics/hdi/

Table 1.4-3. Top twenty provinces with the lowest HDI in the Philippines in 2003.

Provinces in the P-SCS	HDI	Provinces in the P-SCS	HDI
1) Sulu	0.301	11) Romblon	0.483
2) Maguindanao	0.360	12) Northern Samar	0.486
3) Tawi-Tawi	0.364	13) Surigao del Sur	0.487
4) Basilan	0.409	14) Biliran	0.489
5) Masbate	0.442	15) Marinduque	0.489
6) Zamboanga del Norte	0.446	16) Negros Oriental	0.490
7) Sarangani	0.448	17) Agusan del Sur	0.491
8) Western Samar	0.469	18) Siquijor	0.497
9) Eastern Samar	0.474	19) Sultan Kudarat	0.497
10) Lanao del Sur	0.480	20) Davao Oriental	0.503

Source: MEDCo (now Mindanao Development Authority or MinDA) with reference from 2005 Philippine Human Development Report.

1.4.5.2. Education

The level of education of the populace influences the primary and secondary production processes and facilitates acquisition of conservation technology. Primary production processes involve simple extraction or collection of raw materials, in this case, the catching of the fish including its cold storage. Getting the optimum volume at the lowest cost is a key consideration in this stage of production. Meanwhile, secondary production processes involve value adding. This can include canning and bottling of small pelagic fishes.

Literacy rate is relatively high among the population in the SCS LME, the highest of which was in the I-SCS at 97.6% (Table 1.4-4). This will hopefully bring positive impacts and aid in the conservation efforts in the SCS LME. In the case of the Philippines, the quality of education and its corresponding incentives also matter. There has been a decline in students taking up fisheries and other related courses despite that agriculture and fisheries remain to be critical for growth and development. Students perceive that most farmers and fishers remain poor and are discouraged to take up these courses.

Recent planning exercises of the Philippine government, both national and sub-national (referring to the Mindanao Peace and Development Framework for 2011-2030), are finding ways and incentive schemes for students in order to take up agriculture and fisheries related courses. Provision of scholarships and ensuring employment after graduation by partnering with private companies are being considered. Moreover, agriculture and fishery entrepreneurship courses are promoted over the traditional courses. The program expects young farmers and fishers to elevate themselves into the value-adding (secondary production) sector which will give them better incomes.

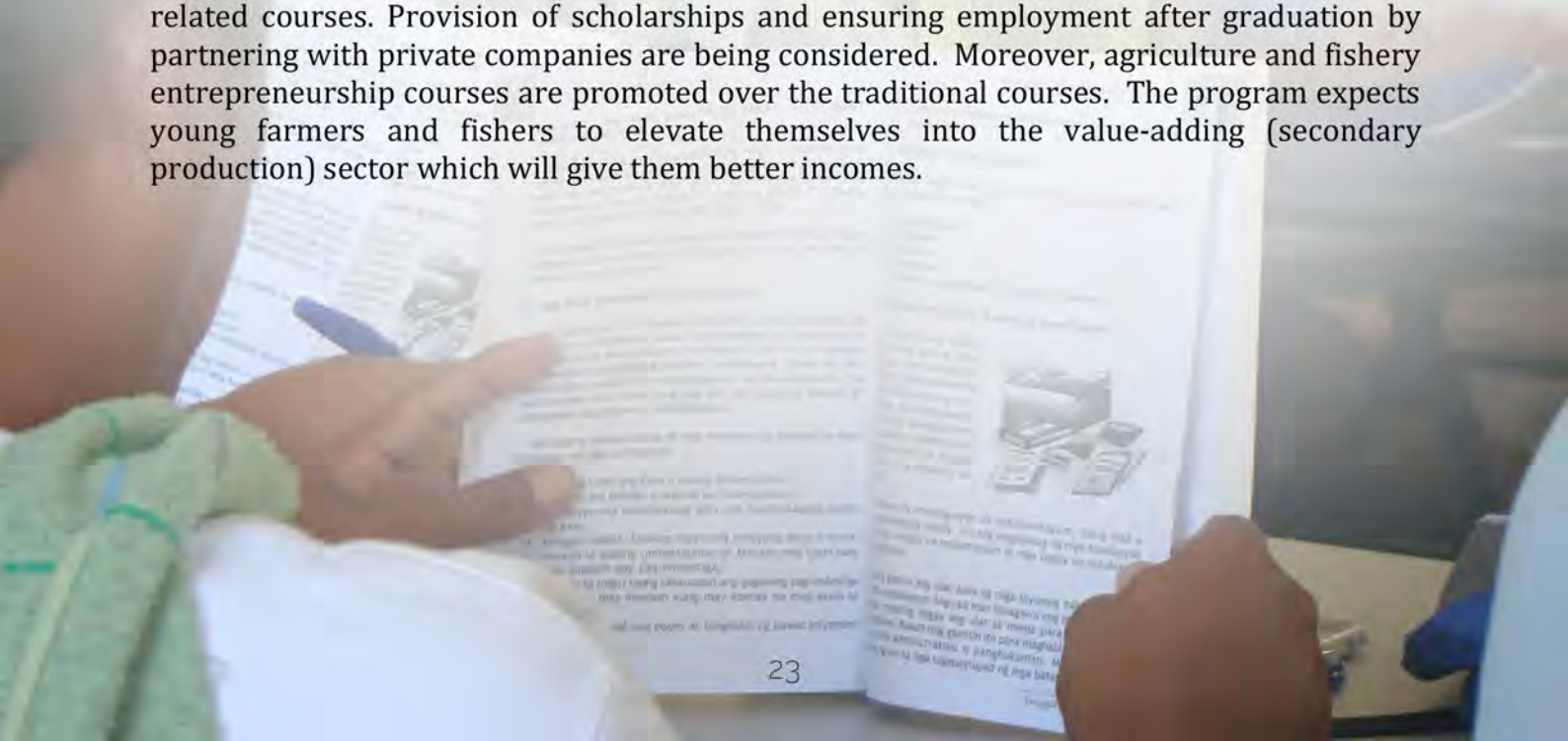


Table 1.4-4. Literacy Rate in the SCS LME.

Malaysia (2000)		Philippines (2003)		Indonesia (2010)	
District	Literacy Rate	Region	Functional Literacy Rate	Province	Literacy Rate
Kunak		IV-A	92.0	E Kalimantan	
Sandakan		IV-B	84.4	N Sulawesi	
Kudat		V	83.8	C Sulawesi	
Tawau		VI	85.2	Gorontalo	
Semporna		VII	83.6		
Lahad Datu		VIII	82.1		
Pitas		IX	79.8		
Beluran		X	86.9		
Kota Marudu		XI	82.2		
		XII	79.7		
		Caraga	84.6		
		ARMM	62.1		
Average	85.0		82.2		97.6

Source: Sabah Human Development Progress and Challenges, UNDP, Kuala Lumpur, May 17; Philippine NSCB; Indonesia Country Report for SCS TDA.

Employment, Income and Poverty Level

Employment rate in the SCSLME is relatively high at about 95% in all three countries (Table 1.4-5). The level of income is important since it is one of the determinants of the population's capacity to manage resources. It is usually correlated to the ability of the populace to pay for the resource use where the true value or price of an environment-related service or product is considered.

In terms of average annual income, it was only Region IV-A in P-SCS that surpassed the average income of the country (PhP129,000 yr^{-1}), all the rest were below that level (NSCB 2009). The ARMM, on the other hand, was consistent of being the lowest earner, lowest spender and lowest saver as well.

In the I-SCS, the total number of poor in its four provinces is about 1,134,600 people or about 14.5% of the total population in the four provinces. Gorontalo Province has the highest percentage of poor population which is about 23%, while East Kalimantan Province has only about eight percent. East Kalimantan Province has higher percentage of poor population compared with the districts in North Sulawesi Province.

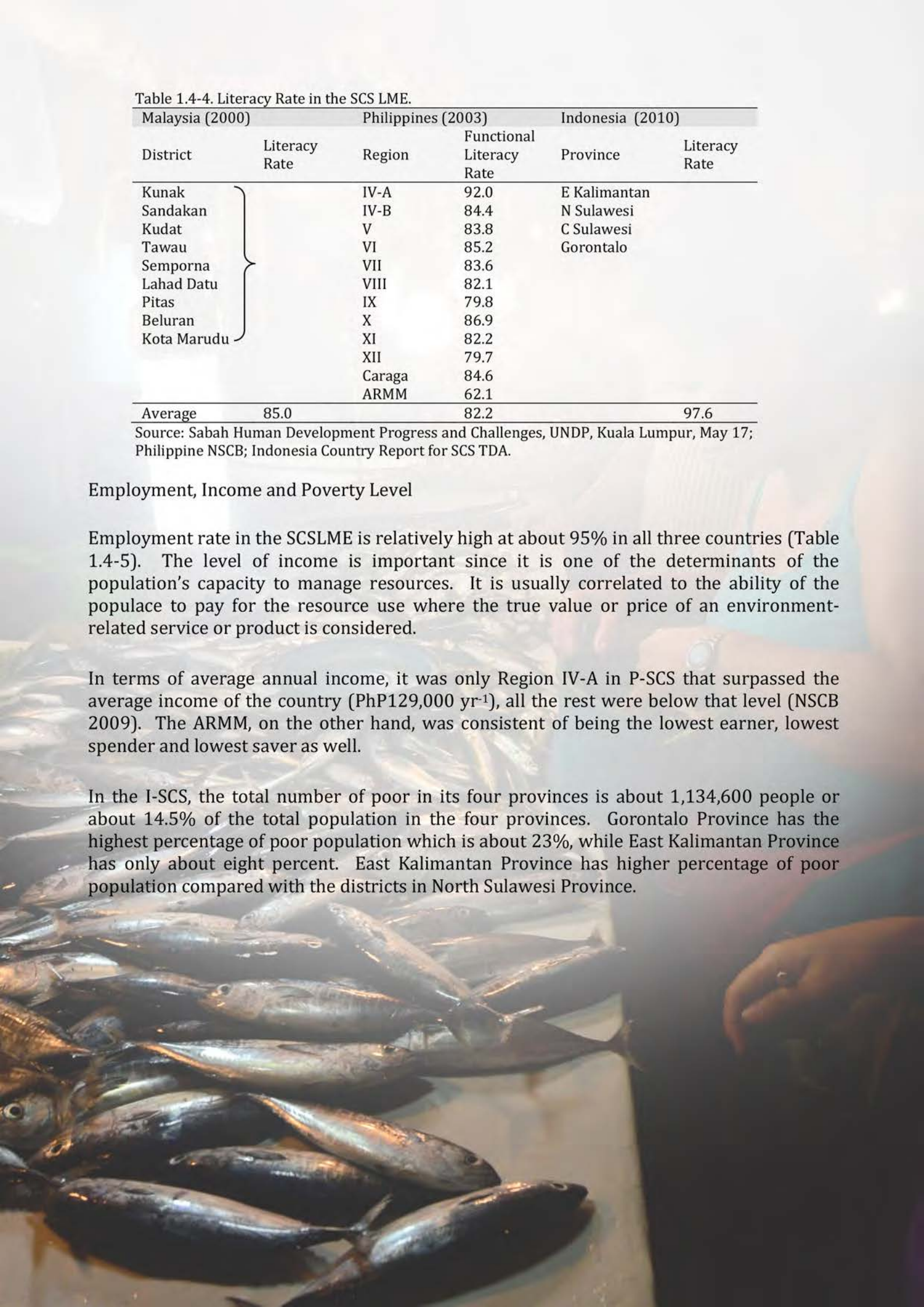


Table 1.4-5. Employment rate in the SCS LME areas.

Malaysia (2009)		Philippines (2009)		Indonesia (2009)	
District	Employment Rate	Region	Employment Rate	Province	Employment Rate
Kunak		IV-A	89.6	E Kalimantan	
Sandakan		IV-B	95.6	N Sulawesi	
Kudat		V	94.2	C Sulawesi	
Tawau		VI	93.0	Gorontalo	
Semporna		VII	92.5		
Lahad Datu		VIII	94.6		
Pitas		IX	96.4		
Beluran		X	95.1		
Kota Marudu		XI	94.1		
		XII	95.9		
		Caraga	94.2		
		ARMM	97.7		
Average	94.5		94.4		89 to 95

Source: Indonesia Country Report for SCS TDA; Malaysia Country Report for SCS TDA; Philippine Statistical Yearbook 2008.

In the M-SCS, a total of 15,283 of households were identified in 2004. The most vulnerable, disadvantaged and poor of all the artisanal fishing communities in SCS LME districts are the Sea Gypsies. Although some of them have already settled permanently (their houses on stilts can be seen in Omadal and Selakan Island of Tun Sakaran Marine Park), most are still trans-migratory. Loss of marine habitats will have devastating impacts to "the people on the move", who are truly dependent on marine resources for livelihood (food) and for exercising their rights to practice unique indigenous traditions. As people on the move, they roam the waters of the SCS LME, staying on the *Lepa-Lepa* at different mooring points in Kudat (near Simpang Mengayau, Balambangan islands, Maliangin islands), Kota Kinabalu (Likas river) or in Tawi-Tawi areas of Tawi-Tawi Bay, Simunul, Manuk-Manukan (Turtle islands group), Pababag island, Bongao, Setanggai, Sibutu, Siasi Island, and Sangalaki Island in East Kalimantan, and North Sulawesi during different months of the year. The primary reason why they continue to cross borders to Philippines or to voyage southward to East Kalimantan and North Sulawesi (less frequent in the recent time) is to visit family or relatives. When families reach their mooring point, which usually is a Bay, lagoon or shallow coral reefs, they will form a flotilla (congregation of *Lepa-Lepa*). These mooring areas are more than a place for family reunion, it is also a place for exchanging information about sea routes, death and sickness, location of spiritual healers, situation across borders, barter trade, marriage market, and so on. Because of their nomadic lifestyle, they do not appear in official statistics (e.g., in population census). Births, deaths or marriages are not registered; hence they are regarded as stateless but nonetheless protected under the international conventions such as UN Declaration on the Rights of Indigenous People, Article 3 of UN Convention relating to Status of Stateless People 1954, and UN Convention Relating to the Reduction of the Stateless 1961. Table 1.4-6 below reflects the number of poor households in the Malaysian part of the SCS LME and the trend has been increasing over the years. They comprised about half of total number of poor in the entire Sabah.

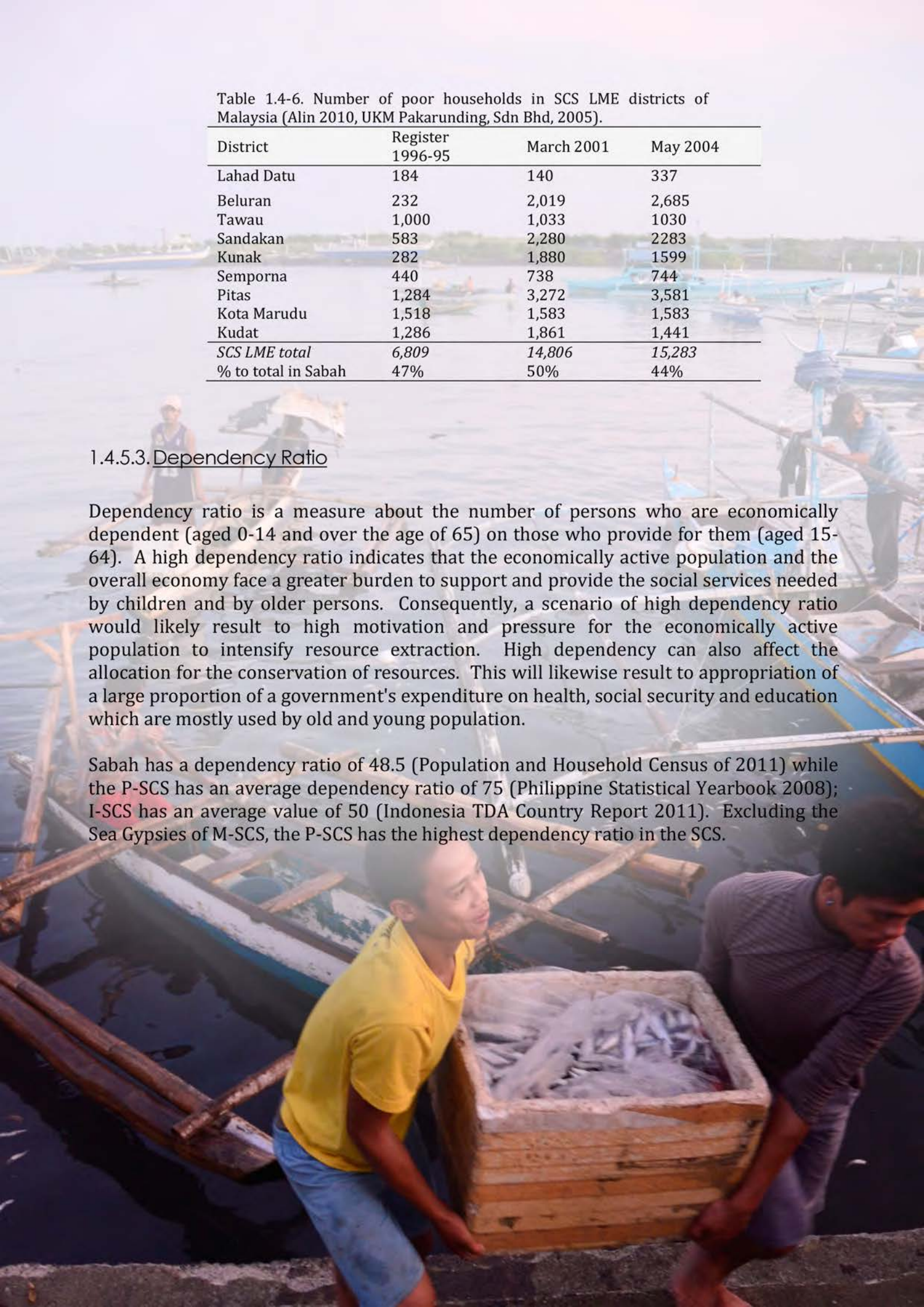
Table 1.4-6. Number of poor households in SCS LME districts of Malaysia (Alin 2010, UKM Pakarunding, Sdn Bhd, 2005).

District	Register 1996-95	March 2001	May 2004
Lahad Datu	184	140	337
Beluran	232	2,019	2,685
Tawau	1,000	1,033	1030
Sandakan	583	2,280	2283
Kunak	282	1,880	1599
Semporna	440	738	744
Pitas	1,284	3,272	3,581
Kota Marudu	1,518	1,583	1,583
Kudat	1,286	1,861	1,441
SCS LME total	*6,809*	*14,806*	*15,283*
% to total in Sabah	47%	50%	44%

1.4.5.3. Dependency Ratio

Dependency ratio is a measure about the number of persons who are economically dependent (aged 0-14 and over the age of 65) on those who provide for them (aged 15-64). A high dependency ratio indicates that the economically active population and the overall economy face a greater burden to support and provide the social services needed by children and by older persons. Consequently, a scenario of high dependency ratio would likely result to high motivation and pressure for the economically active population to intensify resource extraction. High dependency can also affect the allocation for the conservation of resources. This will likewise result to appropriation of a large proportion of a government's expenditure on health, social security and education which are mostly used by old and young population.

Sabah has a dependency ratio of 48.5 (Population and Household Census of 2011) while the P-SCS has an average dependency ratio of 75 (Philippine Statistical Yearbook 2008); I-SCS has an average value of 50 (Indonesia TDA Country Report 2011). Excluding the Sea Gypsies of M-SCS, the P-SCS has the highest dependency ratio in the SCS.



2.1 Objectives

The Transboundary Diagnostic Analysis (TDA) is the first component of the SCS SFM Project. The objective of TDA is to identify and prioritize the transboundary problems in the Sulu-Celebes Sea Large Marine Ecosystem (SCS LME). This also aims to update the earlier assessment of the LME under the Global International Waters Assessment Project (GIWA 56) conducted in 2002 with regional experts. The TDA is conducted so that there is an objective basis for the formulation of a common program for management.

2.2 Process

The Sulu-Celebes (Sulawesi) Sea Sustainable Fisheries Management Project (SCS-SFM) (GEF/UNDP/UNOPS) engaged Conservation International - Philippines (CI-Philippines) to facilitate the conduct of the TDA. The technical staff of the Project Management Office (PMO), SCS-SFM Project provided technical guidance in the execution of the TDA. It was conducted following the module entitled, "Training Course on the TDA/SAP Approach in the Global Environment Facility (GEF) International Waters Programme" (Bloxham et al. 2005).

CI-Philippines employed a team consisting of a Project Manager, a technical assistant, and an administrative assistant. It also employed Technical Task Teams (TTT) in Indonesia, Malaysia, and the Philippines in consultation with the National Coordinating Units (NCU) of SCS-SFMP in the respective countries and the PMO. The three NCUs are the Research Center for Fisheries and Marine Conservation under the Ministry of Marine Affairs and Fisheries (Indonesia), the Department of Fisheries Sabah (Malaysia), and the National Fisheries Research and Development Institute under the Bureau of Fisheries and Aquatic Resources (Philippines). The TTT is composed of four (4) experts in the following fields: fisheries, environment, socio-economics, and legal, institutions and governance. The CI-P Team, together with the TTTs, the NCUs, and the PMO conducted the TDA in the Sulu-Celebes Sea Large Marine Ecosystem (SCS LME).

The TDA was conducted in a series of workshops at the regional and national levels. Two regional workshops were conducted in 2011. The First Regional Workshop was conducted to orient the TTTs and NCUs of the TDA- SAP management framework of the International Waters Focal Area of the GEF. In addition, the scoping of the TDA and the identification and initial prioritization of the transboundary problems were conducted. Consequently, the data and information needed for each of the transboundary problems were identified. Research in the published literature and in unpublished reports and data were done by the TTTs. They also conducted interviews on each of the transboundary problems. In the Second Regional Workshop, prioritization of the transboundary problems was finalized based on the data and information gathered by the TTTs. Causal chain analysis (CCA) to arrive at the root causes of each of the transboundary problems was also done. National workshops were also carried out in each country to validate with the stakeholders the data and information collected by the TTT experts of the respective countries and to gather more data and information and sources, as necessary.

The Technical Task Team, representatives of the NCUs of Indonesia, Malaysia and the Philippines, and the PMO were gathered at a regional workshop to draft the TDA. The draft TDA was completed by the CI-Philippines Team and the PMO in close coordination with the TTTs of Indonesia, Malaysia and Philippines. The PMO reviewed the TDA prior to the presentation to the Sulu-Sulawesi Marine Ecoregion Sub-committee on Sustainable Fisheries which will further review the report and evaluate the findings. When acceptable, the Sub-committee will transmit and endorse the report to the SSME Trinational Committee for approval.

As an initial step in the TDA, the regional team defined the spatial and temporal bounds of the transboundary problems (TPs) to delimit the scope and be pragmatic about what is doable in the SCS LME in a defined timeframe. The scoping results were completed through a participatory process among the TTTs of Indonesia, Malaysia and Philippines (IMP), NCUs, PMO and CI-Philippines.

The initially identified priority TPs guided the TTTs on what information and data they needed to gather in their respective countries in order to prepare the final list of priority TPs. A CCA for each prioritized TP was then conducted.

The following subsections describe the essential first three steps of the TDA process and the corresponding outputs for the geographic and temporal scales, the initially prioritized TPs, and the data and information collected for the final prioritization of TPs.

2.3 Scope of the TDA for the SCS-LME

2.3.1. Geographic Scale

In defining the geographic scale, the country representatives were provided with a map of the SSME with corresponding ecoregion boundaries, as reference (Figure 2.3-1). On this map, country representatives drew their proposed geographic scale for the TDA, in consideration of key factors, which might influence their decision on the scale such as: pollutants coming from the mountains and draining into the SSME waters through the various river systems; and socio-economic activities, which can cause environmental degradation in the SSME.

The three countries were unanimous in their decisions to extending the boundary of interest from the coastline limits of the SSME right up to the catchment areas of rivers draining into the Sulu and Celebes Seas. For the Malaysian team, their decision came from their recognition of two-thirds of Sabah is within the catchment area discharging into the Sulu and Celebes Seas; hence, prompting them to move further inland the SSME boundary for the TDA work to cover the four important rivers in Sabah, namely: Kinabatangan, Sugut, Labuk, and Seguma. Similarly, the Indonesian team decided to expand the SSME boundary to include areas inward below the highlands for the TDA work. This expansion of the SSME boundary was also relevant to the Philippine team and using the ridge-to-reef (R2R) approach, decided to include the ridgeline demarcating the eastern part of Mindanao island; longitudinal half part of Palawan island; and, of the southern part of Luzon island. This scale of geographic scope should necessarily cover the larger, natural water systems of the catchments of the Philippine portion of the SSME. The resulting expanded boundary of the SSME (Figure 2.3-2) defined the geographic scale of the SCLME to which the country teams confined their TDA work.

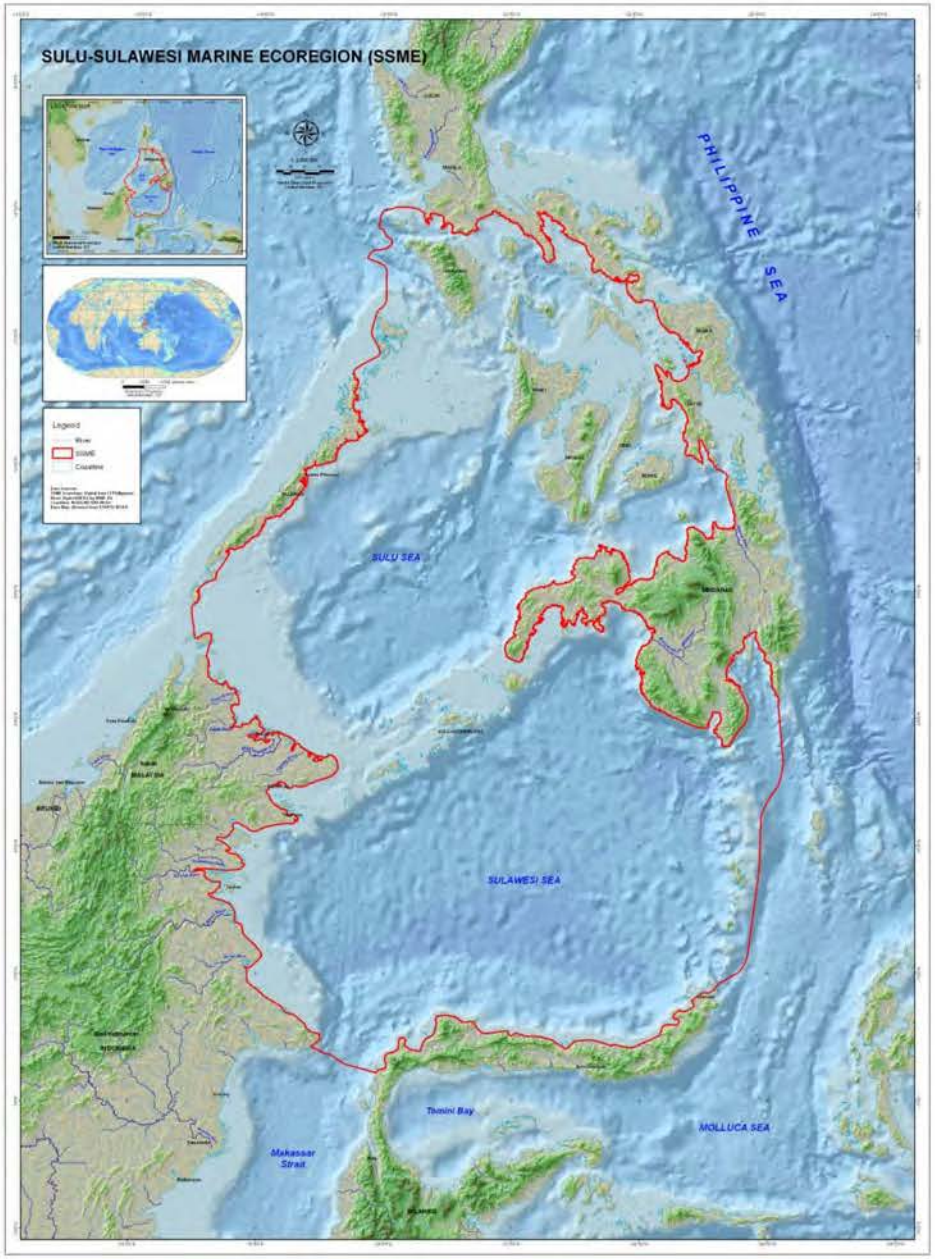


Figure 2.3-1. SSME (or SCS LME) map with its ecoregion boundary.

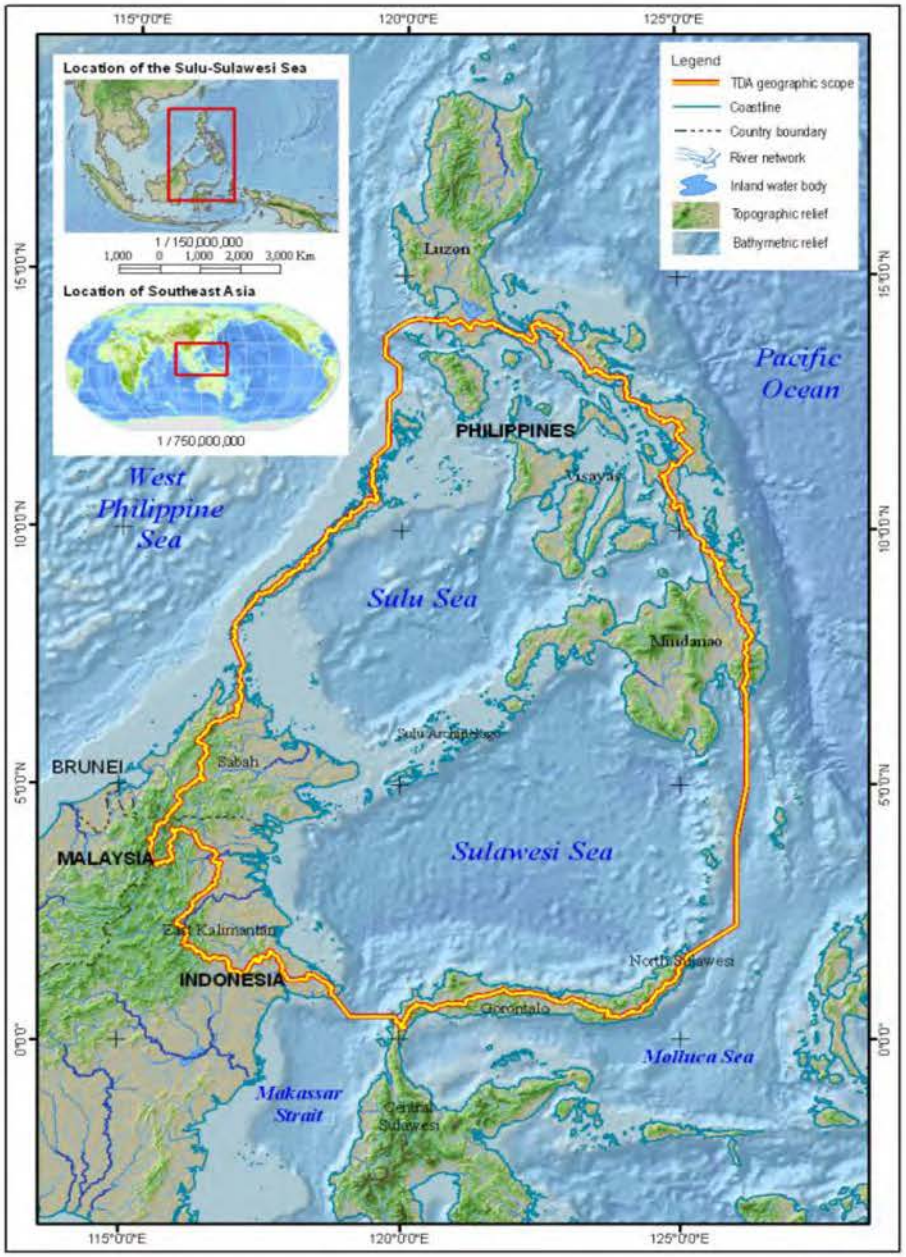


Figure 2.3-2. Expanded boundary of the SSME defining the geographic scale of the TDA.

2.3.2. Temporal Scale

With the geographic scale agreed upon by the country teams, the next stage was to establish the number of years into the future that would be considered to infer impacts of the TPs in the SCS-LME. The main objective in this stage was for the country teams to select a realistic time scale to enable them to identify practical short-term or long-term actions to resolve the TPs.

There were several suggestions that came up from the country teams on how to tackle this timescale selection. The country teams agreed to identify first the TPs before agreeing on the temporal scale. After the TPs were identified, several suggestions on timescale were given based on current commitments of donor support and ongoing international programs and plans. Foremost of these is the Convention on Biological Diversity (CBD) whose commitment target year is 2020. In aligning the TDA with the CBD goals, the country teams agreed to adopt 2020 as the target temporal scale of the TDA scope of work.

2.4 Initially Identified and Prioritized Transboundary Problems

The three countries' outputs on TPs and concerns (Annexes 2.4-1, 2.4-2, and 2.4-3) were then integrated. The highlights of which are as follows:

a. Most of the transboundary problems/concerns (TPs/Cs) identified in GIWA 56 (a study done in 2002 and the results published in 2005), were still deemed valid by the representations from the three SCS countries. However, there have been TPs/Cs which were considered to be no longer relevant, such as:
   - radionuclide; and
   - increased UV-B radiation.

b. On the other hand, ballast water disposal (resulting in the introduction of alien and invasive species) was added as a separate concern, while other concerns were expounded, including:
   - Unsustainable exploitation of fish—use of fish aggregating device (FAD) and capture of undersized pelagic fish;
   - chemical—heavy metals, radioactive, pesticide/insecticide;
   - solid waste—from communities and from seaweed projects (plastic floats, *Raffia* strings, etc.) to other transboundary waters; and
   - spills—waste and oil.

c. Representatives from three SCS countries agreed on changes in terminologies used, as follows:
   - from "Global Change" to "Climate Change";
   - from "Changes in hydrological cycle" to "Extreme weather events"; and
   - from "Changes in ocean CO_2 source/sink function" to "Ocean acidification".

d. Malaysia also proposed additional TPs related to the following:
   - human migration;
   - quarantine and biosecurity; and
   - Illegal, Unreported and Unregulated (IUU) marine fishing and trade.

2.5 Data and Information for Finalization of Transboundary Problems and Concerns (TPs/Cs)

The country teams further collected secondary data and information from their respective countries to be used in the finalization of priority TPs/Cs and come up with the final list. To guide the country teams in the collection of necessary data and information, they identified first the impacts of the TPs/Cs and the corresponding data and information requirements. For expediency in the identification process, the team members were grouped according to their sectors of expertise, namely: fisheries; environment; socio-economic; and legal, institution and governance. Each group was tasked to identify the following elements: impacts of each of the TPs/Cs; their respective indicators; and units of measurement. As reference and sample of recording these elements, the standardized data tables used during the development of the Yellow Sea TDA were provided. Outputs of the groups are in Annexes 2.5-1 and 2.5-2.

Several pointers to consider on data and informationgathering, as presented by the groups, are as follows:

a. On the data requirements under the socio-economic sector, gender data was highly suggested to be included, in particular, population and employment in the fisheries sector by gender. Nationality and immigration status were also proposed to be gathered, as well as, the possible socio-economic benefits from Alien and Invasive Species.

b. For the environment sector, data on restoration and rehabilitation initiatives were proposed to be gathered as among the indicators for mangrove degradation. For the sea-surface temperature increase, the country teams discussed whether or not to consider change in rates of ontogenesis as an impact and they agreed to reassess this further.

c. On the fisheries sector, data on aquaculture was proposed to be added as it will be a big concern in the future especially in the Philippines. For IUU fishing, decrease of fish biomass and profiles of fisheries were identified to be among the secondary data to be gathered.

d. Further consultation on the data requirements will be coordinated by CI-Philippines with the TTTs, NCUs and the PMO. The CI-Philippines assigned a GIS specialist for the mapping needs of the TDA work and to handle map data in electronic form.

2.6 Priority Transboundary Problems (TPs) and Associated Issues in the SCS LME

Process of Identifying TPs

The identification of priority TPs and environmental issues was guided by the basic cycle of Driver-Pressure-State-Impact-Response (DPSIR) Framework (Figure 2.6). The country teams revisited and reviewed the TPs and environmental issues in the GIWA Report No. 56, acknowledging constraints on time and resources. The validity and relevance of these TPs were assessed and new TPs and concerns which needed to be addressed were identified. The standardized scoring scale, which was used in the prioritization exercises for GIWA in 2002, helped the country teams to identify the environmental, economic, social, and community impacts of each of the TPs and project scenarios for the impacts until 2020. In predicting future impacts of TPs, studies and experiences from current marine conservation initiatives were considered.

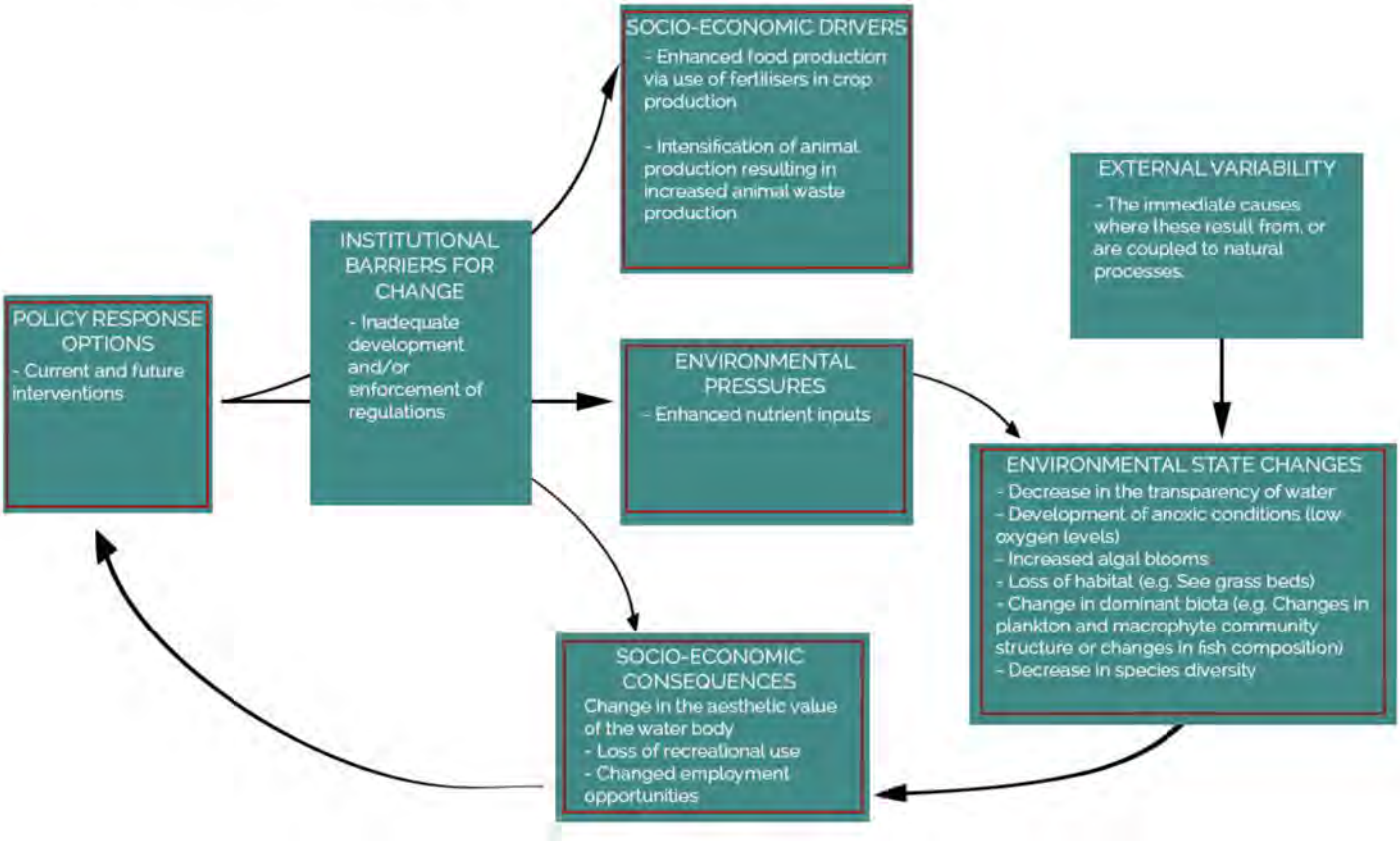


Figure 2.6. The Driver-Pressure-State-Impact-Response (DPSIR) Framework.

In addition to the DPSIR approach, scoring scales were applied to standardize the prioritization process. For the initial list of transboundary problems (TP), two scoring scales were used based on the GIWA exercise; one for the current impacts and another for likely direction of change on future impacts (see box below).

Description of score for the degree of impact of the TP at present	Scale	Description of score for likely direction of TP in the future
No known impact	0	No known impact
Slight impact	1	Decreased impact
Moderate impact	2	No changes
Severe impact	3	Increased Impact

Each TP and corresponding sub-issues were scored using these two scoring scales. Final prioritization process then followed; ranking the TPs based on the degree of impact. Each country ranked the six TPs, with each consultant considering impacts in their respective fields. Scores across countries were summed up to get the rankings for the region (Table 2.6).

Table 2.6. Final prioritization ranking of transboundary problems (TPs).

Transboundary Problem/Concern	Country scores			Regional	
	Indonesia	Malaysia	Philippines	Score	Rank
Unsustainable exploitation of fish	6	5	6	17	1
Habitat and community modification	5	6	5	16	2
Climate change	4	2	4	10	3
Marine pollution	3	4	3	10	4
Freshwater shortage	2	3	2	7	5
Alien and invasive species	1	1	1	3	6

3.1. Unsustainable exploitation of fish

Fisheries in the SCS countries are probably among the most diverse in the entire coral triangle region in terms of species caught and the fishing gears employed (De Vantier et al. 2004). The marine capture fisheries production in SCS increased steadily in the last 60 years, with an almost ten-fold increase in the aggregate production from Indonesia, Malaysia, and Philippines in the last decade with a combined production of more than 53 million metric tons relative to the 1950s of only about six million metric tons (Figure 3.1-1) (www.FAO.org). Despite issues on discrepancies in estimating production values, the growing trend has been mainly attributed to increasing effort, expansion of fishing grounds and use of more efficient fishing gears.

The production estimates presently given are for the entire countries of Indonesia, Malaysia, and Philippines inside the FAO fishing area #71 (Western Central Pacific). APEC (2008) estimates that the marine fisheries production of Indonesia in the SCS (mainly from East Kalimantan and North Sulawesi) is only about 8% of the country's total while Malaysia's marine fisheries production is about 16% (includes all of Sabah) of its total. The contribution of SCS marine fisheries to Philippine's total marine fisheries production has always been more than 60% in the last decade (Bureau of Agricultural Statistics). Refer also to the sections on *Fishing methods and gears* and *Fishing grounds* below.

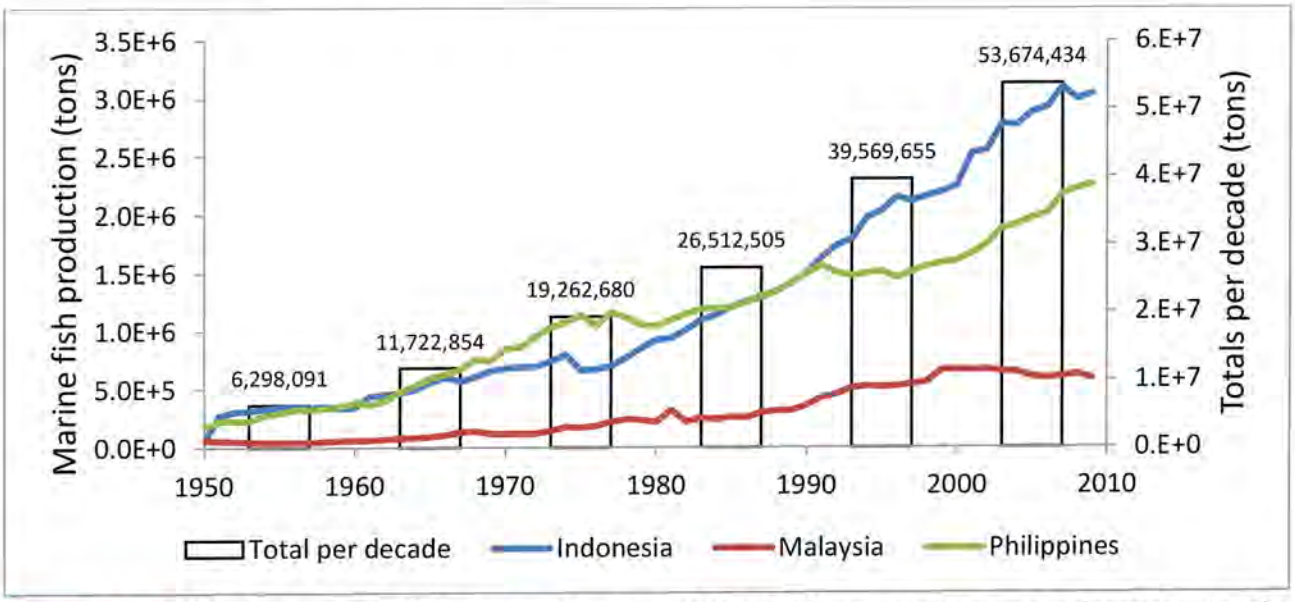


Figure 3.1-1. Marine capture fisheries production of the SSME countries over 6 decades. Yearly production of Indonesia, Malaysia, and Philippines are depicted in lines and their aggregate production per decade in bars (www.FAO.org).

Due to decades of uncontrolled harvesting of wild stocks and IUU fishing, the depletion of productive fishing grounds in Indonesia, Malaysia, and Philippines is becoming more evident. Unsustainable fisheries in the SCS have also resulted to habitat degradation related to blast and poison fishing.

Purse seiners and trawlers dominate the industrial-scale fisheries in the SCS, where fish aggregating devices (FADs) have become commonly used. Out of these concerns, different levels of restrictions have been formulated and implemented by the SCS countries such as seasonal closures and spatial limitation. The participation of industrial-scale fishing operators in the formulation and enforcement of site-specific policies in the SCS also indicates the recognition of a dwindling resource.

3.1.1. Fishery demographics

Philippines accounts for 90.3% of the total (~1.8 million) fishers in the SCS, while Indonesia and Malaysia only account for 8.7% (173,429) and 1% (17,782), respectively. The fisher population, however, cannot be categorized as transient fishers or those who are employed in other countries such as Filipino fishers working for commercial fishing boats in other SCS countries. Women in fisheries are likewise unrepresented and unaccounted in the statistics. These facts should be taken into consideration in assigning responsibilities for conservation of fisheries in SCS-LME - it is just equitable and fair that Philippines, as the biggest appropriator of marine resources from SCS-LME should take bigger responsibility (in terms of initiating regional collaboration) or has the strongest incentive to take immediate actions for conservation.

Fishing fleets in the SCS are categorized based on existing national fishery policies but are generally composed of artisanal or small-scale fishers and commercial or industrial scale fishers. To date, the SCS fishing fleet is estimated at around 825,082 boats operating within and adjacent fishing grounds of the SCS LME (Table 3.1-1). Artisanal fishers based on boat category are the dominant resource users in the SCS countries.

Table 3.1-1. Summary of major boat / vessel categories of fishing fleets in SCS countries (Sources as cited in the 2011 Country Reports: Provincial Fisheries Statistic 2009+; Annual Fisheries Statistics 2009++; BFAR 2009+++).

SCS Country	Boat category					
	Artisanal		Commercial		Total	
Indonesia+	33,481	4.10%	335	3.71%	33,816	4.10%
Malaysia++	4,870	0.60%	2,325	25.74%	7,195	0.87%
Philippines+++	777,700	95.30%	6,371	70.55%	784,071	95.03%
Totals	816,051	100%	9,031	100%	825,082	100%

Fishing fleets in Indonesia are comprised of non-motorized and motorized boats with capacities of 10 to 200 gross tons (GT). Most fishing fleets have capacities of up to 10 GT. Of the 33,816 fishing boats accounted in the SCS side of Indonesia, only 335 boats were within the category of more than 10 GT to 200 GT (considered as large-scale fishing boats). However the majority of fishing fleets that operate in the SCS-LME is between 10-30 GT, while the 200 GT vessels operate not only in Sulawesi Sea but also in the Pacific Ocean. The Malaysian fishing fleet is composed of some 7,195 boats in 2009, categorized into non powered (27%), outboard (44%) and inboard (29%). Most of the fishing activities are concentrated at the SSME-Malaysia (68% outboards, 76% non-powered, and 57% inboard). Capacities of inboards engines are up to 70 Gross registered tons (GRT). Almost 99% of the inboard engines were mostly for vessels below 40GRT. Fleets with more than 70GRT were reported to operate in Sandakan only. Komilus et al. (2011) reported that boat capacities and engine power of Malaysian fishing vessels depended on the type of fishing gear and the fishing ground where they operate (Annex 3.1-1). In Semporna, Malaysia, purse seiners with less than 25 GRT are not allowed to fish in coastal waters less than 3 n mi from mainland and 1 n mi around small islands. On the other hand, boats with higher engine capacities, i.e., 25-60 GRT, 50-70 GRT, 70-100 GRT, and more than 100 GRT, are allowed to explore similar fishing grounds except coastal waters with less than 6 nmi, 10 n mi, 12 n mi and 200 n mi from mainland, respectively.

Philippine fishing fleets are categorized into small-scale or municipal fishing boats (up to 3 GT) and commercial fishing vessels (more than 3 GT). The 2009 survey of Philippine fishing fleet by the BFAR accounted for some 777,700 units of municipal fishing boats and 6,371 units of commercial fishing vessels, both comprising more than 95% of all the fishing fleet in the SCS countries.

3.1.2. Fishing methods and gears

The fishing gears common to the three SCS countries include several modifications of gill nets, seine nets, trawl, hook and lines, and traps. Purse seine fishing contributes to the bulk of small pelagic fishery production with catches composed of scads, sardines, and mackerel. Some fishing implements such as FADs (*payao*), light, and underwater breathing gears are also employed in shallow and deep-water ecosystems to maximize capture. Exclusion devices (like the TED or turtle excluding device) to minimize by-catch and prevent capture of threatened species such as turtles have been introduced in other SCS countries especially Malaysia but remains generally unpopular. The use and deployment of FADs in the exploitation of juvenile cohorts including tuna has raised concern in some SCS countries, leading to implementation of seasonal closures, restrictions, and different regulatory mechanisms on its use (e.g., Philippine Fisheries Administrative Order 236 s. 2010). However, FADs are just used to attract schooling fish and the problem may not come from FADs solely but from the fishing gear (purse seine) used with it. Hand-line fishing may have minimal impact on juveniles.

In Indonesia, purse seine has the highest catch volume among the gears and is widely used in North Sulawesi and landed around Bitung, the largest fishing base. Seine nets (Danish seine or 'payang', 'dogol'), and lift nets are also used to capture small pelagic fishes. Lift nets (especially in Bolaang, Mongondow, and Minahasa), and encircling gill nets are popular in Indonesia's Northern part of Sulawesi. Large pelagic fish such as albacore tuna or *tongkol*

(*Thunnus alalunga*), skip-jack tuna (*Katsuwonus pelamis*), and Spanish mackerel (*Scomberomorus commerson*) are caught by drift gill-net, pole and line (huhate), and troll line while tunas are caught using long line and hand line. The main catch in the waters of East Kalimantan are demersal and reef fishes. Demersal fish species are mainly caught by trawlers while reef fishes are caught using hook and line (i.e., set bottom long line, vertical line). The gear 'jaring dogol' is employed to catch demersal fishes and is similar to mini-trawlers or Danish seine. Hook and line and purse seine contribute about 46% and 34% of the annual landings, respectively. Annual landings are predominantly small pelagics contributing 56% to total landings (Provincial Fisheries Statistics 2009).

Commercial fishing gears contribute 88% to the annual catch in Malaysia while traditional gears contribute only up to 12%. Commercial gears comprise of trawlers and purse seines (*pukat jerut lampu*) while gills nets, hook and line, and traps are categorized as traditional gears. In 2009, commercial gears collectively contributed >56,000 MT fish landings, followed with hooks and lines (>21,000 MT), and drift/gill nets (>20,000 MT) (Annual Fisheries Statistics 2009, DOF Malaysia). Purse seine is the main fishing gear for pelagic fisheries in all districts of Malaysia. *Bagang* or lift net is another important gear mostly used in bays of Lahad Datu and Kunak. This is a non-selective gear and lands diverse catches of mixed cohorts. FADs are commonly used in fishing grounds along the SSME district like Semporna, and deployed in hotspots targeting both large and small pelagic species particularly *ikan tamban* or sardines (*Sardinella sp.*). Purse seiners with high-powered engines venture in areas between Pulau Mabul and Pulau Sipadan (Pulau Kepalai), which are favored spots for FAD deployment. These areas are notably the favourite spots for tuna fishing, where pelagic fishes caught on site are also used as live bait. Besides that, purse seiner *modus operandi* was improved with the application of underwater lights and spotlights to attract pelagic fish.

The Philippine fisheries sector employs a variety of gear types and each has specific variations. There are about 12 gear types used in the commercial sector to catch small pelagics while at least 20 gear types are known in the municipal sector (Dalzell et al. 1990). Bottom trawl was the major fishing gear used for demersal fishes from the late 1940s until the mid-1980s. However, due to increases in fuel prices and depletion of demersal resources, trawl operations dwindled and were replaced by more fuel-efficient Danish seines (Armada 2004). The most common fishing gears used by municipal fishing operators included hook and line (~9.45 million sets), gillnets (~1.19 million) and cast nets, cover pots, and crab pots (4.51 million) (NSO 2002-2005 Census of Fisheries). Other commonly used gears for small pelagic fisheries are bag nets, purse seines, and ring nets for commercial fishing and gillnets, beach seines, and round haul seines for municipal fishing. Stationary and boat-mounted lift nets are likewise used to primarily capture juveniles of small pelagics. FADs are also common and extensively used by purse seiners and ring netters, since they effectively reduce search time and effort. Another innovation is the use of "superlights" (high intensity lights) to attract and herd fish for capture. It has become an essential fishing implement for purse seiners, bag netters, as well as ring netters. The commercial fishing sector contributes about 69% of the annual landings while the rest is from the municipal fishing sector.

3.1.3. Fishing grounds

Fishing grounds in the SCS are mostly concentrated in nearshore areas, narrow passages, and basins bordered by major island formations (see Annex 3.1-1a). The gears used in these fishing grounds are modified to take advantage of the various habitat preferences of the target species. For over 6 decades, the SCS has become a major area for multi-gear and multi-species fishing operations as well as for illegal fishers and poachers who are involved in the trade of endangered wildlife species such as corals, turtles, sharks, and dolphins. Small-scale or municipal fishers operate in shallow coastal waters while the relatively deep open-waters serve as the main fishing grounds for commercial fishers.

Indonesian small pelagic fishery is mostly concentrated along the coasts of North Sulawesi. Shrimp trawlers frequently operate in the areas of Tarakan Island and offshore of Nunukan and Bunyu Islands. The use of beach seines and Danish seines as well as lift nets are common in the fishing grounds of North Sulawesi and East Kalimantan.

The fishing grounds in the Malaysian side of the SCS are located in the East Coast of Sabah, which is a narrow band of marine waters along the international borders with Philippines in the Sulu Sea and Indonesia in the Celebes Sea. The fishing ground is about 28,966 km^2 (Biusing 2001) and is divided into fishing blocks (three fishing blocks between two longitudes) located along Sandakan Bay, Cowie Bay, and Tawau (Annex 3.1-1b). Moreover, Arshad et al. (2011) describe management zones followed by DOF Malaysia namely: Zone A (<5 nautical miles from shore) reserved for small-scale fishers using traditional fishing gear and owner-operated vessels of <10 GT; and Zone B, beyond five to twelve nautical miles which is open to owner-operated commercial fishing vessels of <40 GT using trawl nets and purse seine nets. Prosecution and convictions of owners and skippers of trawl found guilty of fishing within three nautical miles from the shorelines within Zone A (Article 6 of Code of Conduct for Responsible Fisheries) had been made by Sabah and Sarawak High Court, Lower Courts, and District level (Alin 2011) following the above-mentioned management zone delineation.

Philippines' BFAR identify Sulu Sea, Visayan Sea, Moro Gulf, Lamon Bay, Cuyo Pass, Guimaras Strait, Western Palawan, and Manila Bay as among the major fishing grounds for small pelagics in the country. Embayments likewise serve as important fishing grounds especially for municipal fishers. Bays and their adjacent areas harbor pelagic species and are important developmental grounds for small pelagic juveniles (Annex 3.1-1a). Philippines municipal waters of up to 15 kilometers from the coast have been set aside for municipal fishers by virtue of a national policy (Republic Act 8550). Commercial fishing operations may be allowed between 10.1-15 kilometers but should have permission from the local government unit (LGU) concerned.

3.1.4. Level of fishery exploitation

Excessive fishing effort in certain parts of the SCS-LME has been a problem since the early 1980s and the number of fishers and gears continue to increase. Illegal and destructive fishing are being addressed but are still practiced in the SCS. The aggregate catch of SCS countries shows that small pelagic fisheries contribute significantly to fish production in this LME. Herrings, sardines, and anchovies accounted for some 32 million metric tons of

the total aggregate landings in SCS-LME during the 60 years of recorded landings based on FAO fisheries data (Figure 3.1-2). During the past decade (2000-2009), small pelagics (herrings, sardines, anchovies, scads, and mackerels) contributed about 34.5% to the total marine production, which was actually similar over the decades since 1950 (average of 36.6%).

Individual country reports from the SCS districts are limited in terms of historical extent of information on catch volumes and composition. It can be inferred that current figures are less than what is being produced in the region considering the losses from IUU fisheries among SCS fishers as well as those coming from other countries like Japan, China, and Taiwan. There are various efforts to correct country-level information although these statistics still show that fisheries stocks in the SCS-LME are declining (see Figure 3.1-3). Increased total production is basically a function of increased effort plus the contribution of aquaculture.

In Indonesia, the total production of small pelagic fishes caught by purse seine increased between 1984 and 2010 but was also associated with increased effort. The more significant phenomenon was shown in the coastal waters off eastern Kalimantan due to the intensive exploitation of shrimp and demersal fishes by mini-trawlers (Danish seine). After reaching its peak in 2004, total production of Danish seine declined between 2006 and 2010. Intense exploitation has already affected the recovery of the stocks and consequently, the stocks could no longer support the current rate of fishing. The catches of purse seine in Indonesia have been constantly declining from 2006 to 2010 (Figure 3.1-3, top).

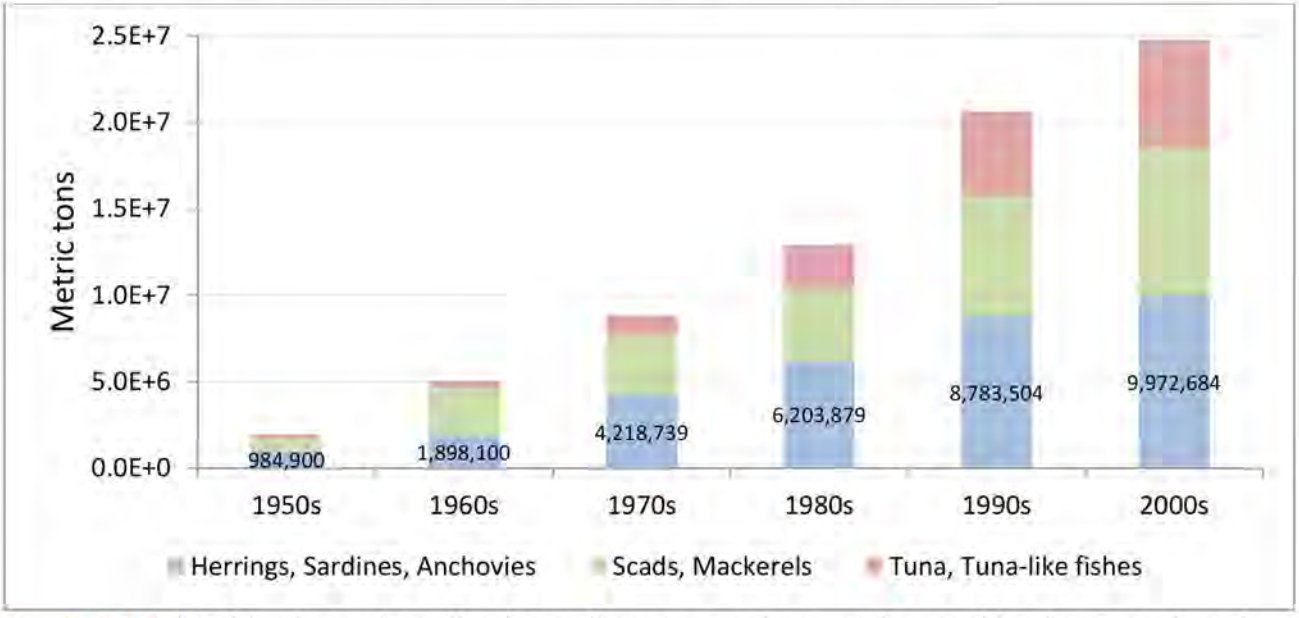


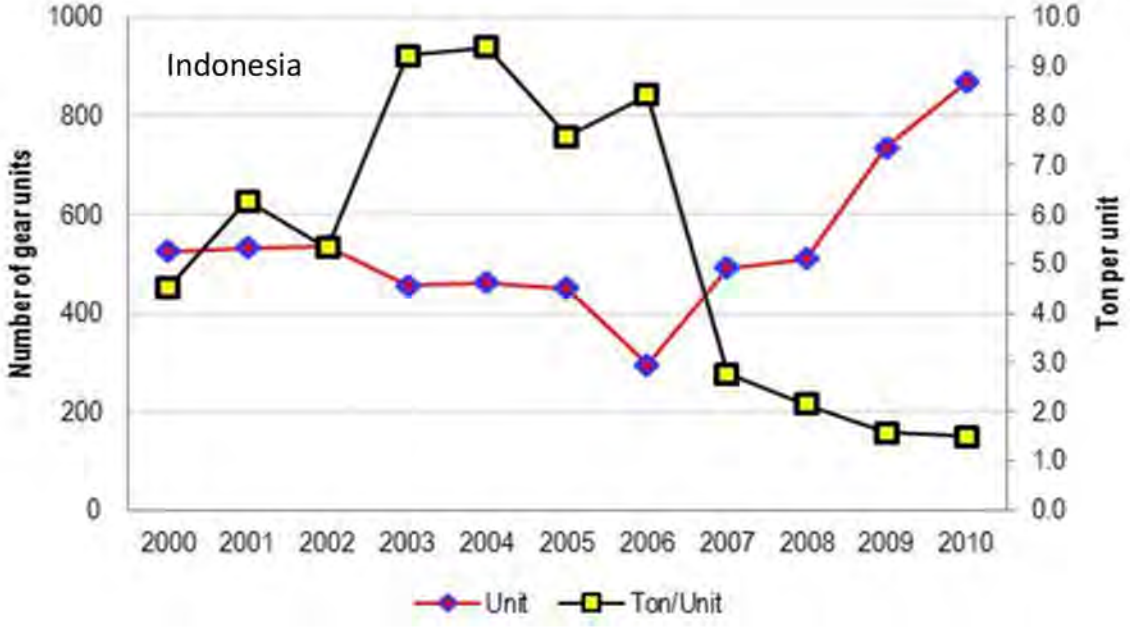
Figure 3.1-2. Total landings of small pelagics (herrings, sardines, anchovies [blue bars], scads and mackerels [green bars]) relative to the tuna and tuna-like fishes (red bars). Data labels are for the herrings, sardines and anchovies only. Stacked bars are for the three fish groups aggregated from Indonesia, Malaysia, and Philippines per decade (FAO).

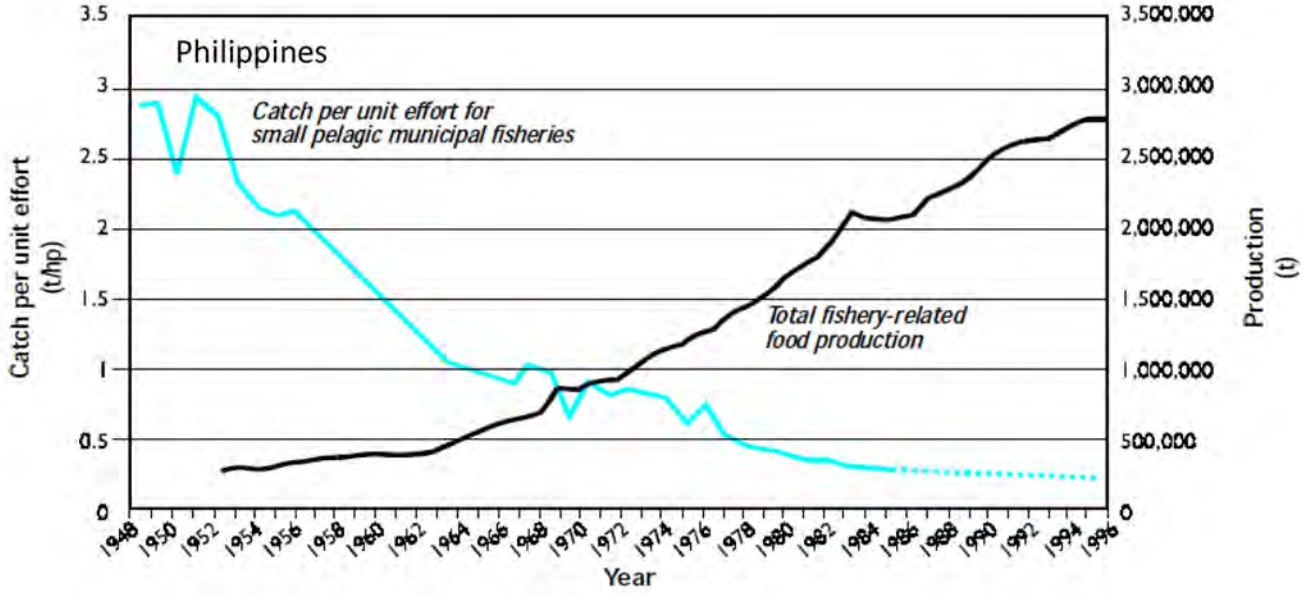
Increasing fish landings in Malaysia are likewise associated with increasing effort and a number of licensed fishing gears grew steadily. Fish landing in Malaysia has slowly declined within a decade due to increase in fishing effort. Fish landings mostly came from

commercial gears like trawls and purse seines, with small pelagics dominating the production. Historical information on Malaysian fisheries was undervalued (Teh et al. 2011) while the lack of viable historical information and inconsistency of data collection on Malaysian fisheries since 1965 has been cited (Teh et al. 2009). Emergence of new market on "trash fish" for fishmeal production in the early 1990s (Biusing 2001) generated revenue for previously discarded undersized fish including surplus of pelagic fish and this adds further pressure to continue unsustainable exploitation of fish in Malaysia. In addition, undervalued catch caused by unaccounted catches in small-scale fisheries have led to substantial underestimation (Zeller et al. 2006) of traditional fisheries production. Therefore, existing fish stocks may be overestimated, thus encouraging further exploitation of the depleting resource. This is a continuing challenge for Malaysian resource managers in terms of coming up with appropriate measures and interventions to address the apparently declining catches.

Catch rates in Philippines have been declining due to the increasing fishing effort since 1950 (Figure 3.1-3, bottom). For over 50 years, commonly caught species in the coastal waters have shown indications of depletion. Though small pelagics have significantly dominated recorded landings in the country for decades because of the scale of extraction, total landings of demersal fishes have relatively levelled off starting 1976 and have shown a steady decline since then. The catch of small pelagics steadily increased in relation to increasing effort and the capacity of the industry to fish in wider geographies but the upsurge in extraction from late 1970s to early 1990s have caused the decline in catches onwards (Barut et al. 2004). Fisheries production in the country from 1946 to mid-1980s was largely due to the expansion of the industry which resulted to the drastic stagnation in municipal fisheries production from mid-70s onwards (Barut et al. 2004). Rapid mechanization in the fisheries sector contributed significantly to fisheries production from 1960s to mid-1970s. After the period, stagnation and decline in production was observed and inferred to as, the fisheries production apex of most of the traditional fishing grounds in the country. Increase in fisher population, further improvements in mechanization and exploration of new fishing grounds also contributed to the increase in fisheries production from mid-1980s to 1990s. Evident during this period, however, is the steady decline in municipal fisheries production, demersal biomass in fishing grounds proximate to coastal areas (Armada 2004), and a marked decrease of more than 90% in catch rates from 1950s to 2000 (Campos 2004). Effort level in the mid-1980s was already more than twice the level necessary to harvest the maximum sustainable yield (MSY) and an obvious indication for the need to reduce fishing effort.

Figure 3.1-3. CPUE estimates for purse seine in Indonesia (top) and for small pelagic fisheries in Philippines (bottom) (source: TDA country reports 2011 and Philippine CRM Guidebook 2001; Annual fisheries statistic (1999-2008).





3.1.5. *Aquaculture*

The aquaculture industry is a major alternative source of food and a major economic driver in the SCS. Nonetheless, it has significant contributions to the overall degradation of the coastal environment (especially mangrove forests) and other associated issues such as aquatic pollution and diseases. The governments of the SCS countries are augmenting

investments in research and development in order to increase production and especially to make the industry more environment friendly.

Production in inland and marine aquaculture industry in the SCS-LME has buffered the dwindling supply of food fishes while being a major income earner for marginal fishers involved in seaweed culture. Of the SCS countries, Indonesia and Philippines are heavily engaged in aquaculture and have started production of milkfish since early 1950s. Malaysia started aquaculture in the 1960s with *tilapia* but did not intensify production since then. A growth in seaweed production and shrimp and prawn farming was seen in the last decade in Malaysia. Indonesia and Philippines, however, showed a steady increase in aquaculture production over 6 decades and have seen an increase by an order of magnitude from the 1990s to the 2000s. Most of the production was from aquatic plants (~seaweeds) and other major commodities including milkfish, tilapia (and other cichlids), and crustaceans (crabs, lobsters, prawns and shrimps) with an aggregate production of about 17million metric tons each for Indonesia and Philippines. Production values for Philippines amounted to more than US$10 million while it was more than US$18 million for Indonesia, attributed to the difference in production of shrimps and prawns (Figure 3.1-4).

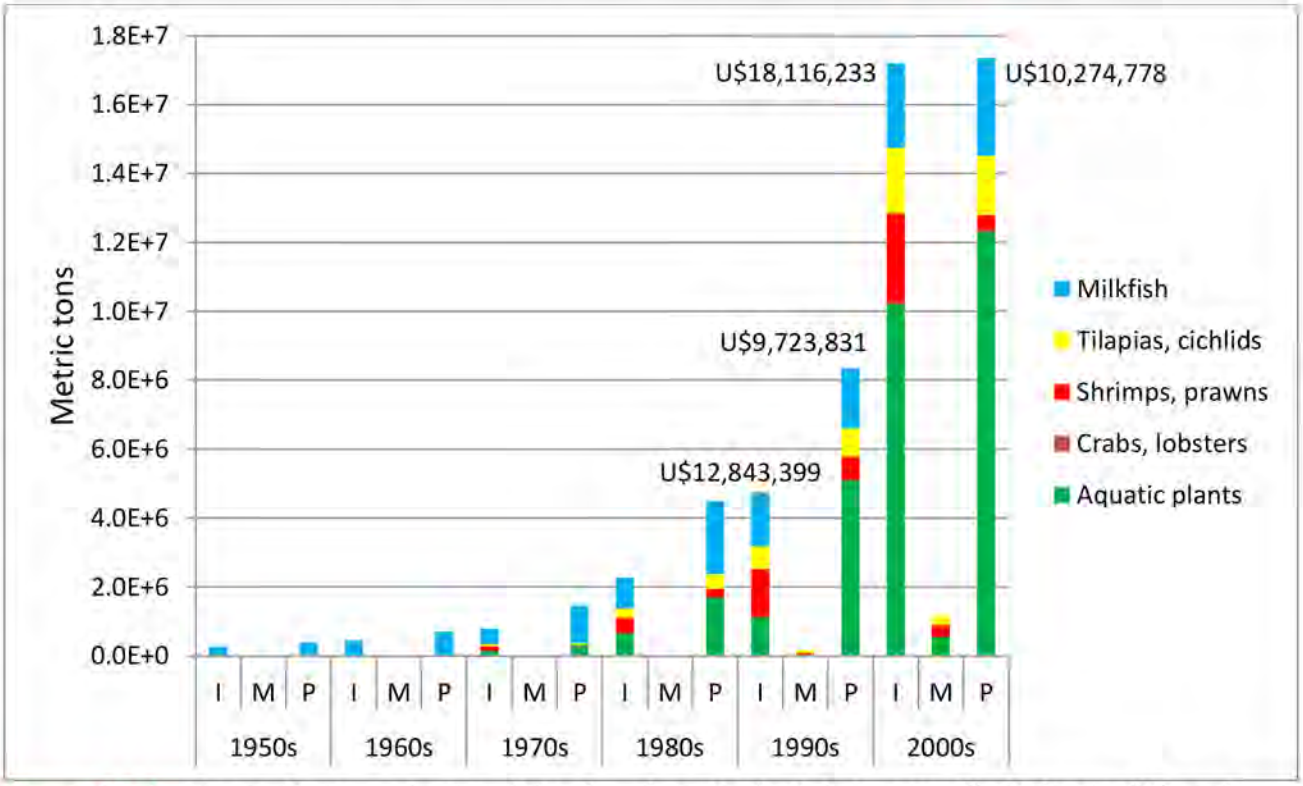


Figure 3.1-4. Aquaculture production (inland and marine) of Indonesia (I), Malaysia (M), and Philippines (P) over six decades. Malaysia is relatively not active in the aquaculture industry and actually has no milkfish production, which Indonesia and Philippines started to produce in the early 1950s. Total aquaculture production values for Indonesia and Philippines are given for the last 2 decades (www.FAO.org).

3.1.6. *The socio-economic consequences of unsustainable exploitation of fish*

Among the identified socio-economic impacts of the unsustainable exploitation of fish are: reduced subsistence food supply, especially throughout Indonesia and Philippines; reduced economic returns to small scale fishers (including decline of the sector's share in the GDP); loss of employment, livelihood or income with the small-scale fishers being affected the most; loss of food and protein sources for human and animal consumption; potential human health impacts (from loss of protein sources); conflict between user groups for shared resources (e.g., between artisanal and foreign fishers); increased risk of disease in commercially valuable stocks (including introduced diseases associated with aquaculture); and inter-generational equity issues (access to resources) among poor local fisher families.

The contribution of fisheries to the respective national economies of the three countries is relatively small (i.e., an average of 4% to Philippines' GDP, 2.4% to Indonesia's GDP, 1.7% of Malaysia's GDP) compared to the contribution of agricultural and commercial crops as well as other sectors such as services and manufacturing. Nonetheless, fisheries is extremely important as it relates to food security and poverty alleviation. On the average, about 50-60% of the animal protein intake in the entire SCS is sourced from marine fisheries. The decline in fisheries stocks will therefore reduce the supply of cheap protein for the consumption of subsistence fishers. Aquaculture is meant to address food security although the products may not be as affordable. Thus, the over exploitation of fisheries has a significant impact especially on the health of the vulnerable lower income population in the SCS.

In the Philippine part of the SCS for instance, reduction of fisheries stocks resulting from their unsustainable exploitation can endanger the PhP8 billion (US$1.87 million) and PhP 23 billion (>US $500 million) sardine and tuna industry in Zamboanga City and General Santos City, respectively (MEDCo/MinDA, 2011). About 120,000 jobs for the sardines industry and 100,000 jobs for the tuna industry will be adversely affected as well (MEDCo/MinDA, 2011). The Visayan Sea of the P-SCS used to be one of the most productive fishing grounds in Philippines. Unsustainable and destructive fishing practices caused dwindling fish stocks that were even close to collapse (Green *et al.*, 2003 as cited in FAO, Philippine National Fishery Sector Overview). The fish stock depletion was noted to increase the poverty level of the municipal fishermen in the area. About 40-50% of the Visayan population were below the poverty threshold and among the small scale fishing household, this was as high as 80% (Muñoz 2004). Overexploitation of fishery stocks will likewise put into risk the approximately US$1.7 billion, US$146.4 million, and the US$ 505 million fishery export industry of Indonesia, Malaysia, and Philippines (FAO).

Sabah employs the highest number of full-time fishers (9,589) in Malaysia, with the fisheries sector providing jobs from the appropriation stage of the supply chain to processing or downstream industries and exporting sector. Sabah's agriculture contributed to almost 25% of the GDP of which, fisheries is a significant component. Until 2010, fish exports tripled to 316,000 metric tonnes of food fish where production from both capture fisheries (onshore or offshore) and aquaculture mainly comes from Sabah. In effect, Sabah is a net exporter of food fish to Peninsular Malaysia and the world. The contribution of fisheries to the national food supply, hence, food security, and the importance of enhancing

local food production base, given a recent food crisis in Malaysia due to dependency on food imports, has highlighted the value of the fisheries sector.

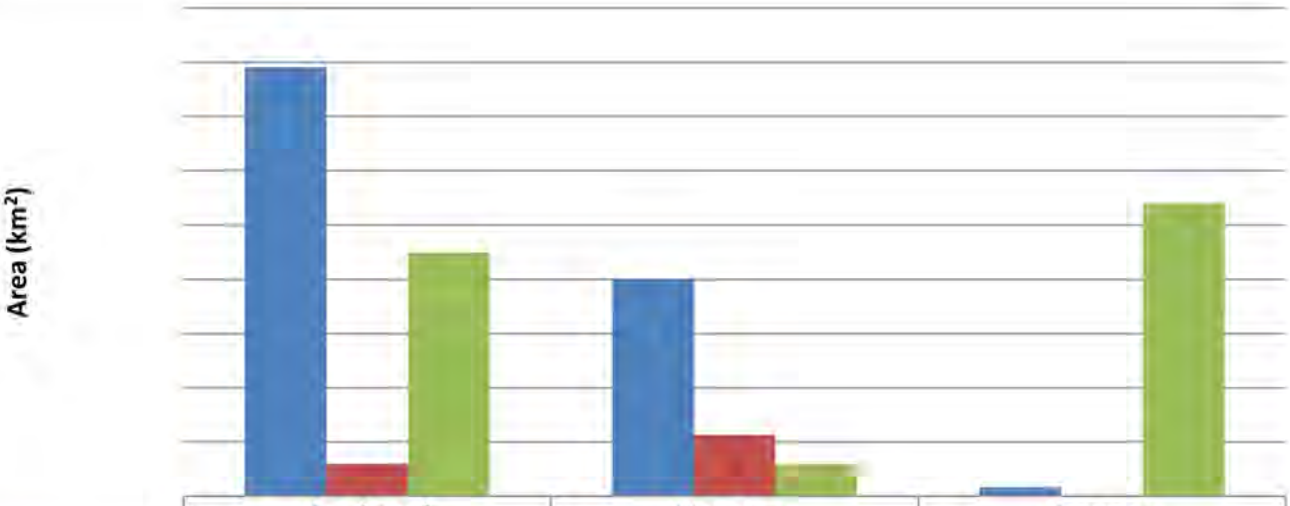
Fisheries production in North Sulawesi is highest among the four Indonesian provinces in the SCS area (70% of 320,697 tons in 2009). However, high population growth rates especially in East Kalimantan (3.8% in 2010) result in higher demand for fishery resources and together with low literacy rate in the Indonesian SCS area (less than 50% completed senior high school) can lead to unsustainable exploitation of fish. This can result in the decline of income of fishers, increased malnutrition due to poor quality of food, and increased unemployment together with heightened conflicts among fishers. A poverty trap is therefore produced where unemployment results in less opportunity for education and awareness, which leads to unsustainable resource exploitation that results to resource depletion, and further unemployment.

3.2. Habitat and Community Modification

The GIWA 56 report identifies habitat and community modification as the second most pressing TP in the SCS-LME. Strongly linked with pollution (suspended solids) and unsustainable exploitation of fish and other living resources, this transboundary problem is projected to persist and cause environmental and socio-economic impacts in the region (DeVantier et al. 2004, UNEP 2005).

The recent TDA for the SCS-LME highlights similar trajectories, identifying specific causes and impacts with the aim of laying appropriate management interventions. Policy options will also be explored in order to curb causes of environmental issues that remain significant at the country and transboundary scales. An in-depth evaluation of the extent and status of habitats at the country level shows consistent decline with some degree of variance attributed to survey methodologies and standards of data collection.

The SCS-LME has a combined area of at least 124,000 km^2 of mangroves, seagrasses and coral reefs (see Annex 3.2-1a,b). Among the three countries, Indonesia has the most extensive coral reef and mangrove ecosystems while Philippines has the greatest extent of seagrass cover (Figure 6B-1). The coral reef ecosystems of the SCS countries is an integral part of the most biodiverse Coral Triangle and provide an annual potential finfish yield of about 1.3 million metric tons per year (Alcala and Russ 2002) to more than 66 million people (see Chapter 3B). This estimate does not include the potential fish and invertebrate production in seagrass and mangrove ecosystems of the region.



	Coral Reef	Mangrove	Seagrass
Indonesia	39,538	20,000	820
Malaysia	3,000	5,670	5
Philippines	22,484	3,000	27,000

Figure 3.2-1. Estimated total cover (in km²) of coral reefs, mangroves and seagrass habitats in Indonesia, Malaysia, and Philippines (TDA country reports 2011).

During the past few decades, the significant decline in the status of coral reef, mangrove, and seagrass ecosystems have been the concern of resource managers in the SCS countries. Fisheries production in coastal habitats declined in Indonesia, Malaysia, and Philippines due to unsustainable and illegal means of fishing (Annex 3.2-2). The integrity of coastal ecosystems has been equally subjected to anthropogenic threats such as pollution from the terrestrial environment mainly due to the ramifications of agricultural and coastal development activities.

3.2.1. *Coral reefs*

Indonesia has the largest coral reef in Southeast Asia at 39,538 km², mainly distributed along the coasts of East Kalimantan, Central and North Sulawesi and Gorontalo (compiled by Bakosurtanal 2010). There are 590 hard coral species catalogued in the area and most reefs have fair (25%-50%) coral cover based on the monitoring by the Coral Reef Rehabilitation and Management Program or COREMAP (http://www.coremap.or.id/tentang_coremap/mengenal_coremap/). However, about 1,850 km² of the country's coral reefs show increasing incidence of degradation through the years (TDA Country reports 2011). Reefs having >50% live coral cover declined from 36% to 29% between 1989-2000 (Suharsono 1998). The total economic value of coral reef habitats in Indonesia is estimated at US$1.6 billion (Burke et al., 2002). Destructive fishing practices that include blast and cyanide fishing, coral excavation for building materials, and varying forms of marine pollution from coastal development (e.g., sedimentation and eutrophication) are some of the major threats to coral reefs. Climate related phenomenon such as seawater temperature anomalies has led to bleaching events and caused mortalities to corals and associated marine life, posing additional risks to this ecosystem (see Annex 3.2-3).

The coral reefs in Malaysia cover approximately 4,000km^2 (National Coastal Resources and Marine Environment Profile of Malaysia, 2010), located along the coastline and most of the islands in south-east, central, north-east, and western Sabah. Seventy-five percent (75%) of the total reef area is actually located along Sabah (DHI 2005). Coral reef type consists of fringing reefs and offshore islands, recognized as economically important ecosystem that provides a significant percentage to the country's tourist industry. The most extensive and well-preserved reefs are located in Southeast Sabah including Darvel Bay, Semporna and Sipadan Island which supports several endemic and rare coral species. There are more than 500 species of corals and live coral cover in the Malaysian Sulu-Sulawesi water is from 50%-70% (Neilsen et al. 2005).

The highest threat to corals in Sabah are fishing intensity and fishing damage. Threats from coastal development, land-based pollution and unsustainable fishing practices have also taken their toll on the coral reef ecosystem of SCS-LME districts in Malaysia. The high amount of sediment run-off from rivers and land-based activities is a primary concern, and tourism in the reef areas, while a major economic activity, adds risks to the health of coral reefs. The tight link of coral reefs to adjacent ecosystems such as mangroves is further demonstrated with the effect of mangrove forest reclamation in Malaysia on the loss of about 23% of coral reefs in the past decade (TDA Country Reports 2011).

Philippines used to have about 25,000 km^2 (Alcala and Russ 2002) of coral reefs along its 36,289 km of coastline and latest estimates peg it at 22,484 km^2 with only seven percent (7%) under marine protected areas (Burke et al. 2011). Apparently, more than 2,500 km^2 of coral reefs have been decimated in less than a decade over this biodiverse area. Philippines is at the apex of the center of maximum marine biodiversity otherwise known as the coral triangle (Hoeksema 2007) where Veron et al. (2009) identified some 540 species of zooxanthellate corals in Philippines. Carpenter and Springer (2005) considered Philippines as the epicenter of marine shorefish biodiversity of the world, with about 1009 shorefish species in this small area. Excellent coral reefs (with coral cover above 75%) were seen in the 1970s albeit these were only a small fraction of the surveyed reefs. Excellent coral reefs still remained but only for the Celebes Sea region in 2004. Good coral cover (50-74.9%) has likewise diminished over the years. Causes of coral reef degradation included coral harvesting for the ornamental trade and destructive fishing methods like blast and cyanide fishing, trawl fishing that scrape the bottom, and siltation or sedimentation. Another cause of coral reef degradation is coral bleaching from unusually warm water temperatures that envelope coral reefs, usually during severe El Niño as has been reported in the north Palawan shelf, Tubbataha reefs, and the Kalayaan Island Group in 1998 (Arceo et al. 2001).

3.2.2. *Mangroves*

Mangroves are important component of the coastal morphology of the SCS-LME districts in Indonesia. There are approximately 9,783 km^2 of mangrove forests (Kusmana 2009) and 18 mangrove species (Soeroyo 2002) listed in the SCS area. The mangrove forest of Indonesia was estimated at 4.25 million hectares in 1994 while a LandSat imagery in 1992 pegged the remaining area at 3.81 million hectares (TDA Country Reports 2011). However, more than half (57.6%) of the country's existing mangrove forests are in a severely damaged condition

and the TDA Country Report (2011) estimates that 75% of its mangrove forests have low density cover. For instance, mangrove forests in East Kalimantan shrunk from an original area of 950,000 ha to 750,000 ha at an estimated rate of 530,000 ha annually (MacKinnon et al. 1996). The most critical threat has been the conversion of mangrove forests into aquaculture ponds for shrimp and fish though recent data suggest that development of new ponds are in a declining trend. Shrimp and fish pond area development in the coastal areas of SCS districts in Indonesia was about 60,000 ha in 2006 going down to about 30,000 ha in 2009. In the North Celebes Sea, 250 ha of shrimp ponds were developed in 2002 going down to about 100 ha in 2009. Port development, road construction and other forms of resettlement in mangrove areas have similarly contributed to their decline.

Mangrove degradation increased every year from 2001 to 2004, but this trend improved substantially since 2007. Mangrove forests classified as re-growth areas increased from 2001 to 2006 although temporal distribution along with degraded areas varied for each site. Nonetheless, no large expanses of mangroves are currently protected within existing conservation reserves in the country (TDA Country Reports 2011). Destruction of East Kalimantan's mangrove forests and seagrass beds, being important fish habitats has caused reduction in fish catch. The modification of the mangrove areas has been primarily caused by the conversion of the 150,000 ha of mangroves in the Mahakam Delta into fish and shrimp ponds, with decimation rates of up to 530,000 ha per year (TDA Country Reports 2011). Logging (resulting to sediment dumping in rivers), urban pollution, and reclamation were the other identified causes of mangrove loss in the area. Forest cover loss in the upland areas and main rivers likewise silted the mangrove and coastal ecosystems in Gorontalo's northern and southern coasts, compromising coastal fisheries, the main source of livelihhood for coastal communities within the Tomini Gulf. Eco-tourism and recreational potentials of the beaches (such as snorkeling and diving), have been threatened as well. Consequently, the quality of life of the Gorontalese was affected.

In Malaysia, mangroves stretch along the coastline intermittently and develop very well in sheltered estuaries, deltas, lagoons and coral reef terrace. The current estimate of the total mangrove area in Malaysia is 575,000 ha. About 57% or 326,487 hectares of this forest is located in Sabah and classified as Mangrove Forest Reserve Class V (National Coastal Resources and Marine Environment Profile of Malaysia, 2010). Chan et al. (1993) reported that nearly 87% of Sabah's mangroves have been represented as an important natural resource to the state and gazetted as Forest Reserve while the remaining 13% of the area is categorised as state land mangroves. However, mangroves in the area are similarly threatened with forest conversion, coastal reclamation, and infrastructure development. Ong et al. (1995) have estimated a one percent over-all annual loss of mangrove forests in Malaysia since the 1970s. About 10% of the mangrove forests in Sabah are threatened due to anthropogenic factors (Saleh et al. 2010). Mojiol et al. (2008) recently reported that 2,440 hectares disappeared in support of a growing coastal population. The most serious threat identified is the conversion of mangroves to shrimp farms which constitutes 80% of Sabah's shrimp production. In particular, aquaculture and agriculture activities reportedly affected 28,145 hectares of forest reserves in Semporna and Kunak (Sofien et al. 2010).

Philippines has 25 true mangrove species and mangrove forests are commonly dominated by species of *Avicennia, Rhizophora, Sonneratia,* and *Ceriops* especially in the Visayas region. Initial mangrove forest cover of Philippines was estimated at 450,000 ha in 1918. Losses

over the years were due to exploitation of this ecosystem for building materials and fuel wood but the greatest losses were in terms of conversion of these areas into aquaculture farms (Janssen and Padilla 1999, Primavera 2000). Overall, it is estimated that 330,000 ha of mangroves or 73% of its original cover were lost from 1918 to 1995; a 77-year history recording an average annual mangrove forest loss of 4,286 ha. This alarming rate of decline has spurred the rehabilitation of mangrove areas and the cessation of mangrove area conversion to aquaculture ponds. Primavera and Esteban (2008) estimated that the long term survival of transplanted mangroves where projects were monitored was only up to 20%. Only after 1995 was there a measureable increase in mangrove cover seen in the country and more than 160,000 ha of mangrove areas were gained in 2009.

3.2.3. *Seagrasses*

Seagrass meadows are an important aquatic ecosystem in Indonesia that support fishery production and serve as nursery areas to commercial fish and shellfish species. There are nine seagrass species in the SCS-LME locality, and seagrass cover is generally classified to be in good condition (>50% cover). Seagrass communities in Indonesia are similarly threatened by the consequences of coastal development and pollution (e.g., sediment run-off and eutrophication) and unsustainable fishing practices. The degradation of seagrass meadows in Indonesia has been poorly documented but is relatively generic across the archipelago with coastal development, sediment run off from land-based activities, coral excavation for building material, and sewage problems as likely causes at a local scale. The loss of 116 ha of seagrass meadows in the western section of Banten Bay was a consequence of coastal development and reclamation (Kiswara 1994, Kuriandewa *et al.* 2003).

The 14 species of seagrasses recorded in the coasts of Malaysia are: *Enhalus acoroides, Halophila beccarii, H. decipiens, H. ovalis, H. minor, H. spinulosa, H. pinifolia, H. uninervis, Cymodocea rotundata, C. serrulata, Thalassia hemprichii, Syringodium isoetifolium, Ruppia maritima* and *Thalassodendron ciliatum* (Ho et al. 2011). Location of known seagrass areas and estimated coverage in Malaysia has been reported in National Coastal Resources and Marine Environmental Profile of Malaysia (2010). Malaysia recognizes that land-based threats and unsustainable fisheries have caused the destruction of its seagrass ecosystems. In Sabah, there are 12 seagrass species belonging to seven genera that are distributed along the shallow intertidal areas. Detailed record of seagrass in Marine Parks was reported by Edang et al. (2008) and distribution of seagrass in Sabah waters was reported by Gumpil and De Silva (2007). Bujang and Zakariah (2003) estimated the seagrass areas of Peninsular Malaysia at 315 ha. In addition, the Malaysian National Report on Seagrasses (bin Ibrahim 2008) estimated seagrass areas in Sabah covering >100 ha.

An estimated 40% of the total Philippines seagrass beds of about 27,000 km^2 have been lost over the past 50 years. Most of the study areas reported here are from the central Philippines, and areas with extensive seagrass cover include the Palawan area, Sulu archipelago, and eastern and western Visayas (Fortes in prep.). In many of these sites, an average of five to six species per site can be observed. Seagrass ecosystems, together with mangrove areas are also targeted for aquaculture. Other coastal development contributes to the alteration, fragmentation or decimation of seagrass beds together with water quality impacts (Duarte et al. 2008).

3.2.4. *Causes of habitat and community modification in the SCS*

The three SCS countries are witnessing the increasing incidence of harmful algal blooms in their aquatic systems associated with polluted and increasingly eutrophic environments. This is particularly problematic to aquaculture activities. With the agriculture and industrial sectors as among the major income earners in the economy, issues related to waste generation as well as household sources, chemicals from agricultural run-off, solid waste from lack of sanitary landfill, mineral and gas explorations and even oil spills from marine vessels pose significant threats to the fishing ground, ecosystems, and fishery stocks. Other causes of habitat loss and community modification include overexploitation, IUU fishing, coastal development and habitat conversion, and natural causes including extreme climatic variations (see Table 3.2-1).

Table 3.2-1. Common causes of habitat and community modification among the three SCS countries (Indonesia, Malaysia, and Philippines) (TDA Country Reports 2011).

Causes	Indonesia	Malaysia	Philippines
Overexploitation	Trawl fishing, purse seine, exploitation of undersized fish,	Trawl fishing, purse seine, exploitation of undersized fish,	Trawl fishing, purse seine, exploitation of undersized fish
IUU fishing	Fish bomb (blast fishing), cyanide fishing, aquarium fishing, poaching by foreign fishing vessels	Use of *payao*, light fishing, blast fishing, cyanide fishing, aquarium fishing, poaching by foreign fishing vessels	Use of *payao*, light fishing, blast fishing, cyanide fishing, aquarium fishing, poaching by foreign fishing vessels
Pollution	Sedimentation, oil spill, solid waste, untreated sewage, agricultural and industrial effluents	Harmful algal bloom, sedimentation, oil spill, solid waste, untreated sewage, industrial and agricultural effluents	Harmful algal bloom, sedimentation, oil spill, solid waste, untreated sewage, industrial and agricultural effluents
Coastal development and habitat conversion	Mangrove logging and conversion, deforestation, reclamation	Mangrove logging and conversion, deforestation, reclamation	Mangrove logging and conversion, deforestation, reclamation
Natural causes and climatic regimes	Typhoon, coral bleaching	Coral bleaching	Typhoon, coral bleaching
Other causes	Anchor damage	Tourism	Anchor damage, tourism

While the threats to these important aquatic ecosystems are common among the countries of Indonesia, Malaysia, and Philippines, individual or country-level approaches to these shared issues are equally notable such as the implementation of protected areas and reserves. Marine protected areas or MPAs are the advocated tool to protect biodiversity and improve fishery productivity. In Sabah, a proposed 1.02 million hectares marine park is considered the biggest in Southeast Asia. In the Sulu-Sulawesi area of Philippines, 83 MPAs covering 700,000 hectares are in various stages of implementation. Similar initiatives relating to marine protection in Indonesia have seen the inclusion of more reefs monitored

under the Coral Reef Rehabilitation and Management Program.[1] (See Annex 3.2-4 for MPA coverage in the SCS LME).

3.2.5. *SCS conservation and management initiatives*

The three SCS countries are now implementing a transboundary project through the Action Plans of the SSME on Sustainable Fisheries with special focus on small pelagic fisheries. The impending threats have been the subject of many resource management initiatives in the SCS countries but socio-economic concerns force the perpetuation of environmental threats and the lack of enforcement remains to be a challenge. The FAO Code of Conduct for Responsible Fisheries under Article 10.3 calls for the regional cooperation between neighboring countries to facilitate sustainable use of coastal resource and conservation of the environment. Article 10.3 calls for subregional and regional level cooperation in order to facilitate timely information sharing and consultations, as well as improve coastal area management and resolve activities that may have adverse transboundary environmental impacts in coastal areas. The Code is based on relevant rules of international law, including the United Nations Convention on the Law of the Sea (UNCLOS).

3.2.6. *The socio-economic consequences of habitat loss and community modification*

Factors causing habitat destruction in coastal areas and the ocean range from unsustainable fishing practices (including trawling and dynamite fishing), inappropriate and poor land use in agriculture and forestry, industry (including mining), and coastal development. These practices destroy sea grasses, corals, mangroves and other wetland areas, all of which serve as nurseries for fish and also act as buffer zones of the coastal areas from storm. The Center for Ocean Solutions estimated that coastal wetland and peat swamp losses are about 55% in Indonesia, 74% in Malaysia, and 67% in Philippines.

The degradation of mangroves in the Mahakam Delta as described in the proceeding section and forest cover loss subject local and nearby communities to increased economic and social vulnerabilities and social conflicts covering land ownership, authority, and identity were noted to have frequently occurred in the area.

Other socio-economic impacts specifically from shrimp farming and conversion of mangrove ecosystems include reduced income from fishing, reduced local food production, and extreme poverty. These are manifestations of sacrificing long-term productivity for short-term profit. Aside from its adverse effects to livelihood, coastal modification likewise changes the natural drainage patterns that compromise freshwater systems. Tourism, recreation, aesthetic values of the coastal area, as well as human health are compromised as well.

The destruction of a square kilometer of coral reef will entail an economic loss for fisheries, eco-tourism, and shoreline protection of some US$ 137,000-1.2 million over a 25 year

[1] http://www.coremap.or.id/tentang_coremap/mengenal_coremap/

period (Burke et al. 2002). Estimated income from fisheries and even tourism and other related ecosystem services that will be affected negatively once coral reefs are damaged amounts to US$1.5 billion annually. It is also projected that the non-implementation of mitigation measures for overfishing, habitat destruction, and sedimentation will result to losses of income of around US$2.5 billion in Philippines and US$2.6 billion in Indonesia by 2020 (Hargreaves-Allen 2004).

3.3. Climate change

3.3.1. Global trends

The Intergovernmental Panel on Climate Change or IPCC (2007) has shown a global trend of increasing temperatures and rising sea level (1.8-3.1 mm yr^{-1} from 1961-1993, which is 18-59 cm at the end of the 21st century) since the mid-1800 (see Figure 3.3-1 and Table 3.3-1). Frequency of extreme events in terms of rainfall and drought has also escalated including changes in wind patterns. Large scale shifts in ocean circulation will have impacts on productivity, fisheries, and carbon dioxide uptake. These changes will put 20-30% of species under increased risk of extinction.

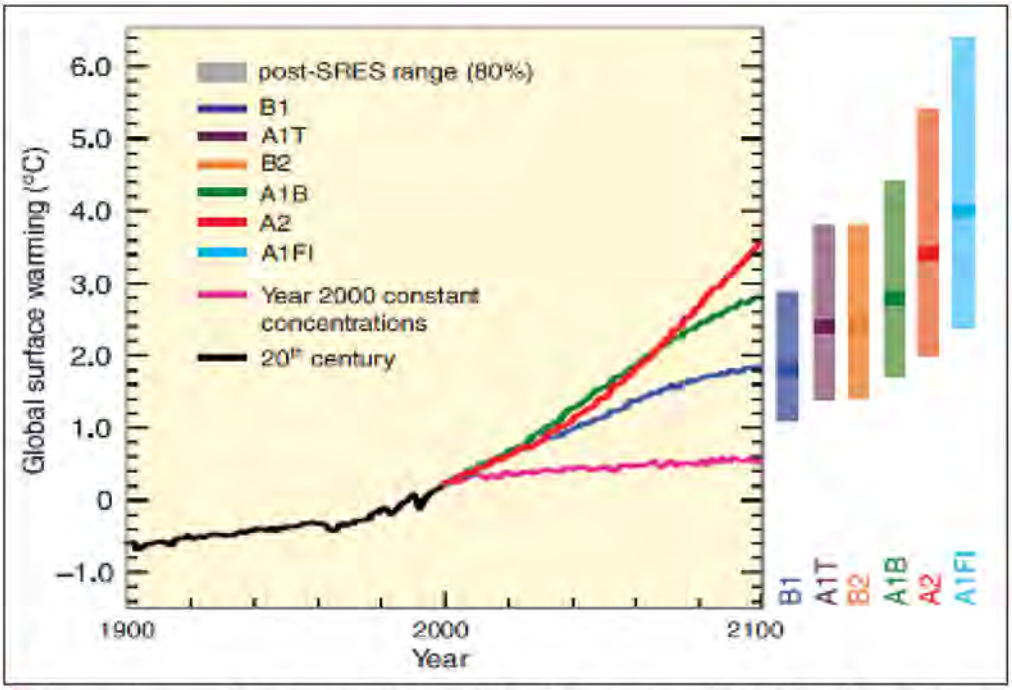


Figure 3.3-1. Increasing surface temperature of the 20th century (black line) and its projection for scenarios A2 (red line), A1B (green line) and B1 (blue line) into the 21st century. Bars outside the figure indicate best estimates (solid line within each bar) and the range modeled for the six scenarios at 2090-2099. Temperatures are relative to the period 1980-1999 (IPCC 2007).

The oceans have become more acidic from anthropogenic carbon since 1750 with an average decrease in pH of 0.1 units. Further reduction in pH is projected over the 21st

century in the range 0.14-0.35 units. This is expected to negatively affect marine calcareous organisms (like corals and shells) and species that depend on them.

3.3.2. *Climate change trends in Southeast Asia*

Over Southeast Asia, some projected impacts described by the IPCC (2007) are as follows:

- By the 2050s, freshwater availability is projected to decrease, especially in large river basins;
- Populated megadelta regions will be at very high risk due to increased flooding from the sea and from the rivers;
- Pressures on natural resources from urbanisation, industrialisation and economic development will be compounded by climate change; and
- Changes in hydrologic cycle will increase morbidity and mortality due to disease associated with floods and droughts.

Table 3.3-1. Projected global average surface warming and sea level rise at the end of the 21st century (IPCC 2007).

Scenarios	Temperature change[1]		Sea level rise[2]
	Best estimate	*Likely range*	Model-based range[3]
Constant year 2000 concentrations	0.6	0.3 – 0.9	Not available
B1	1.8	1.1–2.9	0.18–0.38
A1T	2.4	1.4–3.8	0.20–0.45
B2	2.4	1.4–3.8	0.20–0.43
A1B	2.8	1.7–4.4	0.21–0.48
A2	3.4	2.0–5.4	0.23–0.51
A1FI	4	2.4–6.4	0.26–0.59

[1] (°C at 2090-2099 relative to 1980-1999)

[3] (m at 2090-2099 relative to 1980-1999)

[3] excluding future rapid dynamical changes in ice flow

3.3.2.1. Extreme events (cyclones and heavy rainfall)

Philippines is considered one of most vulnerable areas to climate change in the Southeast Asian Region (Yusuf and Francisco 2009, see Figure 3.3-2). This is most apparent in terms of tropical cyclones whose frequency and intensity have increased since 1950. Consequent landslides and flooding have affected significant population areas. For example, tropical storm Ketsana ("Ondoy") that crossed Luzon in 2009 left almost five million people affected, 464 dead, more than 185,000 houses damaged, and losses to infrastructure and agriculture amounting to PhP11Billion (203,477 ha of agriculture lands flooded with losses of more than 329MT of produce) (NDCC Final Report on Tropical Storm "Ondoy" and Typhoon "Pepeng"). More recently, typhoon Nesat ("Pedring") that passed through Luzon in September 2011 affected more than three million people with 83 deaths and more than

53,000 homes damaged. Infrastructure and agriculture losses from this typhoon amounted to almost PhP15Billion (NDRRMC Sitrep No.26). In December 2011, typhoon Washi ("Sendong") hit Mindanao, first time in history where a storm path runs across Northern Mindanao, brought massive flooding in the cities of Iligan and Cagayan de Oro. It damaged PhP1Bilion worth of agriculture, PhP1Billion worth of infrastructure, and PhP989Million worth of housing. Sendong likewise claimed more than 1,000 lives, more than 2,000 injured, and affected approximately 50,000 families (NDRRMC.gov.ph).

The increasing number of typhoons (tropical cyclones) in the West Pacific Ocean has contributed to changes in weather pattern in the Malaysia part of SSME. Also, climate change is expected to worsen the existing conditions and to create new vulnerabilities to the fisheries industry (Roessig et al. 2004).

Cyclones in the oceans are usually generated beyond five degrees latitude. As such, much of Indonesia and the Celebes Sea area are not directly hit with tropical cyclones but is impacted by local strong winds and heavy rainfall (MoE 2007). Between 1900 and 2000, the strength of ENSO has been found to increase and this has exacerbated flooding events in Indonesia. Around 530 floods were experienced in all provinces of Indonesia just between 2001 and 2004 (MoE 2007).

Rainfall pattern in Philippines has remarkably shifted. Eastern Philippines receives heavier rains than the central regions with least in the western Luzon. While this pattern is generally preserved, more intense rains have been recorded for March 2011 than the average rainfall for the same month over four decades (Figure 3.3-3).

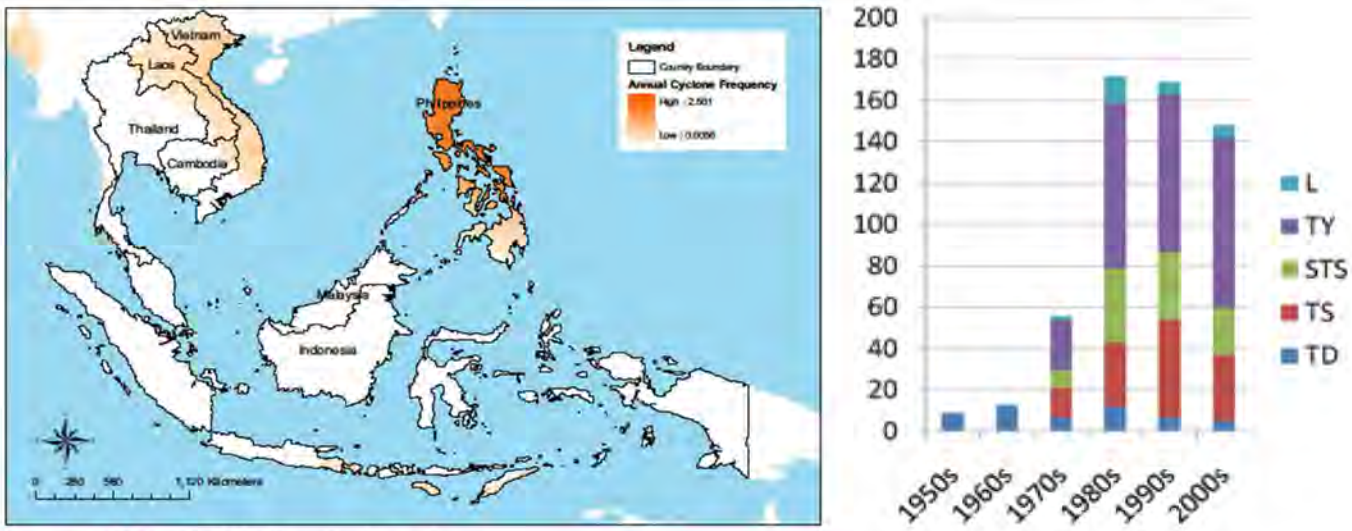


Figure 3.3-2. [Left] Tropical cyclone events per year for the period 1980-2003 (Yusuf and Francisco 2009). [Right] Tropical cyclone frequencies and intensities by decade and category. Category 2 – Tropical Depression (TD); Category 3 – Tropical Storm (TS); Category 4 – Severe Tropical Storm (STS); Category 5 – Typhoon (TY); Category 6 – Extra Tropical Storm (L). (source: RSMC Tokyo, Villanoy in prep.).

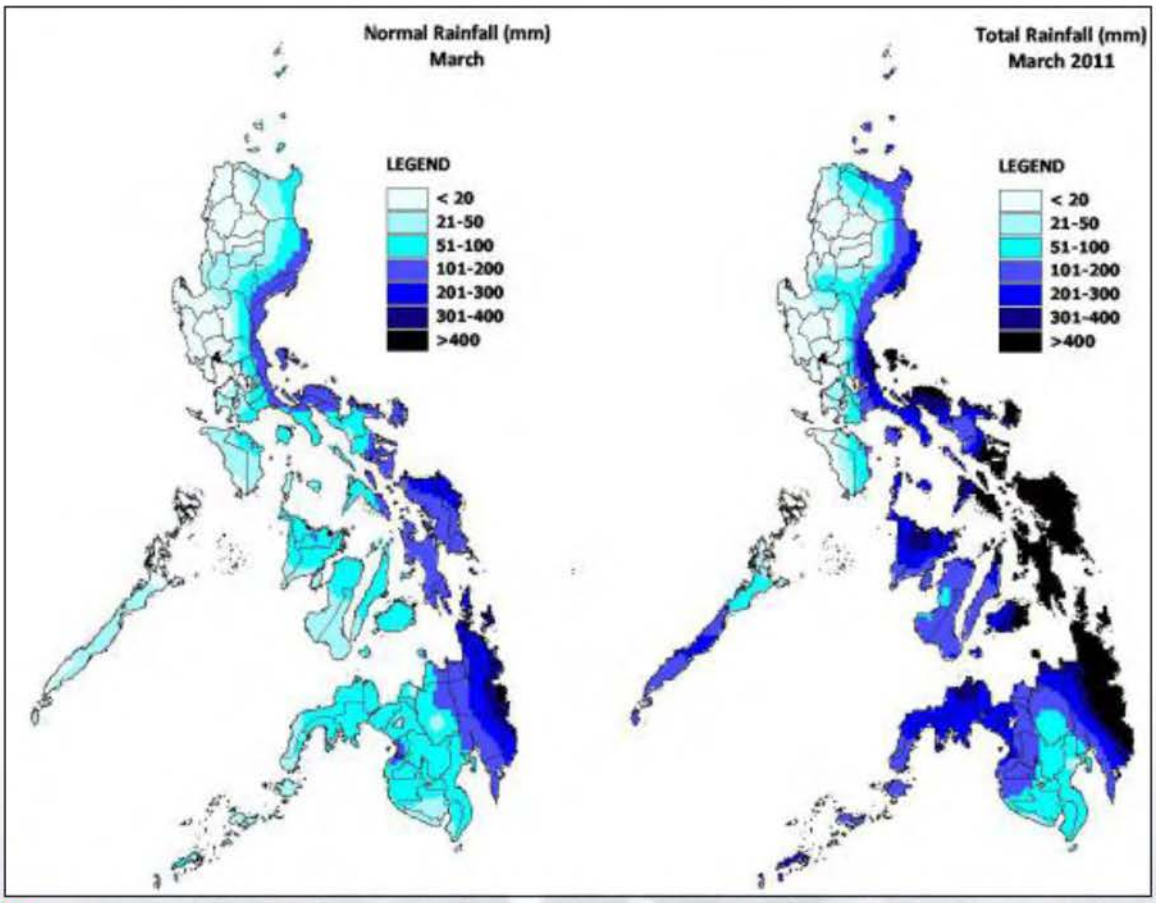


Figure 3.3-3. Average rainfall for the month of March from 1971-2000 (left) and for 2011 only (right) (PAGASA).

The average annual rainfall for Malaysia ranges from 2,420 mm in Peninsular Malaysia to 3,830 mm in Sarawak (National Coastal Resources and Marine Environment Profile of Malaysia 2010). The northeast monsoon from mid-November till March brings the rainy season to the country. Distribution of monthly mean total rainfall in January is shown in Figure 3.3-4.

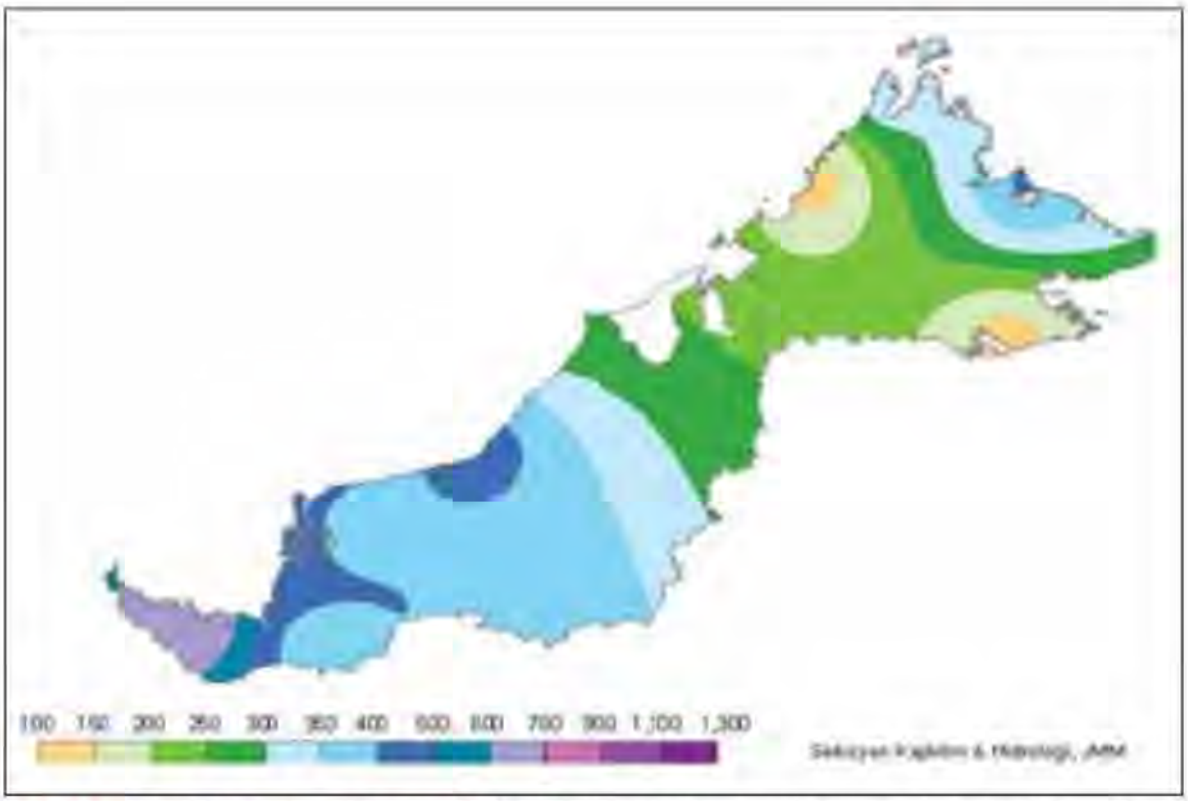


Figure 3.3-4. Monthly Mean Total Rainfall for Sabah and Sarawak (January) (National Coastal Resources and Marine Environment Profile of Malaysia, 2010)

Annual rainfall received in the Malaysian part of SSME is more than 2,000 mm (Department of Meteorology 2003). However, less than 1,800 mm yr^{-1} rainfall was recorded in 1992 and 1998 when most areas of the West Pacific Region were experiencing strong El Niño (Harger 2000a,b). During these events, characteristics of sea water have rapidly changed and affected marine life. According to Burke et al. (2002), approximately 30% of the coral cover was bleached around Darvel Bay during the event.

3.3.2.2. Sea level rise

Another effect of climate change is rising sea levels brought about by thermal expansion of seawater and the melting of the polar ice. Over the SCS LME, inundation by a 1-m SLR is mainly seen in the Sulu Archipelago and East Kalimantan from Tawau to Berau. On the Sulu Sea side, the north of Bohol Island and the southeast side of Panay Island are evidently vulnerable to a 1-m SLR (see Annex 3.3-1).

Finer scale studies in the Sulu Sea area, however, show that a 1-m SLR will inundate most of the mangrove areas in the Verde Island Passage (VIP) and also result in up to 22% loss in coral cover in some places and a concomitant loss of about seven percent in the coral reef of the area (David et al. 2010).

In other locations in Philippines, relative sea level change is mostly positive (Siringan and Rodolfo 2003), i.e., increases in sea level have been observed but at the centimeter scale. However, the same authors attribute some of the observed (relative) sea level change to

subsidence due to over extraction of ground water and the associated compaction of the overlying land (Table 3.3-2).

Table 3.3-2. Relative sea level change (RSLC) estimates of four locations in Philippines (from Siringan and Rodolfo 2003).

Stations	Period	RSLC (mm yr^{-1})
Manila Bay	1947-1969	3.17
	1969-2008	14.09
Davao	1948-1969	2.08
	1969-2008	2.04
Cebu	1947-1969	-3.39
	1970-2007	0.31
Legaspi	1948-1969	0.06
	1970-2008	7.06

The National Hydraulic Research Institute of Malaysia (2010) reported that the general trend in sea level rise along Malaysia's coastlines in the last five years is significantly higher than the general trend corresponding to the previous 20 years. Historical sea level reconstruction from tide gauges and altimetry data from 1955 to 2003 showed that Peninsular Malaysia, Sabah, and Sarawak coastlines experienced sea level rise in the range 1.6-3.6 mm yr^{-1} (Bindoff et al. 2007; Cazenave and Nerem 2004).

Rates of sea level rise calculated by linear regression analyses of tidal gauge data around the Malaysian part of SSME coastlines showed that the sea level rise at most major town area was at least 0.3 cm yr^{-1} (see Table 3.3-3) (National Hydraulic Research Institute of Malaysia 2010). The highest rate change was measured around Sandakan.

Table 3.3-3. Average of rate of sea level rise (SLR) from tidal gauge at different places at east coast of Sabah (National Hydraulic Research Institute of Malaysia, 2010).

Location name	Latitude (N)	Longitude (E)	Period of tidal data	Average SLR (mm yr^{-1})
Kudat	06° 52' 46"	116° 50' 37"	1/1/1996 -1/1/2009	3.0
Sandakan	05° 48' 36"	118° 04'	02 8/20/1993-1/16/2009	4.1
Lahad Datu	05° 01' 08"	118° 20'	46 1/1/1996-1/17/2009	3.6
Tawau	04° 14' 00"	117° 53' 00"	7/1/1987- 1/18/2009	3.5

The Indonesia Sea Level Monitoring Network, with 65 operational stations, has observed varying rates of sea level rise in different locations (Table 3.3-4). These rates are expected to accelerate where the land border has been subsiding, where groundwater is also being overextracted. In Demak, for example, inundation of coastal areas has been happening

since 1995 and has damaged roads and railways affecting the local economy (Ministry of Environment, 2007).

Table 3.3-4. Observed sea level rise in a number of stations in Indonesia (Ministry of Environment 2007).

Location name	Sea level rise (mm yr^{-1})	Source
Cilacap	1.30	Hadikusuma, 1993
Belawan	7.83	ITB, 1990
Jakarta	4.38	ITB, 1990
	7.00	Based on data from 1984-20063
Semarang	9.37	ITB. 1990
	5.00	Based on data from 1984-2006
Surabaya 1.00	1.00	Based on data from 1984-2006
Sumatra	5.47	ITB, 1990
Panjang, Lampung	4.15	P3O-LIPI, 1991

3.3.3. *The socio-economic consequences of climate change*

The major socio-economic impacts of climate change identified include: changes in productivity in agriculture, forestry, and fisheries; changes in resource distribution and political jurisdiction; changes in potable water availability; increased human health care expenses and needs; increased response/mitigation costs to extreme weather events; loss of income and employment from fisheries and agriculture; loss of opportunity for both domestic and foreign investments; damages in infrastructure; and, even loss of lives.

Further, the TDA process identified six stressors of climate change and their corresponding foreseen socio-economic consequences are reflected in Table 3.3-5 below.

Table 3.3-5. Socio-economic consequences of climate change in relation to fisheries.

Climate Change Stressor	Direct Socio-Economic Consequences Related to Fisheries	Other Indirect Socio-Economic Consequences
Increase frequency and intensity of typhoons	- loss in opportunity to fish resulting to low fish catch - Fluctuation in local market prices for fish (low catch would mean an increase in local market price of fish)	- Reduced accessibility to and flow(mobility) of goods and services - Loss of properties (household, infrastructure, vessels) - Loss of lives - Lower income - Poor fishermen (most vulnerable group) trapped in the vicious cycle of poverty

Increase frequency/volume of rainfall resulting to flooding	- Low fish catch (arising from altered ecosystem/ community structure & function due to sedimentation and turbidity; decrease in salinity of waters; strong coastal water column stratification) - Higher fishing cost in terms of time, effort and resources (arising from migration of fish from coastal areas and result to different fish catch composition; the decreased salinity in coastal waters can also result to displacement of fish and other mobile organisms) - Loss in livelihood (including mariculture-dependent areas) - More fishing pressure in coastal areas by people displaced from mariculture areas - Increase likelihood of irresponsible fishing - Fluctuation in local market prices for fish (low catch would mean an increase in local market price of fish) - Incidents of food poisoning (from consuming fishery products affected by HABs/fish kills due to eutrophication)	- Increase in morbidity (small pelagics, being priced relatively cheaper, play an important role in the nutritional protein intake especially among the 70% of the P-SCS population; more than 50% of Filipinos' protein intake come from fish) - Increase unemployment - Lower income - Poor fishermen (most vulnerable group) trapped in the vicious cycle of poverty - Loss of lives - Displacement of population due to flooding - Loss of properties (household, infrastructure) - Increase in incidents of water borne diseases (from contamination of potable water) resulting to increase cost of hospitalization and even increase morbidity - Loss of aesthetic value affecting tourism
Ocean acidification	- Fish and shellfish catch compromised - Less fishery production - Loss in fishery investments - Fluctuation in local market prices for fish (low catch would mean an increase in local market price of fish) - Increase likelihood of irresponsible fishing practices	- Increase unemployment

Sea level rise	- Mangrove-based livelihood compromised due to inundation further landward - Potential expansion of seagrass and coral reef fisheries resulting to potential augmentation of livelihood	- Displacement of coastal population - Loss of properties (household, infrastructure) - High cost of construction and maintenance of hard engineering structures along the coast (e.g., sea wall) due to shoreline erosion (this can result to potentially lesser budget allocation for social services such as education and health in favour of hard infrastructure thereby compromising the welfare of the poor and vulnerable coastal population)
Sea surface temperature increase	- Low fish catch due to degradation of habitats - Fluctuation in local market prices for fish (low catch would mean an increase in local market price of fish)	- Lower income - Increasing incidence of poverty
Shifts in ocean circulation (slowing of meridional overturning)	- Additional investment costs in technology and capacity due to shifts in productivity zones - Potential collapse of the fishery due to weakening of upwelling systems	- Increasing incidence of poverty

There is a dearth of quantitative data on the foreseen socio-economic impact of climate change. The considerable number of the populace in the SCS dependent on fisheries and the contribution of the fisheries sector to the GDP (including exports) provide an estimate of its potential impact to the economy and to the welfare of the people.

3.4. Pollution

Marine pollution is one of major concern in the SSME. Water pollution problems are generally derived from anthropogenic sources, coming from sediment, domestic and industrial wastes including agriculture runoff that are carried by rivers into coastal waters.

River water quality degradation is another concern (this will be discussed in the next section on Freshwater Shortage) especially since existing rivers are still the main source of

raw water to meet the clean water needs of communities. This is clearly the case when mined areas are left without rehabilitation after exhausting the mined resource. Among others, impacts include loss of natural vegetation, decline in soil fertility, decrease in biodiversity, and wildlife migration.

3.4.1. Marine Water Quality

According to Burke (2003) and Milliman et al. (1999), sedimentation is one of the highest forms of pollution on earth. They cited that one billion tons of sediments are discharged from Philippines, while the 29 rivers from Borneo and Sulawesi Islands discharge 4.2×10^9 MT sediment or 20 to 25% of the global sediment export. Land-based activities that contribute to sedimentation include coastal urbanization, industrial development, and agriculture activities.

Corals usually thrive in clear waters with low nutrient levels. Reef building species are mostly symbiotic with zooxanthellae (unicellular algae), which require high levels of light for primary production. Thus, increased sediment can negatively affect coral growth, leading to coral die-off in severe cases. Coral reefs affected by land pollution exhibit 30-50% less diversity at 10-meter depths, in comparison with pristine reefs. In addition, according to conservative estimates, between the years 1989 and 2000, the number of coral reefs containing 50% live coral has declined by as much as 36%.

DHI (2005) highlighted the pollution (BOD, TN and TP and sediment load) of 13 major rivers flowing into the Sulu and Celebes seas. According to the report, the highest suspended sediment is from Sg. Kinabatangan Kechil (7,196,148 ton yr^{-1}) followed by Sg. Trusan Kinabatangan (6,939,018 ton yr^{-1}). Indeed, Sg. Labuk, Sg. Sugut, Sg. Kinabatangan, and Sg. Segama rivers are the main sources of suspended sediment to the Malaysian part of SSME. Even small rivers also contribute to high sediment discharge to the marine ecosystem due to human activities in the catchment area, resulting in high pollution inputs in coastal areas. However, the Malaysian part of SSME recorded the lowest percentage of total suspended solids (6%), but exceeded the Malaysian Marine Water Quality Criteria and Standards (MWQCS) that should also be free from oil and grease contamination (Department of Environment Report 2009). Malaysia's coastal and marine sources of pollution are related to manufacturing, maritime and shipping, agriculture, urbanization (organic waste, sewage and garbage), and activities in the oil and gas industry. The manufacturing sector is the major contributor of heavy metal pollution (electroplating, etching, metal components) (Rahman and Surif 1993). Water quality parameters from 233 stations in Malaysia (2000-2007) showed that stations with contaminants exceeding the Interim Marine Water Quality Standards (IMWQS) were 56.9% for total suspended solids, 44.1% for *Escherichia coli,* and 43.6% for oil and grease (Figure 3.4-1)

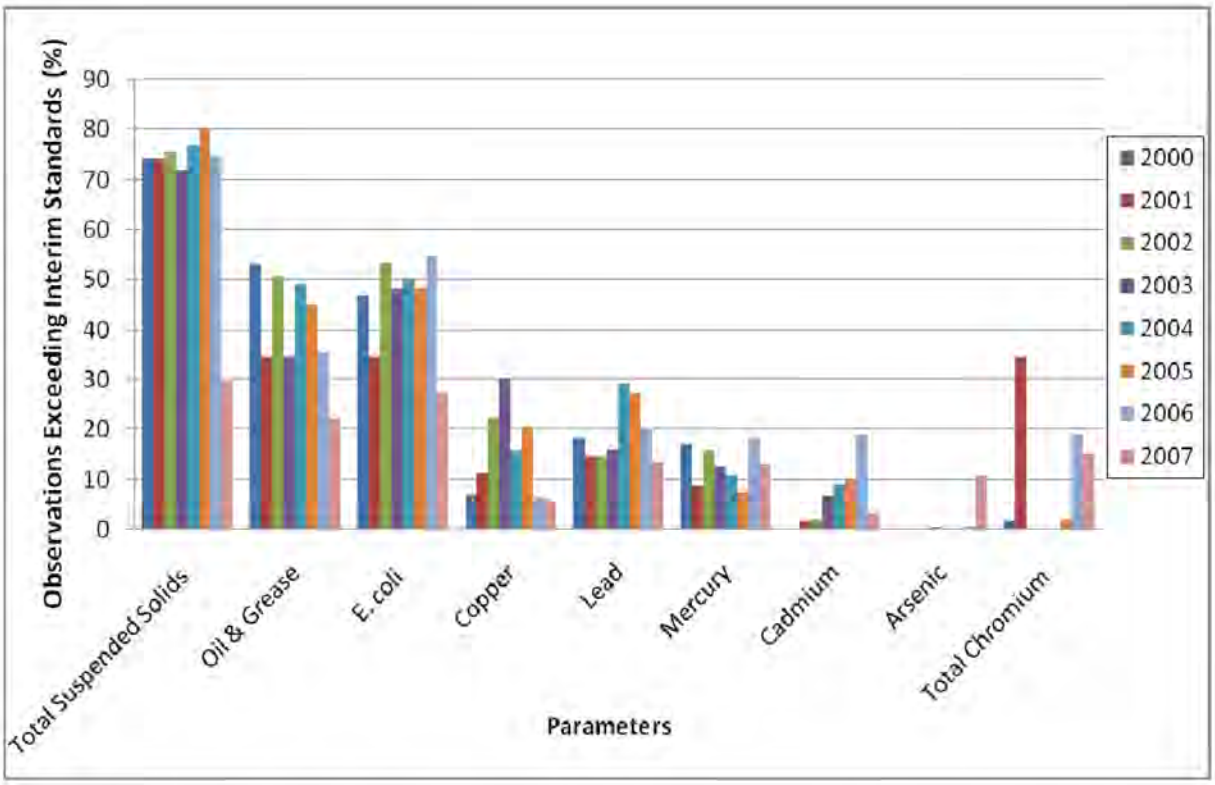


Figure 3.4-1. Malaysia marine water quality status from 2000 to 2007 (National Coastal Resources and Marine Environment Profile of Malaysia 2009).

As of 2005, 57 bathing beaches in Philippines were prioritized for monitoring and protection. Of these, only 26 were monitored for dissolved oxygen where 54% had good water quality. Another 83% (34 of 41) of bathing beaches passed the criteria for coliform (EMB 2005). In Sabah, the main sources of *Escherichia coli* were untreated or partially treated animal and domestic wastes including uncontrolled sewage from coastal premises like hotels and restaurants. In these areas, the marine water quality criteria and standards were exceeded for *E. coli* by 11% (Department of Environment Report 2009).

Apart from beaches, there are several priority bays monitored for water quality in Philippines. Those within the Sulu-Celebes Sea areas that raised concern include Ormoc Bay during the southwest monsoon and Ragay Gulf during the summer season. However, San Diego-McGlone and co-workers (2004) caution the interpretation of these results as values may not be directly comparable from one site to another because different laboratory groups may have different laboratory standards and protocols.

3.4.2. *Solid waste*

Burgeoning population is accompanied by the delivery of service goods and materials that generate wastes. Pollution from solid waste is one of the challenges faced by the Marine Parks in Sabah (Spait 2001) that affects marine life and the cleanliness of beach areas. Common solid waste found on beaches and coastal islands are plastic bags and bottles, food containers and beverage cans. Those that wash out to sea accumulate underwater and interfere with trawling activities. There are also frequent reports of entanglement and suffocation of animals by litter.

Solid waste management is generally poor or non-existent in water villages along the shoreline and islands especially if not within the jurisdiction of a local government body. In Sabah, there are only 23 solid waste disposal sites under the jurisdiction of the respective councils (City, Municipal or District) (Environmental Conservation Department 2002). Some solid waste disposal sites are located close to the coast and may leach into the marine environment (such as in Semporna and Beluran) and contribute to marine pollution.

Similar problems in solid waste occur in the Indonesian part of SCS LME and are disquieting because of the high solid waste generation in the area. According to Tamod (2008), Manado produced 208.82 $m^3 d^{-1}$ (Anon. 2009a) while Tarakan and Gorontalo produced 505.02 $m^3 d^{-1}$ and 344 $m^3 d^{-1}$, respectively (Anon. 2007, 2009b).

In Philippines, it was not until 2000 that a law (Ecological Solid Waste Management Act of 2000 or RA9003) was enacted to institutionalize a national program that will manage the control, transfer, transport, processing, and disposal of solid waste in the country. In 2003, Metro Manila alone generated one-fourth (25%) of the national total solid waste and practically led the per capita municipal solid waste (MSW) generation of up to 0.71 kg d^{-1}. Despite the number of materials recovery facilities (MRF) in Metro Manila and the highest local government allocation for garbage collection (3.54 billion pesos annually), only about 83% of municipal solid wastes are collected (NSWMC 2004).

Coastal cleanup, the mobilization of volunteers to gather garbage along shores, river banks and even in coral reef areas by SCUBA divers, has been practiced in Philippines since 1994. Estimates from 2008 and 2010 collected 852,261 pounds (~387 MT) and 529,903 (~241 MT) of trash, respectively. Not all areas in Philippines participate in the annual coastal cleanup so that the collected garbage is still an underestimate. Breakdown of the 2008 data show that more than 60% (by quantity) is composed of bags (mostly plastics) followed by packaging materials for food (~8%).

3.4.3. Heavy metals

Heavy metal contamination of marine organisms has implications for human health through the consumption of fish, shellfish, and crustaceans (Arifin 2011). These types of contaminants accumulate in the environment, especially in bottom waters and form complex compounds with other materials (Djuangsih et al. 1982, Damar 2006).

Heavy metals are monitored in very select areas in the Philippines. Mercury is regularly monitored in Dupon and Matlang Bays in Leyte, and in Murcielagos Bay, Zamboanga del Norte. All of these areas passed the monitoring standards as of 2005. For lead, Dupon and Matlang Bays in Leyte and Camotes Bay in Cebu also passed (EMB 2005).

Biota that live in waters polluted with heavy metals accumulate these pollutants in proportion to the concentration (Rai et al. 1981). In many vertebrate species, these can accumulate in liver and kidney tissues. Six species of avian waders in Calatagan Bay, Philippines, were tested and found positive for heavy metal contamination. Cadmium was found to be highest in two species of wintering birds (common sandpiper and pintail snipe), possibly accumulating trace metals in stopover sites and breeding grounds. A resident bird

species, the painted snipe, was found to have lower trace metal contamination (Prudente et al. 2005).

Another investigation by Prudente (2008) on butyltin (BT) compounds showed that BTs, especially tributyltin (TBT), a major component of antifouling paint, were detected in green mussels in Manila Bay and Visayas Seas (in 1994, 1997 and 1998) from various aquaculture and coastal sites. Levels were up to 790 ng g^{-1} wet weight where intense maritime activities occur (Manila Bay), which is more than four times (173 ng g^{-1} wet weight) the tolerable average residue level (TARL) for Filipinos weighing 60 kg. Skipjack tuna caught in the Philippine Sea (Pacific area) was also found to have high BT content (220 ng g^{-1} wet weight of liver tissue) including small cetaceans sampled from the Sulu Sea (42-98 ng g^{-1} wet weight of liver tissue). Only two species of small cetaceans were sampled, Fraser's dolphin, *Lagenodelphis hosei* and spinner dolphin, *Stenella longirostris*.

Hazardous chemicals such as organochlorine compounds, organotin compounds and heavy metals are among environmental problems that are closely related to industrial activities (Miyazaki 2008). These compounds can accumulate in the fatty tissues of living organisms and is toxic to human. Organochlorine compounds can remain intact in the environment for long periods. Multipurpose sea transportation within the two seas has been intensified by the economic development along the coastal area of the Malaysian part of the SSME. Contamination of butyltin from ships and boats from antifouling paints can accumulate in sediment and threaten aquatic ecosystems (Rumengan et al. 2008).

3.4.4. Harmful algal blooms

Harmful algal blooms (HABs) are recognized as among the major environmental problems in many parts of the world, usually triggered by nutrient enrichment of coastal areas. Occurrence of HABs is most significant in semi enclosed bays, harbours, and lagoons with limited water circulation, and particularly where sewage or industrial wastes discharge into. Coastal upwelling can also cause HABs (Wiadnyana 1996).

The high population density of phytoplankton in the waters can cause a variety of negative consequences for aquatic ecosystems, such as decrease of oxygen in the water which can cause death of various underwater organisms including humans when consuming contaminated fish and shellfish species (Damar 2006, Anderson et al. 2008). This is compounded by the fact that some phytoplankton species (many of them dinoflagellates) are toxic under bloom conditions (Mos 2001).

HABs in Kota Kinabalu, Sabah coastal waters are mainly attributed to three species, i.e., *Pyrodinium bahamense var. compressum*, *Cochlodinium polykrikoides* and *Gymnodinium catenatum* (Adam et al. 2011). *P. bahamense var. compressum* was first recorded in 1976 in Kota Kinabalu (Roy 1977) while the first evidence of *C. polykrikoides* was in 2005 which caused red discolorations of the coastal waters of Sepanggar Bay (Anton et al. 2008). Occurrence of harmful algae species such as *Pyrodinium bahamense var. compressum*, *Dinophysis caudate*, *Dinophysis miles*, *Chaetoceros affine*, *Prorocentrum micans*, *Prorocentrum sigmoides*, *Peridinium quinquecorne*, *Leptocylindrus danicus*, *Trichodesmium sp.*, and *Oscillatoria sp.* were also reported in Darvel Bay (Anton and Suibol 1999).

In Philippines, HAB was first recorded in Samar in 1983 (although HABs could have occurred in other areas, and even previously but were not recognized) and became more widespread over the years (Annex 3.4). In all recorded events, solely *Pyrodinium bahamense var. compressum* was the main causative agent (Montojo et al. 2011). It is also quite alarming that Murcielagos Bay in Zamboanga del Norte, Dumanguilas Bay in Zamboanga del Sur, and Matarinao Bay in Eastern Samar almost have HABs year-round.

Vicente et al. 2002 first reported a *Cochlodinium sp.* bloom (bloom density of $3.1x10^4$ to $3.8x10^4$ cells ml^{-1}) in an aquaculture area in Iligan Bay, Mindanao. Although the bloom itself is not harmful, fish kills were reported but were not associated with toxins or clogging of the gills but most likely due to lack of dissolved oxygen (2.4 to 0.5 mg L^{-1}) during the bloom die-off.

Illnesses caused by toxins from HABs include paralytic shellfish poisoning (PSP), amnesic shellfish poisoning (ASP), and diarrhetic shellfish poisoning (DSP). Fatalities caused by HAB toxins were recorded in Lewotobi and Lewouran (East Nusa Tenggara), Sebatik Island (East Kalimantan), Makassar, and the Bay of Ambon. In Philippines, fewer poisoning incidents have been recorded through the years because of the government's initiative to setup HABs awareness and an early warning system. The Philippines' Bureau of Fisheries and Aquatic Resources (BFAR) has put up the Shellfish Bulletin Series in their website indicating areas where HABs are occurring including their recommended actions.

3.4.5. Oil and other hazardous natural substances

Based on the Department of Environment Report (2009), the island marine water quality status for Sabah showed that oil and grease have exceeded the criteria and standards of marine water quality by three percent. Presence of oil and grease in the coastal waters were from discharges of shipping vessels, leakages, and disposal of engine oil by boat operators.

The Philippine Coast Guard Marine Environmental Protection Command (PCG-MEPCOM) is in charge of marine pollution concerns in the country especially when it comes to oil spills. Since 1975, records of the PCG-MEPCOM show that a major oil spill only happened in 2006 in a maritime accident during a typhoon that made a tanker (Solar I) ran aground in Guimaras Strait. About two million liters of oil was spilled and affected ~1,000 ha of mangroves and badly affected coral reefs and fishing grounds including the Taklong Island Sanctuary (see also http://earth.tryse.net/oilspill.html).

3.4.6. The socio-economic consequences of pollution

Based on the respective national workshops conducted in the three countries (Indonesia, Malaysia, and Philippines), the identified socio-economic impacts of pollution are as follows: decline in fisheries harvest; reduction in revenue from coastal and marine resource use/harvest including exports of said products and tourism revenue; loss of livelihood or increase in unemployment; loss of income; costs incurred in clean-up; increase in morbidity (especially from waterborne illnesses and diseases); and decline in natality (see Table 3.4-1).

Table 3.4-1. Socio-economic impacts of pollution in the SCS.

Indonesian-SCS	Malaysian-SCS	Philippine-SCS
• Human illness (more or new diseases) • Increase mortality and decrease natality • Displacement of community – migration • Loss of alternative livelihood/income	• Low revenues for use of coastal and marine land • Loss of employment • Decline in GDP (exports)	• Waterborne illnesses/diseases • Decline in tourism activity • Loss of income

Among the identified most vulnerable areas to the impact of pollution within the SCS are Mindanao and the urban centers in Visayas for the Philippine part of SCS; Sabah for the Malaysian part of SCS; and, Kalimantan for the Indonesian part of SCS.[2]

As emphasized by GIWA 56, severe occurrence of water pollution (e.g., solid waste and refuse from households, industrial and agricultural wastes, pathogens, pesticides and salt, as well as thermal pollution) can compromise water system reliability, increase operating costs for industries and pose serious health risk and dangers to the population. Health hazards can happen when people get poisoned from drinking arsenic contaminated water or die during outbreaks of *Vibrio* cholera. Casualties upon consuming fish or shellfish contaminated with heavy metals (e.g., mercury) can also happen.

The poor and disadvantaged coastal populations are most vulnerable to the impacts of marine pollution, or any environmental concern for this matter, since they lack or do not have the financial capacity to cope. In the SCS, the poverty incidence for the Philippine side is 30.2% while the Indonesian side is 14.5%.

In the Philippine case alone, it is estimated that about seven to ten million tons of solid wastes are produced each year (National Solid Waste Management Commission). It is estimated that a 10% reduction in solid waste will translate into about US$8 million savings from the government. Also, recycling of solid wastes can generate income, which has become a cottage industry in some parts of the SCS. Technology should also be advanced to minimise wastes from packaging materials while marketing strategies of packaging in small quantities, especially when using plastics, should be discouraged.

According to the World Bank Philippine Environment Monitor 2003 data, water pollution in general has been responsible for 31% of illnesses among the populace. It further estimated that about PhP67 billion (PhP3 billion for health, PhP17 billion for fisheries and PhP47 billion for tourism) are lost annually due to water pollution.

For tourism in particular, the reduction in aesthetic value of marine habitats can translate into potential reduction of income from tourism including diving. The SCS has numerous diving sites and pollution can certainly compromise the potential income generation from this sector. The Philippine Department of Tourism (DOT) estimated that a diver usually spends an average of US$100 per day.

[2] Workshop discussions by Technical Task Teams (TTTs)

In 2008, only about seven percent of the total Philippine population is linked to sewerage systems. From solid waste and water pollution, the economic cost of pollution roughly takes up two of the Philippine GDP. This cost takes into account losses in productivity, hospitalization and medication costs, as well as losses in revenue from tourism.

3.5. Freshwater Shortage

Water shortage and water scarcity for beneficial use are often experienced in the SSME. Water shortage is considered as the unavailability of good water supply for end users. From the economic point of view, it is the supply and demand of water in relation to a country's water balance (Hidadin et al. 2010).

Freshwater sources of the SSME areas in Indonesia, Malaysia and the Philippine mainly come from rivers, lakes, ground basins and even rain (Annex 3.5-1&2). Freshwater is generally defined as water containing less than 500 ppm dissolved salts (commonly sodium chloride) that are generally sourced from natural runoffs. The present scoping and scaling results from the second TDA workshop in Manila indicated that freshwater shortage, among the six transboundary problems, has relatively moderate to high degree of environmental and economic impacts but is projected to scale up in the future (see Table 3.5-1). Analysis of health impacts due to water shortage is expected to be severe in the future. The environmental impacts of human activities in the watershed and drainage basins include 1) modification of stream flow (sand mining), 2) contamination of existing supply (water quality), 3) changes in the water table, 4) loss of freshwater sources, 5) sewage from palm oil industry, 6) loss of watershed due to development, 7) dead rivers/water source, 8) seawater intrusion, and 9) subsidence. Apart from these, Pawitan (2010) also considered climate variability and their likely impacts on freshwater resources.

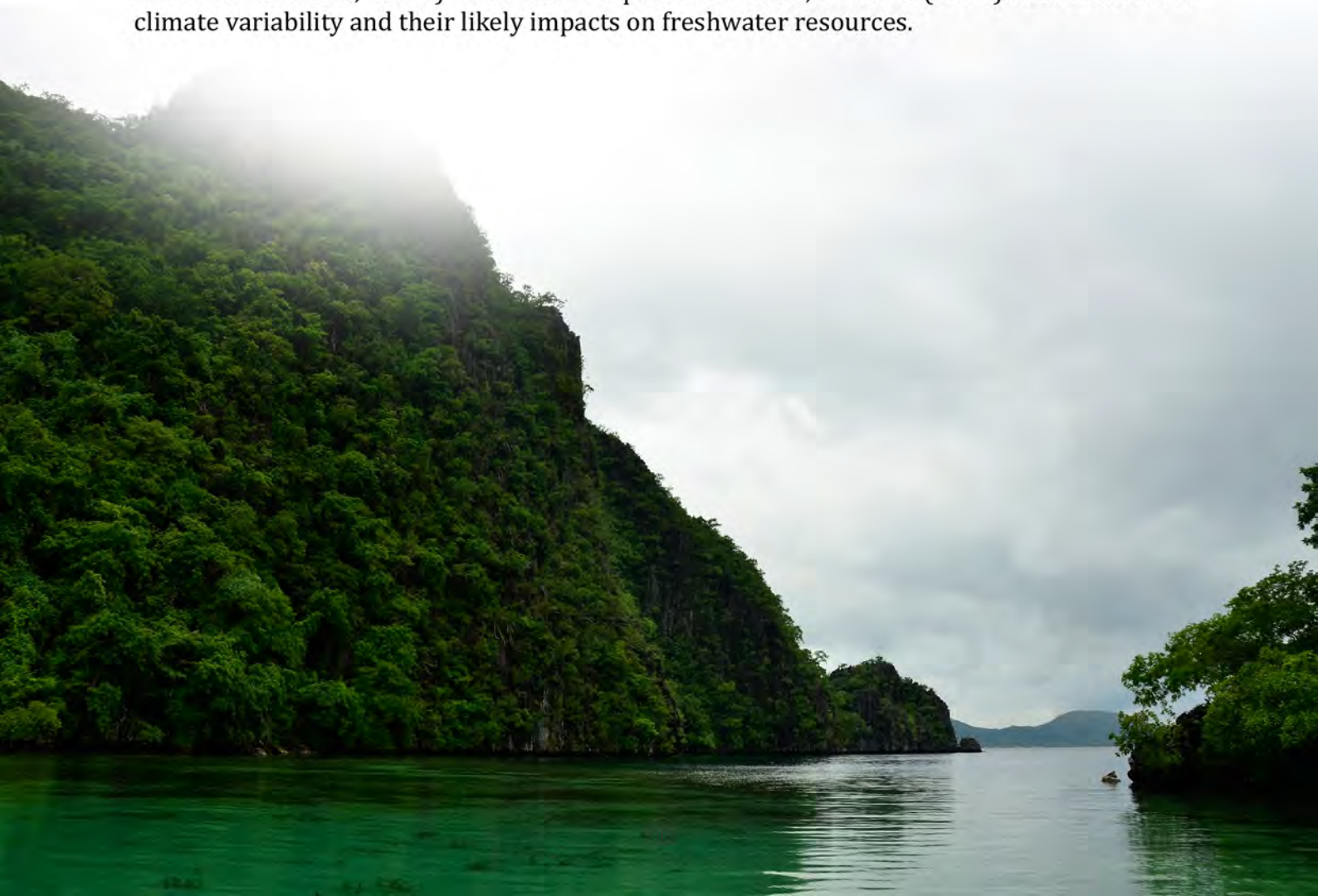


Table 3.5-1. Environmental impacts and socio-economic consequences on freshwater shortage in the SSME.

Country	Environmental impacts	Socio-economic consequences
Indonesia	Land conversion Over exploitation of water Mining – coal, gold, sand Natural Decreasing of fresh water sources Biodiversity degradation	Lack of public awareness Conflict in water use Loss of income Loss in investment Illness and disease Increase of disease and variability social problem
Malaysia	Seawater properties change Water circulation change Loss of freshwater resources	Poor, disadvantaged people GDP (exports) Employment Water/ land conflict
Philippines	Land conversion Biodiversity loss Seawater intrusion Increased runoff Changes in stream flow	Lack of public awareness Added cost for infra/water services Loss of income & investments Disruption in agri-industrial activities Water-borne illnesses & diseases

As a basic human need, freshwater use and demand increase with rising population and economic growth. The freshwater needs throughout Indonesia, for example, have been seen to increase over the decade 1990-2000 and are projected to rise in the coming decades (Figure 3.5-1).

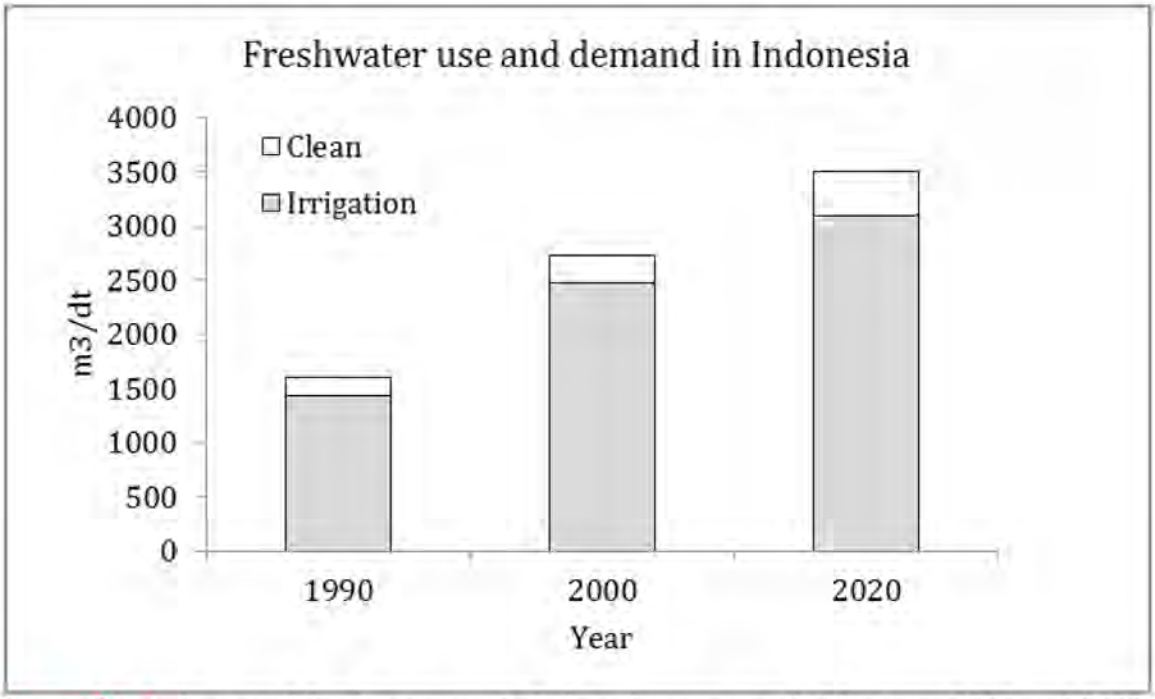


Figure 3.5-1. Increased freshwater use in Indonesia was recorded between 1990 and 2000 with a projected increase in demand in year 2020. Clean water comprise a small fraction of the total usage/demand while most (~90%) goes to irrigation (TDA Country Reports 2011).

3.5.1. Mining/quarrying

Mining for gravel and sand from rivers contribute to revenues of the local government and is actively conducted in the SSME. Philippines reported that the production of sand and gravel was 35.26 million cubic meters in 2001 and increased to 36.79 million cubic meters in 2005. In Malaysia, extraction of gravel and sand especially silica-rich sand has been sustained over the period 2001 to 2005 (Table 3.5-2).

Table 3.5-2. Production of industrial minerals in Malaysia compiled from Ministry of Primary Industry, Department of Minerals and Geosciences (Kuala Lumpur), and Department of statistics, Malaysian Chamber of Mine between 2001- 2005 (Kementerian Sumber Asli dan Alam Sekitar 2006).

Commodity	2001	2002	2003	2004	2005
Sand and gravel (metric tons x 1000)	15,020	19,574	17,955	18,371	17,072
Silica sand (metric tons)	575,105	447,398	533,617	631,402	531,891

3.5.2. Ground water

In the SSME, apart from rivers and lakes, ground water comprises another freshwater source that is utilized for direct consumption especially in remote areas or islands. Aggregate area of ground water reservoir that is recharged by rain and seepage from rivers and lakes are given below (TDA Country Reports 2011).

Area of reservoir	Indonesia	Malaysia	Philippines
Groundwater/river	5212.05 km	517.16 million liters	50,000 km^2

There is no groundwater quality monitoring data available for any of the groundwater under investigation in Sabah (Town & Regional Planning Department, 1998). Nevertheless the quality of the groundwater is in constant threat by several contaminants that leach into the groundwater from either leaks in the sewer pipelines, accidental chemical or oil spills, runoff of animal wastes from feedlots, agriculture runoff (fertiliser), salts and other contaminants. Nitrates are the most common chemical contaminants from domestic and agriculture activities. Bacterial leachates from animal feedlots, sewer leakage and sewage catchment areas also commonly contaminate the groundwater.

3.5.3. Pollution

The SSME freshwater is contaminated due to defective or ill-designed septic tanks, garbage dumps, animal wastes, and inadequately treated wastewater. Ground water that is not suitable for drinking in Philippines was reported in Region IVB – Oriental Mindoro; Region VI – Iloilo City; Region VIII – Leyte; Region IX – Zamboanga City; and Region XI – Davao City.

In Malaysia, rivers located in Sandakan (Sungai Kinabatangan, Sungai Segama, Sungai Sugut) and Tawau (Sungai Kalumpang) are very polluted in terms of suspended solids and slightly polluted with heavy metals and nutrients. Heavy metal contamination is only measured or monitored in water bodies proximal to where mining, tanning, electroplating and similar activities are operating. Mercury contamination is particularly associated with gold mining activities. Inland surface waters in Philippines like Meycauayan River exceeded (=failed) the standards for chromium and cadmium in 2001 and lead in 2004 while Bocaue River passed for chromium, copper and cadmium for 2001 to 2004 but failed for lead in 2004. In 2005, Philippines also reported high levels of mercury (beyond 0.002 mg l^{-1}) in some stations in Naboc, Hijo, Masara, Kingking, Manat, Matiao, Napnapan, and Agusan Rivers (EMB 2005).

3.5.4. Seawater intrusion

Groundwater extraction in SSME areas is done to meet freshwater needs. Overexploitation from the bottom freshwater basins particularly in islands and coastal areas causes intrusion of seawater to replace the decreasing fresh water volume. Seawater intrusion has been detected as much as five kilometers from the shoreline of the coastal strip of Metro Manila and is of utmost concern in the following areas in Philippines because of over-extraction, namely, Guiguinto, Bocaue-Marilao, Meycauayan-North Caloocan, Navotas-Caloocan-West Quezon City, Makati-Mandaluyong-Pasig-Pateros, Paranaque-Pasay, Las Pinas-Muntinlupa, and Dasmarinas, Cavite (NWQSR 2005). Seawater intrusion in Pulau Kepalai and Pulau Mabul due to ground water extraction by island inhabitants is observed in Malaysia (Alin 2011).

Degradation and loss of watersheds cause problems to fisheries and aquaculture development. Insufficient freshwater source affects water exchange rates in hatcheries and pond culture that could catalyse occurrence of diseases in a culture environment.

3.5.5. The socio-economic consequences of freshwater shortage

Based on the scoping and scaling results during the second TDA workshop in Manila, freshwater shortage has moderate to high environmental and economic impacts and is projected to scale up in the future. Stream flow modification is severe in Mindanao and Visayas Islands, Sabah, East Kalimantan as well as other islands in the SCS region. Some identified causes leading to freshwater shortage are listed in Table 3.5-3.

Among the identified socio-economic impacts of fresh water shortage in the SCS are: loss or interruption of potable water supply; added cost for infrastructure and water services; increased costs of irrigation; increased cost in power (especially in Mindanao whereby more than 50% of its power supply are hydro-based); potential damage to infrastructure; reduction in future use options; and, potential conflict from competition among water users, between sectors, and even between countries and regions sharing a common water resource. All these will translate to disruptions in agri-industrial activities that will result in loss of investments and income and eventually worsens poverty.

Table 3.5-3. Problems leading to freshwater shortage.

Problems leading to freshwater shortage	Indonesia	Malaysia	Philippines
Anthropogenic influences due to increasing population	Yes	Yes	Yes
Harmonization of development and environmental conservation in rural areas	Moderate	Moderate	Moderate
Water crisis during drought	Yes	Yes	Yes
Sedimentation	Yes	Yes	Yes
Water pollution and eutrophication of water bodies	Yes	Yes	Yes
Water shortage	Only at Sangihe Island and Talaud Island	Only Kudat; water scarcity at other places	Yes
Use of drill wells/draw water from water sources	Yes (Marore Island)	Yes (Pulau Kapalai & Pulau Mabul)	Yes
Uncoordinated mechanism between the relevant stakeholders in integrated water resources management and synergy	Yes	Yes	Yes
Lack of adequate appreciation of water saving, pollution control and water damage	Yes	Yes	No
Pollution and overexploitation of natural resources	Yes	Yes	Yes

Water quality	Deteriorating with limited provision of safe water	Deteriorating (some are very polluted)	Little information

The United Nations Development Program (UNDP) reported in 2006 that people in developing countries living below the poverty line and without access to piped potable water spent five to ten times more per unit of water compared to people with access to piped water.

The agriculture sector, which plays a major role in the SCS economies, will suffer the most with scarcity in water. Data from the Food and Agriculture Organization (FAO) reveal that agriculture consumes at least 70% of the world's water supply and this is as high as 95% in regions where agriculture is the main economic activity like in the SCS. This will ultimately affect food security as well.

In the prolonged dry spell in Mindanao in 1992, the Philippine National Power Corporation (NPC) reduced the power supply of the island down to 10-15 hours daily. This resulted in several billions of pesos in unrealized revenues and economic opportunity loss. In another event in 2010, the low water levels in major lakes including Lake Lanao[3] reduced the electric generation of hydroelectric plants by 6.33% or 430 million kwh causing an estimated economic loss of PhP 62 billion for Mindanao. Moreover, consumers in Mindanao had to pay an additional PhP0.50/kwh when the power grid was forced to tap thermal power from power barges (for baseload power) at the peak of the crisis (Gold Star Daily 2011).

SSME is currently facing scarcity of water and not shortage of this resource (Alin pers. comm.). Water scarcity is defined as limited availability of fresh and safe potable drinking water and for other household use. As SSME is populated with islanders and coastal communities, water scarcity means that most islanders and informal coastal settlers do not have any access to public goods like water, electricity, sanitation or any type of local government services since settlers are illegal immigrants including those categorized as the sea gypsies or stateless people. These communities are disadvantaged and besides being poor, they are also the most vulnerable to drought or other extreme variation in climate. Availability of money does not guarantee that a person could get water from the market. At present, government water coverage for industrial and household usage is more than 90% which indicates officially that SSME Malaysia is not facing freshwater shortage. Based on the statistics by Alin (pers. comm.), supply (reservoir) of untreated water is more than enough to supply the covered 90% consumers of water. Therefore, the 10% is uncovered by public water supply for reasons known to many as per described above. However, this is not similar to Philippines and Indonesia situation in terms of water shortage. Both countries especially Philippines indicated shortages due to overpopulation at the SSME. It is important to note that increased access to clean and improved piped water (Rural Water Supply Coverage for Sabah in 2004 is already at 95%, slightly less than national level) has been a powerful factor in improving public health and reducing the outbreak of contagious water borne diseases such as cholera, typhoid, and dysentery among inland rural

[3] Lake Lanao in Mindanao is the second largest lake of the Philippines with an approximate watershed area of 1,680 square kilometers. It is the main source of hydroelectric power in Mindanao. More than 75% of the total power needs of Mindanao's industrialization come from the Lake Lanao-Agus hydropower plants.

communities. Thus, accessibility to freshwater supply and facilities are equally important to combat infectious water borne diseases that may affect not only the health and lives of people, but the flora, and fauna of SSME as well.

3.6. Alien and invasive species

3.6.1. Status

Alien or non-native species are species that have been introduced either accidentally or intentionally into an ecosystem. In the marine environment, they may be introduced through ballast water of ships and activities in the aquaculture industry. Other means are listed in Table 3.6-1. Increasing mobility through trade, business travel, migration, tourism and human interaction are among the key drivers in spreading alien species. Bax et al. (2003) estimated that around 10,000 species are being carried in ballast water around the globe and new species are being recorded in their studied ports every 32 to 85 weeks. Alien species can be invasive and repress or exclude native species and disrupt ecosystems such that impacts can be immense, insidious, and irreversible.

For instance, the oyster's marketability in the U.S. is being negatively affected by the introduction of the mud blister worm (*Polydora websteri),* which creates a blister-like appearance on the shell's surface. The golden snail (*Pomacea canaliculata*) of Argentina was brought to Asia to become a source of high-protein food for the local population and was also intended as an export commodity to rich countries. However, this has now become a major rice pest in Philippines with losses estimated at US$425 million – US$1.2 billion in the 1990s. The invasive cut throat coral, also called snowflake coral (*Carijoa riisei*), endangered the black coral industry valued at US$30 million annually in Maui, Hawaii. The genus, which is native to the Western Atlantic, is now known to occur in Philippines and Indonesia.[4]

In terms of human health, species of invasive snails known to be hosts of the rat lungworm (*Angiostrongylus cantonensis*) were identified to cause a fatal disease known as eosinophilic meningoencephalitis. While documented as threats to human, both the golden apple snail (*Pomacea canaliculata)* and the giant African land snail (*Achatina fulica*) are pet and aquarium trade commodities.

On a global scale, UNEP has mapped the major origins and pathways of marine invasive species (see Figure 3.6-1 below). The maritime traffic shows that most marine invasive species reaching the SSME area come from the Atlantic Ocean. A list of species is not available but according to Williams and Smith (2007) these are mainly seaweeds that attach to vessel hulls and other microorganisms that get into ballast water. Figure 3.6-2 details the archipelagic sealanes in Southeast Asia through which invasive species may be introduced from neighboring countries.

[4] http://www2.bishopmuseum.org/HBS/invertguide/species/ carijoa_riisei.htm

Table 3.6-1. Anthropogenic activities leading to introductions of alien species (lifted from Bax et al. 2003).

Source	Vector	Target taxa
Commercial shipping	Ballast water	Plankton, nekton, benthos in sediment
	Hull fouling	Encrusting, nestling, and some mobile species
	Solid ballast (rocks, sand, etc.)	Encrusting, benthos, meiofauna and flora
Aquaculture and fisheries	Intentional release for stock enhancement	Single species
	Gear, stock or food movement	Various
	Discarded nets, floats, traps, trawls, etc.	Various
	Discarded live packing materials	Various
	Release of transgenic species	Single species
Drilling platforms	Ballast water	Plankton, nekton, benthos in sediment
	Hull fouling	Encrusting, nestling, and some mobile species
Canals	Movement of species through locks due to water motion or active swimming	Various
Aquarium Industry	Accidental or intentional release	Aquarium fauna and flora
Recreational boating	Hull fouling	Encrusting, nestling, and some mobile species
Dive practices	Snorkeling and scuba gear	Algal spores, bacteria, some small mobile species
Floating debris	Discarded plastic debris	Encrusting and some mobile species

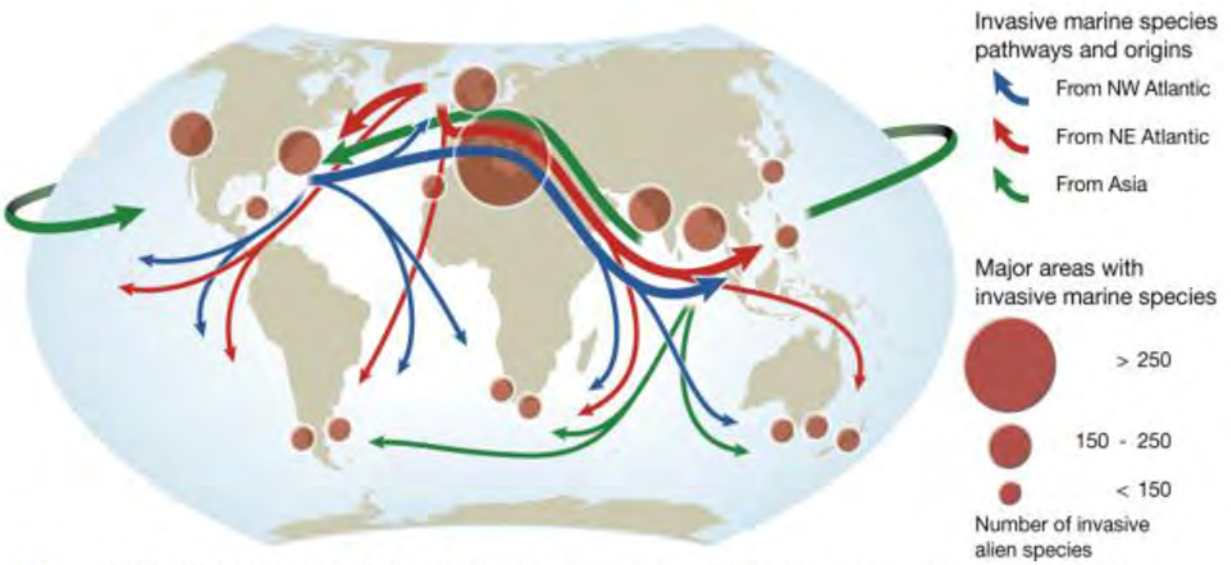


Figure 3.6-1. UNEP/GRID-Arendal, Major pathways and origins of invasive species infestations in the marine environment, UNEP/GRID-Arendal Maps and Graphics Library, http://maps.grida.no/go/graphic/major-pathways-and-origins-of-invasive-species-infestations-in-the-marine-environment (Accessed 26 July 2011).

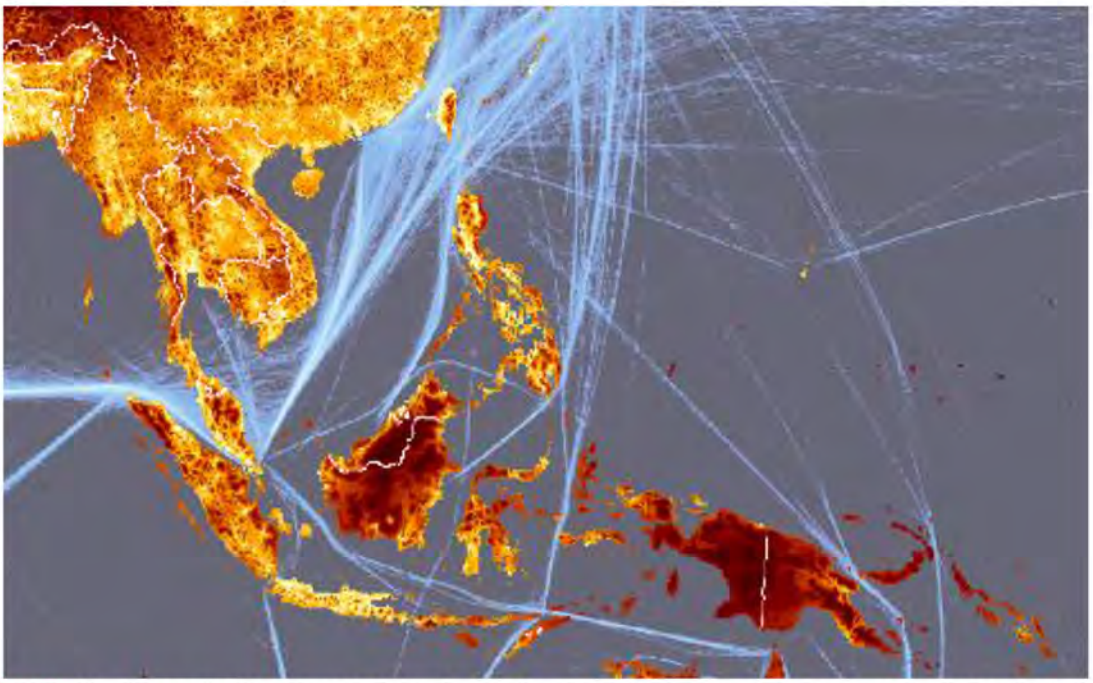
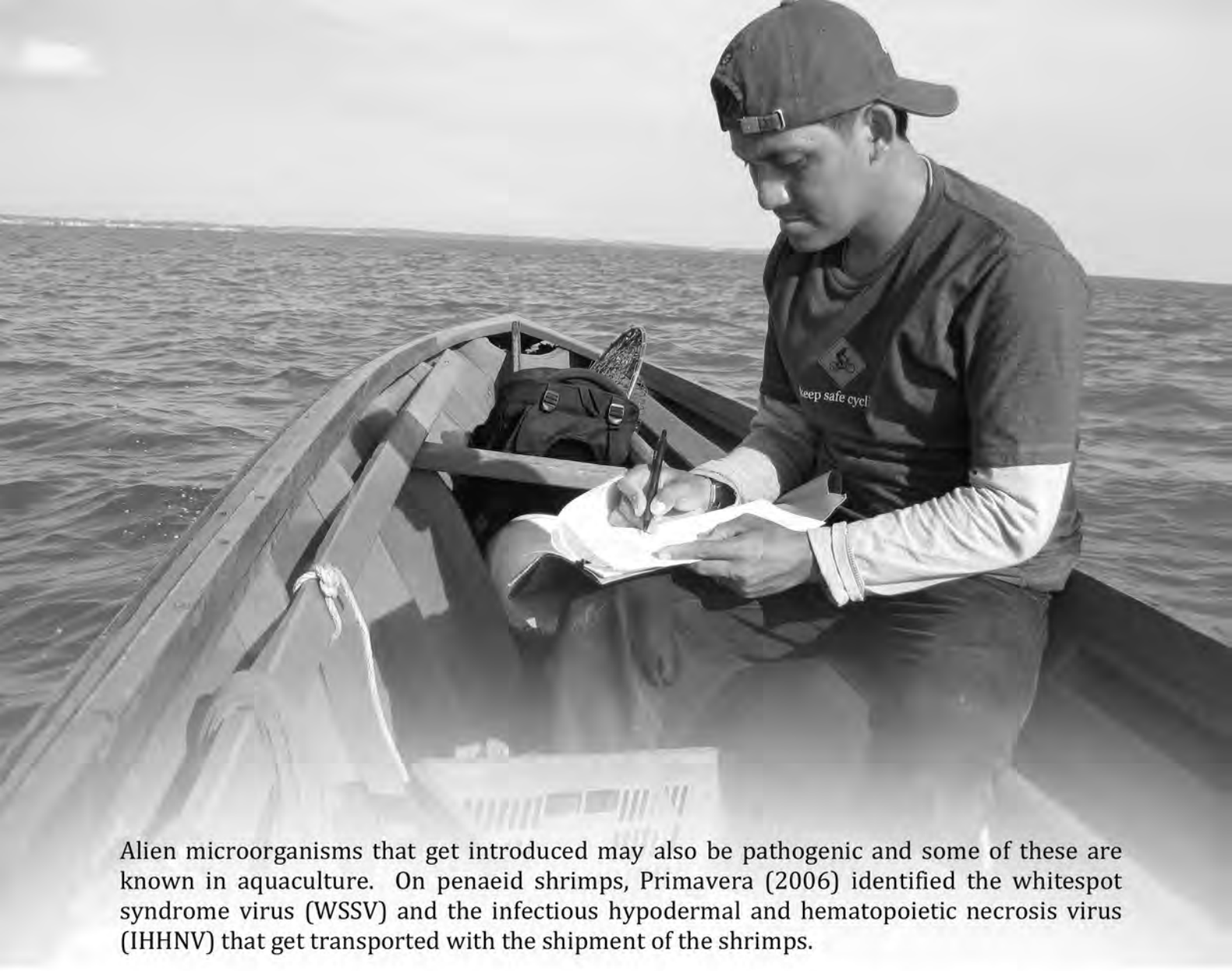


Figure 3.6-2. Sea lanes in Southeast Asia through which invasive species may be introduced into the SSME (http://bioval.jrc.ec.europa.eu/products/gam/sources.htm).



Alien microorganisms that get introduced may also be pathogenic and some of these are known in aquaculture. On penaeid shrimps, Primavera (2006) identified the whitespot syndrome virus (WSSV) and the infectious hypodermal and hematopoietic necrosis virus (IHHNV) that get transported with the shipment of the shrimps.

Other diseases thrive with poor water quality, which is associated with population centers near coastal areas. This was shown by Kaczmarsky (2006) in Central Visayas (Philippine part of SSME) where prevalence of coral diseases decreased with distance from major urban centers. Some of the coral diseases detected were *Porites* ulcerative white spot (PUWS) disease, coral tumors, black band disease, and white band syndrome.

Apart from maritime transport, many alien species are also introduced through the ornamental trade (Padilla and Williams 2004) or through aquaculture (e.g., ARCBC 2002). Available information, however, is mostly on aquaculture species. According to the FAO[5] database, there are a total of 183 introduced aquaculture species in Philippines, 64 species in Indonesia, and 51 species in Malaysia.

While alien species are generally considered a threat to the local ecology, some species in certain situations may be beneficial if they become a new resource, especially as food items

[5] http://www.fao.org/countryprofiles/default.asp?lang=en

(e.g., tilapia). Recently, lionfish that was introduced in the Caribbean and became dominant is now a delicacy in restaurants serving tourists.[6]

From the economics perspective, alien species contribute substantially to the aquaculture production of Southeast Asian countries (NACA 2005). Table 3.6-2 shows that the economic contribution is high for Indonesia and Philippines relative to Malaysia. While the economic benefit is apparent, the environmental impact should also be studied to determine the net loss or benefit of this system.

Table 3.6-2. Aquaculture production (in metric tons) from alien species by country (NACA 2005.)

Country	Production from alien species (mt)	Total Production (mt)	Percent of total aquaculture production from alien species
Indonesia	491,775	5,679,391	8.66%
Malaysia	18,308	1,463,625	1.25%
Philippines	208,164	3,371,874	6.17%

Aquatic alien species could either be pathogens themselves that cause transboundary aquatic animal diseases, or carry pathogens that lead to diseases and epizootics in aquaculture following introduction. Transboundary animal diseases (TADs) are considered epidemic diseases that are highly infectious or transmissible, with the potential for very rapid and serious socioeconomic consequences. The present status of national aquatic animal health strategy development and implementation in the ASEAN is being discussed. This will provide the basis for health management strategies for the ASEAN region as part of the responsible transboundary movement of live aquatic animals.

Alien and invasive species present serious challenges to regional efforts to conserve the environment and to meet development objectives. The threats they pose cannot be treated in isolation as they are part of a complex set of pressures and drivers of biodiversity loss and environment change. The changing marine environment due to climate change, especially increases in sea surface temperature and shifts in ocean circulation, can potentially also change species distributions and alter present ecosystems. The lack of policies or laws on alien and invasive species possibly reflects the dearth of information we have on this concern, which may also be indicative of the lack of scientific inquiry into this subject matter.

3.6.2. *The socio-economic consequences of alien and invasive species*

While it has been pointed out that the islands and island ecosystems[7] like the SCS are less vulnerable to invasive alien species compared to continental landmasses, the Convention of

[6] http://www.voanews.com/english/news/usa/Eat-to-Beat-Invasive-Lionfish-98332004.html

[7] Includes terrestrial, inland water and coastal marine environments.

Biological Diversity (CBD) made mention that the implications of invasive alien species to human health and/or the economy (specifically for local and indigenous communities) can be considerable. For one, invasive alien species could contribute to economic hardship and put restrictions on economic growth and sustainable development. The rate at which invasive alien species spread around the globe is being accelerated by trade, travel, and transport globalization (especially from ballast water of ships). There has been recognition that alien species can have the potential as source of food for local consumption or export. This prompts the need to evaluate carefully the supposed economic costs vis-à-vis benefits of invasive alien species to the community. While marine alien and invasive species are yet to be catalogued in the SCS, a list of alien aquatic species introduced in Indonesia, Malaysia, and Philippines mainly for aquaculture purposes is given in Annex 3.6.

Studies are needed on the quantitative ecological and socio-economic impacts of invasive alien species and even the specific resilience of ecosystems especially in the SCS. This will inform decision makers on how to address the problem and for stakeholders to weigh the consequences of their actions. The CBD stated that many of the authors in the *Status of Coral Reefs of the World* do not cite invasive alien species as one of the threats to coral reefs. This might be due to the lack of awareness on the issue or the lack of information to properly report and address the problem.

CAUSAL CHAIN ANALYSIS (CCA) OF TRANSBOUNDARY PROBLEMS (TP)

Priority TPs and Causal Chain Analysis (CCA)

Out of the six TPs, only the top four were subjected to CCA. Exclusion of the last two TPs (Freshwater Shortage and Alien and Invasive Species) was due to inadequacy of data to properly assess impacts and urgency to conduct a thorough CCA. Overall, they were still identified as priority concerns, therefore, as more data on background and status are gathered, these two TPs can be analysed later especially if funding is made available.

The TP on Climate Change was given special attention due to its cross-cutting nature. After an attempt to conduct a CCA for Climate Change, the country teams realized that a clear-cut causal chain cannot be implemented due to circular references and lack of straightforward data. Nonetheless, the pressing issue on climate change cannot be ignored and relegated as a lesser priority. It was then decided that Climate Change be treated separately, with a different approach, but still retaining the essence of cause-impact relationships.

Causes of Problems on Unsustainable Exploitation of Fish

There were three problems that comprised the transboundary concern of Unsustainable Exploitation of Fish in the SCS-LME. They are as follows:

a. Illegal and unreported fishing (which include the smuggling of fish fry);
b. Unregulated fishing; and,
c. Excessive by-catch and discards (see Figure 4.2).

The first two problems constituted the illegal, unreported, and unregulated (IUU) fishing. After further analysis, the first problem was mainly differentiated from the second in that in the former, there were acknowledged policies, rules, and regulations but which were not being followed by fishers. In the second problem, the main qualifier was that there were still no specific policies and rules on a fishery which then allow the fishers to undertake fishing with no limitations and/or restrictions.

For the illegal and unreported fishing, the four immediate or primary causes identified were:

a. Lack/weak implementation/enforcement of related fisheries policies and regulations;
b. Lack of awareness of fishers on the long-term impacts of destructive fishing practices;
c. High dependency of commercial fishers on fishing as source of income; and,
d. High dependency of municipal/artisanal/subsistence fishers on fishing as source of income.

The first two primary causes led to subordinate governance causal chains while the last two immediate causes produced two subsidiary socio-economic causal chains. The first secondary cause was the lack of capacity to implement and enforce (referring to both manpower and financial resources for monitoring, control, and surveillance [MCS] activities) which was caused by the low prioritization of resources for fisheries management (tertiary cause). The latter arose from the quaternary cause of the lack of appreciation of the optimum contribution of the fishery sector and its environ with the identified root cause of the lack of political will due to existing or prevailing economic model (system) that does not account for the real value of the fishery sector and/or total economic valuation (TEV) of the resource. The other governance-related causal chain had the secondary cause of low level of environmental awareness which was brought by the absence of extension workers doing information, education, and communication (IEC) activities in the field (tertiary cause). The identified quaternary cause for this chain was the lack of funds and the root cause was the low priority afforded on fisheries and the marine environment.

The two socio-economic causal chains were initiated with the secondary causes of fishing as a lucrative business and unsustainability issues of alternative livelihood among coastal communities. These were in turn caused by (tertiary cause) high demand from developed countries for fishery products and lack of sense of stewardship among fishers, respectively. The former chain had the root cause of government thrust for economic growth while the latter chain still had the quaternary cause of the fishers' culture/value of being accustomed to their life as fishers, which then had the root cause in poverty.

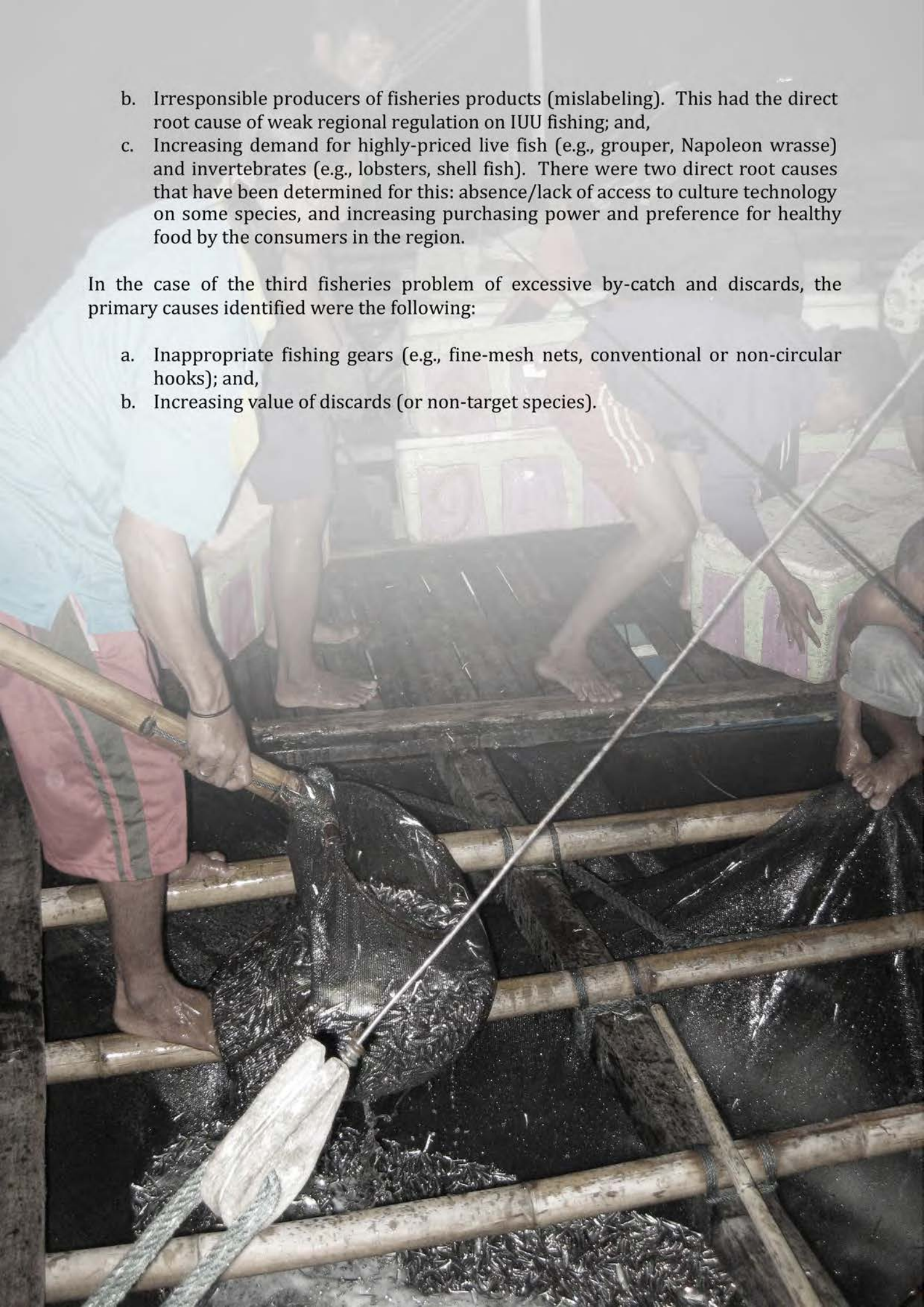
For unregulated fishing, it had one straight root cause in the increasing demand for small pelagic fishes (for food, fish bait, fish meal and feeds for aquaculture). Further, two of its five ascertained primary causes and their corresponding causal chains were the same as that for illegal and unreported fishing (i.e., lack of awareness of fishers on the long-term impacts of destructive fishing practices and high dependency of fishers on fishing as source of income). The other three distinct immediate causes were as follows:

a. Lack of appropriate sustainable fisheries management policies and regulations (e.g., gear-specific rules such as for purse seine, species-specific such as for sardines, quota systems, licensing mechanisms, and joint regional management arrangements). This generated two causal chains, one with a direct root cause of the lack of studies and information, and the secondary cause of the non-usage of existing ecosystem fisheries and population studies in the formulation and updating of coastal resource and fisheries management. The latter was brought about by the tertiary cause of the lack of appreciation of the scientific aspects of fisheries management by both managers and policy makers which in turn was attributed to the gap in information transfer from science to management and policy (quaternary cause). The root cause in this chain was the same as the root causes of illegal and unreported fishing: lack of political will due to existing/prevailing economic model/system that does not account the real economic value of the sector (i.e., the total economic valuation of the resource);

b. Irresponsible producers of fisheries products (mislabeling). This had the direct root cause of weak regional regulation on IUU fishing; and,
c. Increasing demand for highly-priced live fish (e.g., grouper, Napoleon wrasse) and invertebrates (e.g., lobsters, shell fish). There were two direct root causes that have been determined for this: absence/lack of access to culture technology on some species, and increasing purchasing power and preference for healthy food by the consumers in the region.

In the case of the third fisheries problem of excessive by-catch and discards, the primary causes identified were the following:

a. Inappropriate fishing gears (e.g., fine-mesh nets, conventional or non-circular hooks); and,
b. Increasing value of discards (or non-target species).



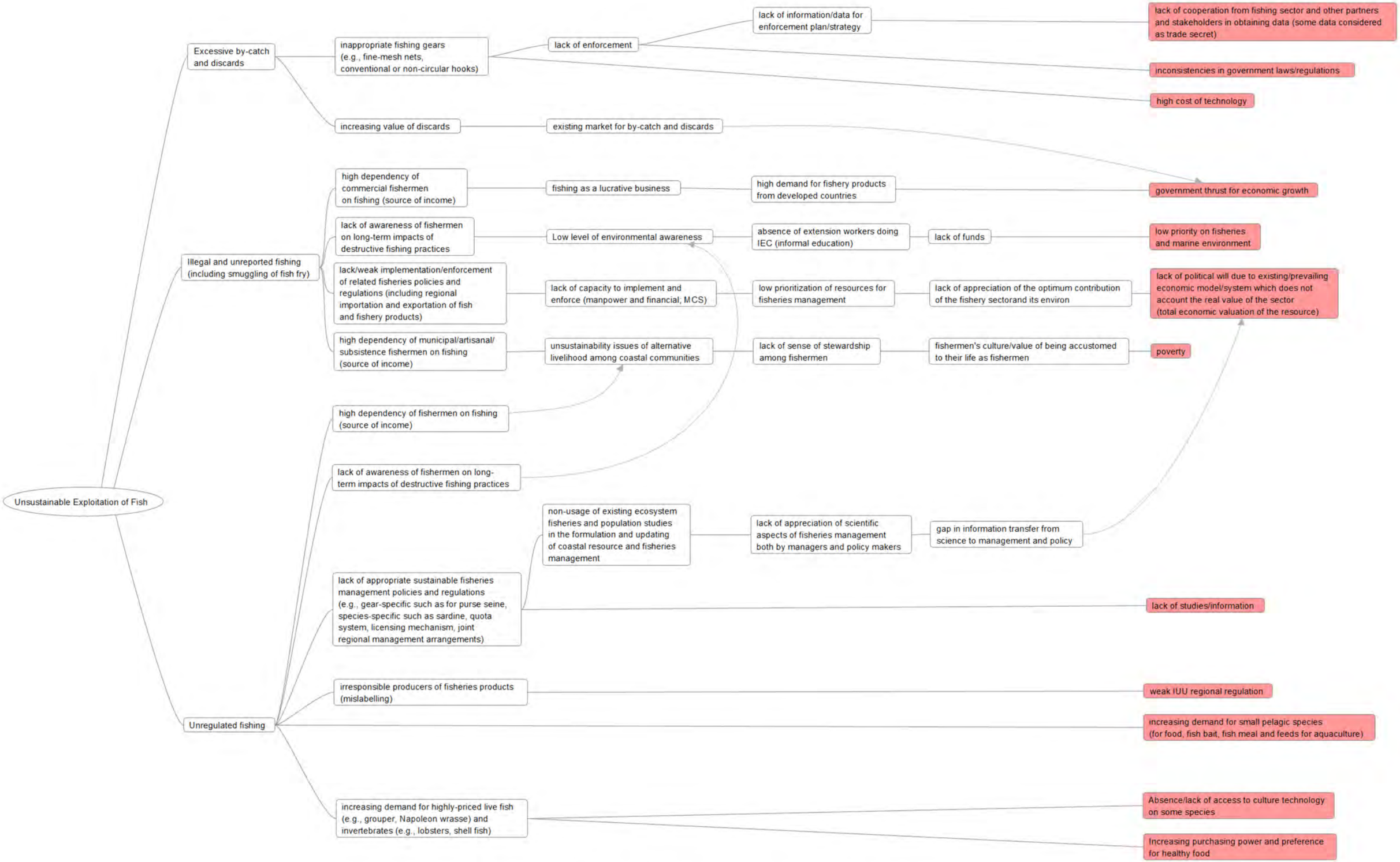


Figure 4.2. Causal chain analysis on unsustainable exploitation of fish.

The former results to three causal chains—two governance-related and one economic which pertained to the direct root cause of high cost of technology. Lack of enforcement had been identified as a secondary cause which had been attributed to the lack of information or data for enforcement plans/strategy with the root cause of lack of cooperation from the fishing sector and other partners and stakeholders in obtaining data, with some data considered trade secret. The other root cause of lack of enforcement was inconsistencies in government laws and regulations. In relation to the other primary cause of increasing value of discards, it was recognized that it arose from the existing market for by-catch and discards. The root cause for this chain had been identified as government thrust for economic growth which was also cited in the foregoing discussion as one of the root causes of the fisheries problem of illegal and unreported fishing.

Causes of Problems on Habitat Loss and Community Modification

In the case of the transboundary problem of Habitat Loss and Community Modification, the three main ecosystems considered were coral reefs, mangroves, and seagrasses (Figure 4.3). Crosscutting issues between two or three ecosystems were also identified and analyzed. Only one of the first-level causes was natural in origin (sea level rise) while the rest were found to be anthropogenic in nature as follows:

a. Relative sea level change;
b. Untreated sewage/run-off;
c. High rate of sedimentation (for corals and seagrasses);
d. Oil spill;
e. Dumping of garbage;
f. Coal spill from transport (from barges pulled by tugboats);
g. Gleaning or harvesting of shells and others in the intertidal zone (coral reefs and seagrasses);
h. Overfishing (coral reefs and seagrasses);
i. Destructive fishing (e.g., blast fishing, use of poison, trawl);
j. Coastal modification, foreshore development (coral reefs, seagrasses and mangroves); and,
k. Invasive species.

For the sea level rise, two of the causal chains ended up in natural root causes (natural variability and El Niño-Southern Oscillation [ENSO]) while the third chain traced the melting of the polar ice (secondary cause) from global warming which was brought about by the quaternary cause of greenhouse gas emissions that resulted from the root cause of industrial development.

On the other hand, the relative sea level change was attributed to too much extraction of groundwater leading to land subsidence. The tertiary cause of this causal chain was the high demand for freshwater for domestic, agriculture and industrial usage. The chain then branched into two quaternary causes of per capita demand increase, and inefficient and wasteful use of freshwater. The latter was ascribed to the quinary cause of improper valuation of, and/or no payment for, the water resource. The chain eventually converged into the common root cause of poor management and lack of policy on water management.

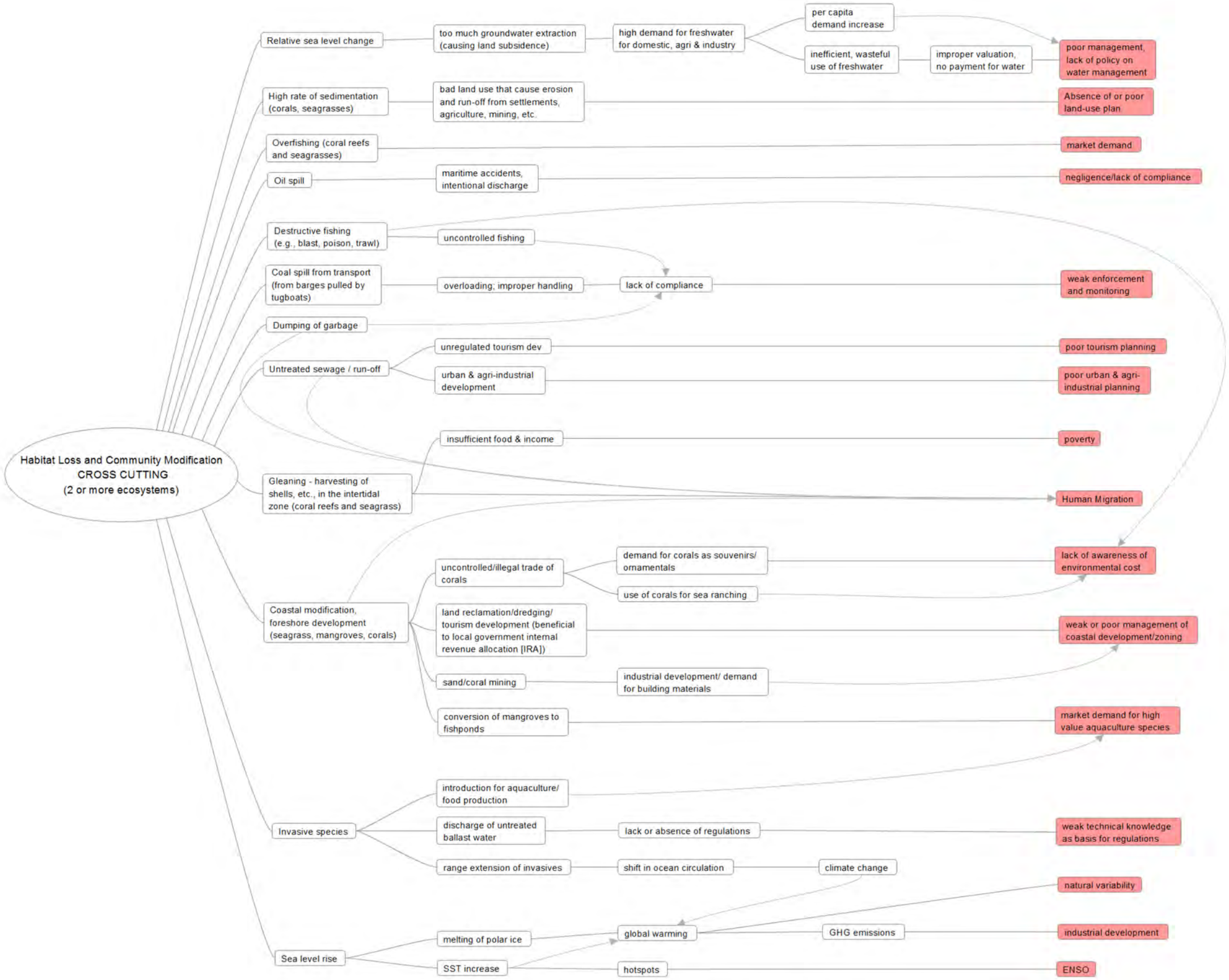


Figure 4.3. Causal chain analysis on habitat and community modification.

The other second-level causes of the anthropogenic primary causes were numerous and these included the following (in alphabetical order):

a. Bad land use that cause erosion and run-off from settlements, agriculture, mining, etc.;
b. Conversion of mangroves to fishponds;
c. Discharge of untreated ballast water;
d. Human migration;
e. Insufficient food and income;
f. Introduction for aquaculture/food production;
g. Lack of compliance;
h. Land reclamation/dredging/tourism development (beneficial to local government internal revenue allocation [IRA]);
i. Maritime accidents, intentional discharge;
j. Overloading, improper handling;
k. Range extension of invasive species.
l. Sand/coral mining;
m. Uncontrolled fishing;
n. Uncontrolled/illegal trade of corals;
o. Unregulated tourism development; and,
p. Urban and agri-industrial development;

The latter three secondary causes accounted for the primary concern of invasive species which was recognized as affecting the composition of the species community in the ecoregion. The root cause of the introduction of non-native invasive species was the market demand for high value aquaculture species. Ballast water was identified as an emerging concern in the SCS-LME and its untreated discharge in the ecoregion waters was attributed to the lack or absence of appropriate regulations which had the root cause of weak technical knowledge as basis for regulations. The other tertiary cause was shift in ocean circulation which was attributed to climate change. Afterwards, this particular chain converged with that of sea level rise (primary cause) which started with global warming (tertiary cause).

The increase in the population along the shorelines of the SCS-LME has been attributed to human migration and thereby contributing further to the fundamental problem and primary cause of untreated sewage/run-off, coastal modification, and foreshore development including garbage dumping into the waters of the SCS-LME. However, these movements need to be documented more clearly to determine the degree and extent of their associated impacts.

The other tertiary causes were negligence/lack of compliance (for oil spill), lack of compliance (for coal spill from transport), no compliance (for destructive fishing), and industrial development/demand for building materials, demand for corals as souvenirs/ornamentals, and use of corals for sea ranching (for coastal modification and foreshore development). The other quaternary cause was lack of awareness (for destructive fishing) which eventually pointed to market demand as the root cause, same with that of overfishing (coral reefs and seagrasses).

The other root causes identified, mostly governance-related, were as follows:

a. Poor tourism planning;
b. Poor urban and agri-industrial planning;
c. Absence of or poor land-use planning;
d. Lack of awareness;
e. Lack of enforcement;
f. Poor enforcement of regulations;
g. Poverty;
h. Demand for marine products;
i. Weak or poor management of coastal development/zoning; and,
j. Lack of awareness of environmental cost.

Causes of Problems on Marine Pollution

The immediate causes of pollution in the SCS-LME were varied and associated with discharges from industries, heavy rainfall, households and marine transport (Figure 4.4). These primary causes were:

a. Chemical pollution (heavy metals, pesticides);
b. Suspended solids;
c. Solid waste;
d. Oil spills; and,
e. Ballast water.

For chemical pollution, the following four secondary causes were identified:

a. Dumping of untreated mine tailings (applicable to Indonesia and Philippines);
b. Accumulation of fertilizers and pesticides from agriculture run-offs;
c. Accumulation of fertilizers from aquaculture; and,
d. Dumping of untreated waste water from manufacturing and processing industries.

These narrowed to three tertiary causes and corresponding causal chains, with absence of buffer zones or sewage system accounting for the secondary cause b and c listed above. The other third-level causes were lack of waste treatment and management (for Indonesia and Philippines; for the dumping of untreated mine tailings) and lack of waste treatment and management (for all three countries; for dumping of untreated waste water from manufacturing and processing industries). There were two quaternary causes identified: weak enforcement and monitoring, and low compliance due to high cost of sewage treatment system. The three root causes determined for chemical pollution were as follows:

a. Lack of political will;
b. Weak enforcement and monitoring; non-compliance of some farms on best farming practices; and,
c. Weak enforcement and monitoring.

In the case of suspended solids, the lone secondary cause identified was erosion, sedimentation and siltation (resulting from flooding during heavy rainfall). This generated two chains with tertiary causes of deforestation and degradation of forest, and coastal development and land reclamation. However, both had the same quaternary cause of land use conversion (including land clearing) due to expansion of agricultural production, industrial and residential/settlement areas, and logging, with the root cause of weak land use planning coupled with weak governance.

Solid waste had two secondary causes with separate causal chains; household solid wastes (including non-biodegradable packaging) and dumping of solid wastes from ships. The former was further brought about directly by the root cause of attitude/culture of community with regards to proper waste management and by the following tertiary causes: 1) limited/no access to proper waste management and sanitation facilities (including materials recovery facility [MRF] and recycling facility); and, 2) absence of proper waste management facilities. The main difference between the two was that in the first tertiary cause, there were facilities but their accessibility was constrained or none at all while in the second, there were actually no facilities available. There were three quaternary causes: 1) limited services to waste management facilities (in the case of Indonesia and Philippines); 2) high cost of waste management facility; and, 3) poor planning. The remaining identified root causes were the following:

a. Different policies of member countries (IMP) on solid waste management for coastal settlers
   (Note: In the case of Malaysia, there is the non-inclusive policy for illegal settlers who are denied access to government services.);
b. Lack of funding (in the case of Indonesia and Philippines); and,
c. Weak land use planning coupled with weak governance.

In relation to the dumping of solid wastes from ships, its two tertiary causes were non-compliance of relevant maritime laws by the concerned ships and lack of reception facilities in ports. Their respective root causes were weak enforcement and monitoring, and lack of financing.

As for the primary cause of oil spills, the secondary and tertiary causes identified were marine transportation accidents and inaccurate navigational charts, respectively. It had three causal chains with the following three root causes:

a. Accidents and system failure from oil exploration, production, transport (of oil), and distribution;
b. Negligence of crew; and,
c. Lack of funding to update navigational charts.

The fifth primary cause of ballast water generated two chains starting with the two secondary causes of negligence and poor compliance of some marine transport vessels regarding the proper disposal of ballast water and lack of proper standards for environmental laws and regulations (regarding ballast water discharge). Their respective two tertiary root causes were lack of understanding of the ecological impacts of ballast water discharge and weak technical knowledge as basis for regulation. Only the latter had the quaternary cause of limited research or studies on proper ballast water treatment and disposal and both were attributed to the root cause of lack of funding or investments and lack of willingness to undertake research on the subject issue and concern.

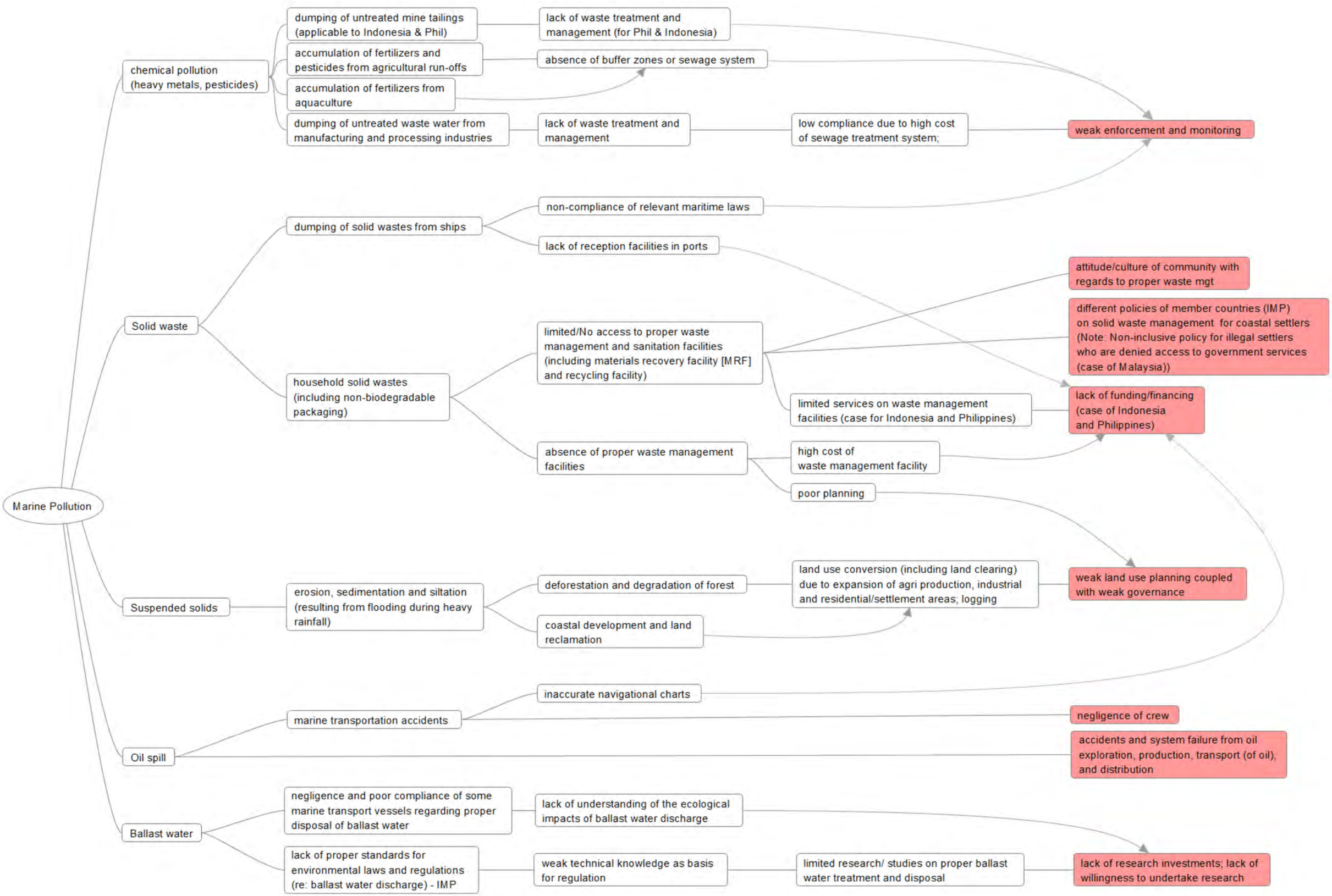


Figure 4.4. Causal chain analysis on marine pollution.

Commonalities among Root Causes

It was observed that many root causes appeared in two or more TPs. The most frequent root causes among the three TPs is given in Table 4.5.

Table 4.5. Most frequent root causes among the three TPs of Unsustainable Exploitation of Fish, Habitat and Community Modification, and Marine Pollution.

Root Cause	No. of times of appearance in the CCA
Weak enforcement and monitoring	8
Lack of funding/financing	4
Human migration	4
Lack of awareness of environmental cost	3
Weak land use planning coupled with weak governance	3
Industrial development	3
Natural variability	3

Weak Enforcement and Monitoring topped the list of root causes, appearing eight times. It is followed, at a frequency of four, by Lack of Funding/Financing and Human Migration. Following them further are Lack of Awareness of Environmental Cost, Weak Land Use Planning Coupled with Weak Governance, Industrial Development and Natural Variability.

This information will serve as a good guide for the three countries on which root causes and areas to focus their plans of interventions on. These will further serve as valuable inputs to the conduct of the Strategic Action Program (SAP) for the SCS-LME.

Analysis of Impacts of Climate Change to the Fisheries of SCS-LME

As mentioned in the beginning of this chapter, this TP was treated differently and focused more on the observed climate change stressors as they impact the fisheries of SCS-LME. Their proximate ramifications and their foreseen ultimate effects on fisheries including socio-economic conditions were analysed based on present conditions. Finally, data gaps to address the challenges in climate change and recommendations for policy and governance were also identified.

4.6.1. Observed or supported manifestations of climate change and their corresponding impacts on fisheries

A summary of the effects of climate change on different systems directly affecting human population is given in Figure 4.6-1. Briefly, with increasing global temperatures, damage from floods and storms will also increase. Moist tropics and higher latitudes may become water logged whereas mid-latitude areas and semi-arid low latitudes are expected to experience freshwater shortage or droughts. Natural ecosystems will experience increased stress (e.g., bleaching of coral reefs) and suffer widespread extinctions at temperature increases higher than three degrees centigrade.

Ecosystems will also undergo dramatic changes because of species migrations and invasions, compromising productivity and food security. There will be substantial burden on health services as lack of food and freshwater become widespread and increase morbidity and mortality as disease vectors also change distribution.

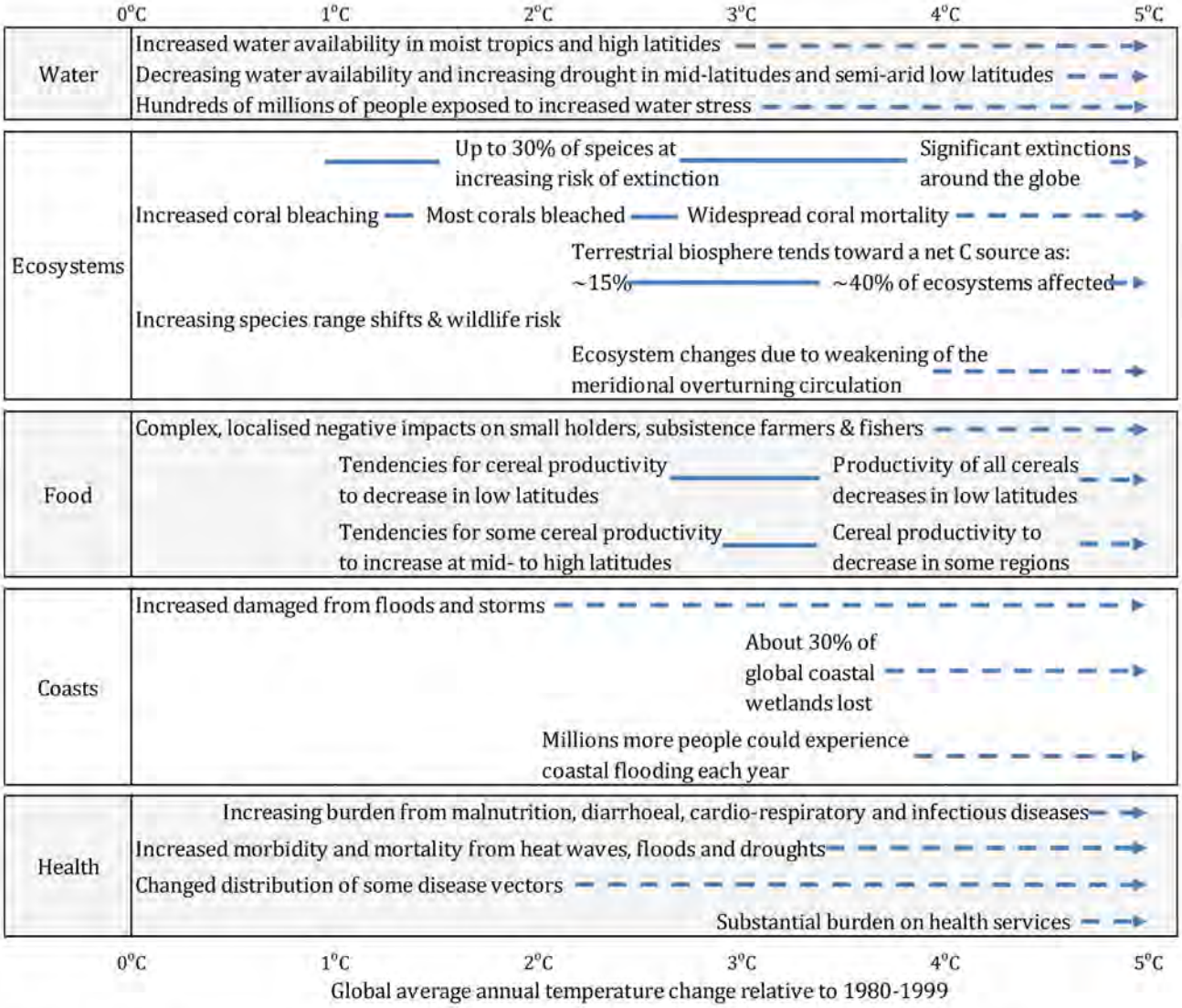


Figure 4.6-1. Projected impacts on systems with increased temperature (IPCC 2007).

The effects of climate change on fisheries and impacts on the socio-economics of the SCS-LME were detailed in a mindmap shown in Figure 4.6-2. Briefly, five climate change stressors were identified with immediate biophysical effects that were almost three times as many. These effects ranged from the physical stress and damage of the environment to the alteration of ecosystem processes. Transitional effects were seen in the changes in ecosystems and the services they provide that ultimately drive local market instabilities. Ultimate effects (the terminal nodes in red) were socio-economic in nature with impacts on lives, health and the economy of the people. Investments and financing were identified needs for new technologies to match the increasing threats of climate change, and cover welfare services and employment opportunities with the sustainable management of natural resources.

Extreme weather events including heavy rainfall

Typhoons emanating from the Pacific that sweep through Southeast Asia have been observed to increase in both strength and frequency (David et al. 2010). Many coastal areas have been negatively affected by this natural force and corals are commonly dislodged, broken and reduced to rubble. Seagrass beds may experience blowouts (see Fourqurean et al. 2003) from wave attack while winds break or topple mangrove trees. Considerable reworking of the coastline can also take place.

Monsoon rains, apart from the rains brought by typhoons, have also been recorded to intensify. Sediment plumes are readily seen from river mouths in many areas and commonly, dissolved nutrients and even solid wastes are brought to the sea. Sediment and solid waste smother coral reefs. Nutrients favor algal growth that competes with coral reefs and seagrass communities or may result to harmful algal blooms that are detrimental to coastal fisheries, mariculture, and especially to people who consume contaminated fish and shellfish (see Nellemann et al. 2008). Rainwater decreases salinity in coastal areas that can also be detrimental to nearshore communities. This freshwater layer that stays above the seawater makes the water column more stable (stratified) and weakens or prevents upwelling where it usually happens and results in the reduction of fisheries production (e.g., Villanoy et al. 2011).

Increased Sea Surface Temperature (SST) and Sea Level Rise (SLR)

The Intergovernmental Panel on Climate Change has clearly affirmed the warming of our climate system (IPCC 2007). More than 2500 scientific experts from 130 countries were in agreement that the global mean temperature increased by 0.74°C from 1906 to 2005. Global average sea level rise from 1961 to 1993 had also increased from 1.8 mm yr^{-1} to 3.1 mm yr^{-1}, with the sea level projected to be 18-59 cm higher by the end of the century.

Coral reefs are sensitive to increases in SST and manifest it by the phenomenon called coral bleaching or the loss of symbiotic microalgae responsible for their (generally brown) color. Coral bleaching can be extensive and may result to mass mortality of corals that in turn could result in an ecosystem phase shift. Coral reefs of the world were effectively reduced by 16% in a mass bleaching event in 1998 (Wilkinson 2000). In other monitoring studies that lasted one to three years described by Pratchett et al. (2008), coral mortalities greater than 50% can shift fish dominance towards the herbivores. This is due to algae that immediately colonize dead corals and become source of food for herbivores. However, unless coral cover is reduced to less than 10%, no dramatic declines in fish abundance and diversity may be observed (Holbrook et al. 2006). The loss of topographic complexity with the decimation of corals affects food availability and shelter for many reef fishes (Pratchett et al. 2008). Analyses by Cruz et al. (2007) indicated that in the next 30 years, 30% of coral reefs in Asia will be lost.

With high confidence, climate experts project shifts in distribution ranges and abundances of algae, plankton, and fish especially with changes in salinity, temperature, water quality, and circulation (Nellemann et al. 2008). High latitude fishes are particularly affected by shifts in thermal regimes (Perry et al. 2005). Species movements (invasions) are likely to alter ecosystem structure and function and may pose further problems if they also harbor pathogens (see Occhipinti-Ambrogi 2007). In small increases in seawater temperatures, larval development may be favored but has a negative effect on the reproduction of adult fishes (Munday et al. 2008). Shifts in time, space, and magnitude of spawning and recruitment will then alter particular fisheries with concomitant socio-economic consequences. In the tropical Pacific, for example, the potential fisheries catch may decrease by up to 40% because of fish redistribution caused by climate change (Cheung et al. 2010).

Coastal inundation with SLR will impact mangrove communities whose dynamics will depend on the health of the forest and its sediment supply. A relatively steep coastal slope can easily deliver sediment to the mangroves that can accumulate it and perhaps keep pace with the rising sea level. SLR will have a greater area of inundation if the coastal slope is gentle. In this situation, mangroves may be forced to retreat. However, in cases where human communities are settled behind mangrove areas and structures like dikes are in place, it is not possible for mangroves to retreat (=coastal squeeze).

Ocean acidification

"The uptake of anthropogenic carbon since 1750 has led to the ocean becoming more acidic with an average decrease in pH of 0.1 units. Projections based on scenarios give a reduction in average global surface ocean pH of between 0.14 and 0.35 units over the 21st century" (IPCC 2007).

In this respect, carbonate based organisms like corals and shells will be compromised with concomitant effects in larval survival and changes in community structure and secondary productivity like fisheries. It is recognized that large-scale impacts on marine systems may be brought about by the interaction of increasing temperatures and acidification but scientific knowledge on this is yet to accumulate (Barange and Perry 2009).

4.6.2. Projected or anticipated implications on the socio-economic sector based on present situation

4.6.2.1. On extreme weather events including heavy rainfall

Destruction or disruption of coastal ecosystems from typhoons leads to the disruption of fisheries including loss of lives and properties and the devastation of infrastructure (IPCC 2007). Disease may also be spread by flooding and contaminate drinking water sources that pose serious health risks. Consistent flooding displaces coastal human communities with heavy costs especially among the poor. Unemployment resulting from business closures (aquaculture) may lead to desperation and could increase irresponsible fishing practices. Further degradation of the coastal environment deepens the poverty trap among poor fishers (e.g., Teh and Sumaila 2007). See also Figure 4.5-2 for details.

Globally, coastal ecosystems (that include both transformed and natural terrestrial and aquatic systems) provide products and services worth US$ 25,783 billion yr^{-1} (Martinez et al. 2007). In another study, the goods and services from coral reefs amount to US$ 29.8 billion yr^{-1} (Cesar et al. 2003), derived from tourism and recreation (US$ 9.6 billion yr^{-1}), coastal protection (US$9 billion yr^{-1}), fisheries (US$5.7 billion yr^{-1}), and biodiversity (US$5.5 billion yr^{-1}). Total net benefits of coral reefs for the Southeast Asian region range from US$23,100-US$270,000 km^{-2} yr^{-1} (Burke et al. 2002). The potential sustainable net benefits from coral reefs derived from fisheries, shoreline protection, tourism, and aesthetic value is estimated at US$1.6 billion yr^{-1} for Indonesia and US$ 1.1 billion yr^{-1} for the Philippines (Burke et al. 2002). In the Turtle Islands Park inSandakan, tourism benefits were estimated at RM 4 million (US$1.32 million) annually (Alin 2007). The diving industry in Sabah generated RM 192.5 million (US$63.9 million) in 2011, employing 2,000 people locally (Alin 2012). Teh and Cabanban (2007) showed that tourism in Pulau Banggi (Malaysian part of SCS-LME) was highly dependent on the local biodiversity and supply of clean freshwater, which can easily be compromised by climate change stressors.

4.6.2.2. On SST and SLR

Alteration of the coastline and being inundated by seawater may force human communities to settle elsewhere. This is costly by itself and the problem will be amplified by potential water-borne diseases and losses in coastal productivity including aquaculture. Again, the need to survive may lead to desperate measures and could increase irresponsible behavior including unsustainable fishing practices, which in turn deepens the poverty trap among the poor members of the community (Figure 4.6-2).

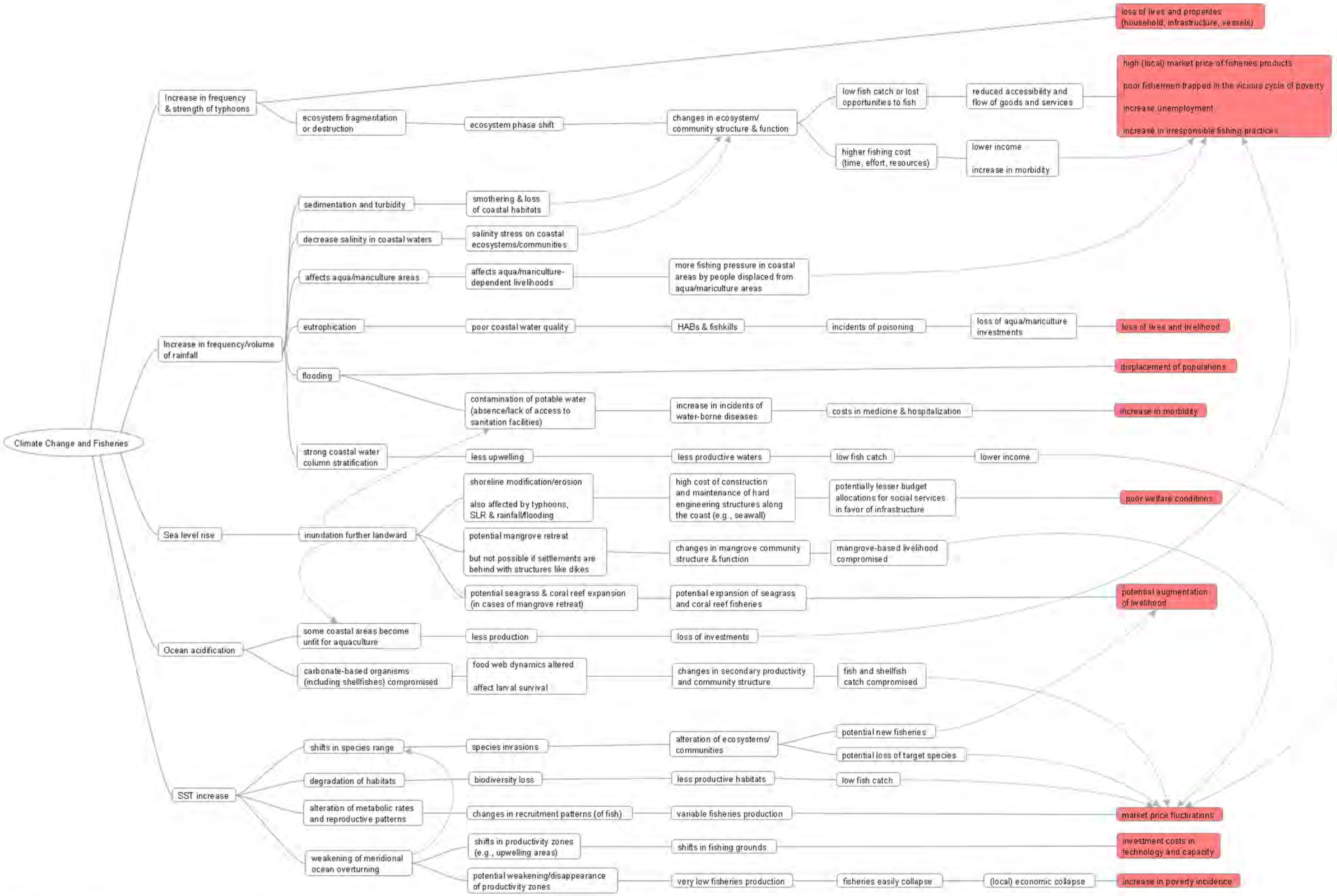


Figure 4.6-2. Mindmap of the biophysical effects of climate change stressors on coastal and marine systems as they affect fisheries with their consequent socio-economic impacts. Rightmost boxes in red are the ultimate socio-economic impacts that are perceived to be driven by climate change.

In the absence of natural barriers, seawalls and structural barriers against storm surge may be necessary to protect coastal human communities and will require huge financial resources for this infrastructure. This need might divert funds intended for welfare purposes or may result to loans (for projects) that will be paid off from the taxes of the general populace.

Development programs in the face of climate change promote ecosystem-based adaptations. Among the strategies is the rehabilitation of the coastal zone by mangrove planting as this has other benefits to the poor coastal dwellers. Table 4.6-1 lists some of ecosystem services derived from mangrove ecosystems. Apart from stabilizing coastal areas and their maintenance function, mangroves also take up carbon dioxide from the atmosphere and provide direct food and livelihood. For example, in the Malaysian part of SCS-LME (in Pulau Banggi), artisanal fishing produced about 7-18 kg fisher^{-1} day^{-1} and together with subsistence fishing amounted to 3,687 tons yr^{-1} (Teh et al. 2007).

Table 4.6-1. Some of the mangrove ecosystem services and their economic values and benefits (adapted and modified from Walters et al. 2008).

Ecosystem service	Values and benefits	Reference (see Walters et al. 2008)
Water quality maintenance (biofilter function)	US$ 5820 ha yr^{-1}	Lal 1990
	US$ 1193 ha yr^{-1}	Cabrera et al. 1998
	7.4 and 21.6 ha of mangroves needed to remove nitrate and phosphorous, respectively, in effluents per ha of intensive shrimp pond	Robertson and Phillips 1995
	1.8–5.4 ha of mangroves needed to remove nitrate in effluents per ha of shrimp pond	Primavera et al. 2007
Environmental disturbance prevention (storm, flood and erosion control)	US$ 4700 ha^{-1}	Costanza et al. 1989
	US$ 3679 ha^{-1}	Sathirathai and Barbier 2001
	US$ 120 per household	Badola and Hussain 2005
Carbon sink	155 kg C ha^{-1} day^{-1}	Clough et al. 1997
	1500 kg C^{-1} ha^{-1}	Ong 1993
Mangrove fisheries		
Irian Jaya, Indonesia	US$ 900 household^{-1} yr^{-1} in subsistence fisheries	Ruitenbeek 1994
Malacca Strait (southern)	constitutes 49% of the total demersal fish resources	Macintosh 1982
Sarawak	10–20% of total catch is from subsistence fisheries in mangroves	Bennett and Reynolds 1993
Godavari Delta, India	50,000 tiger prawn spawner yr^{-1} = US$ 6 million	Ronnback et al. 2003
Developing countries	1-10 tons (~1,000-10,000 US$) of fish & shellfish ha^{-1} yr^{-1}	Ronnback 1999
ASEAN countries	30% of total fish catch and almost 100% of shrimp catch	Singh et al. 1994

UNEP (2005) provided a previous discussion of climate change impacts on the SCS-LME and likely impacts were identified on freshwater shortage, oceanography (due to changes in ENSO), coral reef ecosystems (due to changes in ocean chemistry), and increased SST. Population growth in the area (estimated at 2-3% per year) will accelerate urbanization and increase the extraction of natural resources (especially fishing). Foreign trade will also increase and expand international shipping. Unless safeguards are properly put in place, species introductions are also likely to increase because of the maritime traffic. In the Philippines, this is one of the main and pressing concerns of the Coast Guard (Lt. Cmdr. E.P. De Luna Jr., PCG, personal communication).

4.6.3. Data gaps to be addressed to serve as inputs to policy or management support

- Science and technology that make climate change assessments relevant and meaningful to the human dimensions of time and space
- Near-field climate change stressors like extreme weather events, heavy rainfall and the increase in sea surface temperature need to be addressed for communities heavily dependent on coastal resources while preparing for the impacts of the far-field climate change stressors (like sea level rise). Presently, ecosystem based adaptation efforts are being implemented but their success and replicability need to be shown more clearly.
- For marine fisheries to be sustainable, about 30% of their habitats need to be protected (e.g., Balmford et al. 2004). Large tracts of marine protected areas (MPA) are recommended as opposed to many small ones (Halpern 2003, Alcala 2004) although combinations may be employed through MPA networks (Lowry et al. 2009)
- Mapping and updated status of coral reef habitats are needed together with the adjacent systems and determine to what extent (thresholds) they support each other and the fisheries. Tools in spatial planning are requisite to design strategic management options (e.g., Center for Ocean Solutions 2010)
- How much coastal vegetation, like mangroves and seagrasses, needs to remain is essential information (thresholds) to support both economic growth (like aqua[silvi]culture) and conservation to maintain coastal integrity and resilience (see Walters et al. 2008)
- Science and technology that will enhance habitat restoration
- Many restoration studies especially on coral reefs are still on the experimental stage and small scale only (see Edwards 2010)
- Mangrove reforestation techniques need to fully incorporate results of ecological studies
- Research on new or improved fisheries (including aquaculture/mariculture) technology including fishing gears and methods
- Identification and protection of productivity zones (upwelling areas) including a good understanding of the biology and ecology of the fisheries involved (e.g., Villanoy et al. 2011)
- Research on invasive species and their socio-economic impacts (see Occhipinti-Ambrogi 2007)
- Good communication outreach program targeting behavior change

Given the foregoing, the five "reasons for concern" as a framework to consider key vulnerabilities to climate change according to IPCC (2007) should also be considered, as outlined below:

- Risks to unique and threatened systems
- Risks of species extinction are included here, which should be given adequate protection or listed as among the Red List species
- Risks of extreme weather events
- Projections of strong typhoons and heavy rains should be more accurate to avoid heavy losses
- Distribution of impacts and vulnerabilities
- Specific groups of the community, like the poor, children and elderly, are more vulnerable
- Aggregate impacts
- Over time, costs of impacts of particular climate change stressors especially increased temperature are estimated to increase
- Risks of large-scale singularities
- For example, sea level rise from thermal expansion alone is projected to be greater over longer time scales than is observed for the recent century

4.6.4. Initial recommendations for policy or governance that can be used later in the SAP

Below are two broad considerations for policy or governance directly taken from the IPCC (2007). Some points in section 4.5.3 also need to be considered here.

Increase ecosystem resilience – presently, many coastal ecosystems are already degraded and stressed from anthropogenic activities to the extent that the effects are exacerbated by climate change stressors. Health and integrity of coastal ecosystems need to be restored to enable them to function properly and dampen or resist any stressor. This will include the combination of easing exploitation rates, preventing physical disturbance and massive or chronic pollution.

Adaptation to climate change in the fisheries and aquaculture sectors already exists in the region (Sriskanthan and Funge-Smith 2011). Some of these include:

a. Improving coastal protection systems;
b. Improving design of infrastructure (including housing);
c. Mangrove reforestation and conservation;
d. Relocation of coastal infrastructure, e.g., aquaculture;
e. Mapping hazards with vulnerability assessments; and
f. Improving awareness and knowledge of people.

Increase adaptive capacity – the capacity to adapt is dynamic and is influenced by a society's productive base, including natural and man-made capital assets, social networks and entitlements, human capital and institutions, governance, national income, health, and technology.

Sriskanthan and Funge-Smith (2011) have reviewed the impacts of climate change on the fisheries and aquaculture of the Asian region. They stated that good governance needs to incorporate cross-sectoral concerns (e.g., watershed management) if climate change adaptation is to become effective. Elements of transparency and good governance and some specific policy-level actions for fisheries and aquaculture are given in Table 4.6-2 below.

Table 4.6-2. Some key elements and policy-level actions to strengthen governance and improve adaptive capacity of the fisheries and aquaculture sectors (Sriskanthan and Funge-Smith 2011).

Key elements of transparency and good governance for fisheries and aquaculture:
• Supporting science-based decision-making processes that are responsive and accountable to all stakeholders; • Strengthening key institutions such as fisheries administrations, fisher co-operatives, relevant civil society institutions; • Enabling local government agencies to make specific policy decisions based on differentiated local needs; • Identifying and resolving perverse incentives, which are counter-productive to good governance; • Tackling patterns of corruption and patronage that may lead to decision-making based on short-term vested interests; • Ensuring cross-sectoral collaboration is made possible (e.g. developing multisector decision-making bodies; ensuring fisheries and aquaculture considerations are reflected in key development policies such as national development strategies and poverty reduction strategy papers; removing interdepartmental competition for power and resources); • Incorporating integrated governance approaches, such as integrated coastal management (ICM) and the Ecosystem Approach to Fisheries (EAF) management in policy objectives can assist in making important extrasectoral links. EAF, for instance, can be linked to ecosystem-based adaptation such as the use of coastal ecosystems for shoreline protection that can also contribute to fisheries habitat management, biodiversity protection and the tourism sector (McFadyen and Allison 2009); • Adopting the ecosystem approach to aquaculture, which emphasizes the integration of other sectors, especially the potential of integrated aquaculture-agriculture and aquaculturesylviculture (Troell 2009); and • Developing gender differentiated data on the impact of climate change and emphasizing the capacities of men and women to adapt and mitigate climate changes. A specific focus on the possible advantages of implementing gender-sensitive adaptation projects (IUCN 2007) should be considered.
Some policy-level actions (McFadyen and Allison 2009, cited in Sriskanthan and Funge-Smith 2011):
• Coordinating with agencies responsible for climate change adaptation and disaster preparedness and response policies to ensure that fisheries and aquaculture concerns are integrated in key policies and initiatives (e.g. National Plans of Adaptation or NAPAs); • Capacity building of fisheries and aquaculture line management agencies to take on disaster preparedness and response responsibilities; • Providing technical expertise on fisheries issues to key agencies responsible for disaster relief; • Supporting strategic post-disaster rehabilitation actions that improve the adaptive capabilities of fisheries and aquaculture infrastructure that may have been damaged; • Investing in weather information and storm warning systems; and • Addressing conflicts and synergies presented by adaptation strategies for different sectors in a holistic manner.

5.1. Stakeholder Analysis

Sustainable fisheries management in the SCS-LME requires a concerted effort among institutions and various stakeholders in the region. It is noteworthy that the three countries are working together to address the threats to the shared marine resources of SCS as early as the late 1990s. The SSME Ecoregion Conservation Plan (ECP) has been formulated in 2001 to make way for a collaborative and participatory transboundary management in the SCS-LME. The SCS-SFM Project hopes to enable the member countries to put in place the sub-regional institutional mechanisms to monitor the effectiveness of resource management measures in the marine ecoregion.

5.1.1. Stakeholders at the Regional Level

The three SCS countries are members of fisheries-related regional organizations which have SCS as part of their geographic coverage. These organizations include the BIMP-EAGA (Brunei, Indonesia, Malaysia, Philippines - East Asia Growth Area), SEAFDEC (Southeast Asian Fisheries Development Center), NACA (Network of Aquaculture Centres in Asia-Pacific), and Food and Agriculture Organisation (FAO) of the United Nations (UN). The countries are also members of the Association of Southeast Asian Nations (ASEAN).

Moreover, the countries are members of the Tri-National Committee for the Sulu-Sulawesi Marine Ecoregion (SSME). They are also one of the strongest proponents of the Coral Triangle Initiative (CTI) which includes three other neighboring Pacific island nations. The CTI program has a number of sub-projects where the three countries are also covered. The SCS countries, therefore, have several institutional platforms in their region through which they can pursue their common goal of conservation and sustainable management in the SCS.

5.1.2. Stakeholders at the National and Local Level

Aside from the main fisheries institutions, other government institutions also take part in the management of the resources at the in-country level.

The major national stakeholders of the SCS-SFM Project in Indonesia are the Ministry of Marine Affairs and Fisheries (MMAF) and its relevant subordinate fisheries offices such as the Directorate General of Marine, Coasts and Small Islands and Directorate General of Capture

Fisheries and the Agency for Marine and Fisheries Research (AMFR) as well as Directorate General of Surveillance of Marine and Fisheries Resources (PSDKP). At the local level, the primary stakeholders are the Provincial/District Marine and Fisheries Services and commercial and artisanal fishers in the Indonesian side of the SCS.

The primary stakeholders at the national level in Malaysia are the Department of Fisheries (DOF) of the Ministry of Agriculture (MA) and its relevant offices including the Fisheries Research Institute (FRI). At the local level, the main stakeholders are the DOF Sabah of the Ministry of Agriculture and Food Industry and the commercial and artisanal.

For Philippines, the major stakeholders are the Bureau of Fisheries and Aquatic Resources (BFAR) of the Department of Agriculture (DA) and the National Fisheries Research and Development Institute (NFRDI). The important stakeholders at the local levels are the provincial and municipal agriculture offices, the regional office of BFAR and the commercial and municipal fishers in the Philippine side of the SCS.

In addition, the environment agencies and offices of the local and national governments in Indonesia, Malaysia and Philippines, particularly those involved in the management and conservation of marine resources in the SCS are important stakeholders of the Project.

In addressing the concern on top priority transboundary problems, the following agencies/institutions are involved through policy, regulatory and enforcement functions.

Stakeholders	Policy	Law & Regulation	Enforcement
Unsustainable Exploitation of Fish			
Indonesia			
National Coordinating Agency for Maritime Security		√	√
Ministry of Marine Affairs and Fisheries	√	√	√
Ministry of Foreign Affairs	√		
Provincial Marine & Fisheries Services	√	√	√
District Marine & Fisheries Services	√	√	√
Indonesia Marine Police			√
Indonesia Navy			√
Judicial Institutions		√	√
Malaysia			
Malaysia Maritime Enforcement Agency			√
Royal Malaysia Custom Department			
Marine Dept.			√
Dept. of Fisheries Malaysia	√	√	√
Natural Resource Office		√	
Environmental Protection Dept.		√	
Lands & Surveys Dept.		√	
Sabah Wildlife Dept.		√	
Philippines			
Department of Foreign Affairs	√		
DA-Bureau of Fisheries and Aquatic Resources	√	√	√
Dept of Environment and Natural Resources	√	√	
Local Government Units	√	√	√
Philippine Navy			√
Coast Guard			√
PNP Maritime		√	√
Habitat and Community Modification			
Indonesia			
Ministry of Marine Affairs & Fisheries	√	√	
Ministry of Environment	√	√	√
Agency of National Population and Family Planning	√	√	
Malaysia			
Environment Protection Department	√	√	√
Sabah Parks (only in marine parks)	√	√	√
Land & Survey Department		√	√
Town & Regional Planning Dept.	√		
Philippines			
DENR-PAWB	√	√	√
Local Gov't Units	√	√	√
Protected Area Management Board (PAMB)	√	√	√
DENR-CMMO	√	√	√

Climate Change			
Indonesia			
National Council on Climate Change	√		
Ministry of Environment	√	√	√
Ministry of Forestry	√	√	√
Ministry of Marine Affairs & Fisheries	√	√	√
Ministry of Public Works	√	√	
National Development Planning Agency	√		
Other relevant ministries or institutions	√	√	
Malaysia			
Ministry of Natural Resources & Environment	√		
Ministry of Science, Technology & Innovation	√		
Philippines			
National Climate Change Commission	√		
DA-BFAR	√	√	√
DENR	√	√	√
Marine Pollution			
Indonesia			
Ministry of Marine Affairs & Fisheries	√	√	√
Ministry of Environment	√	√	√
Ministry of Transport	√	√	√
National Development Planning Agency	√		
Environmental Impact Management Agency	√	√	
National Police			√
Provincial Marine & Fisheries Services	√	√	√
District Marine & Fisheries Services	√	√	√
Provincial Environment Services	√	√	√
District Environment Services	√	√	√
Judicial Institutions		√	√
Other relevant ministries or institutions	√	√	
Malaysia			
Dept. of Environment	√		
Environmental Protection Dept.	√	√	√
Philippines			
Environmental Management Bureau of the Department of Environment & Natural Resources	√	√	√
Local Government Units	√	√	√
Fertilizer & Pesticide Authority of the Department of Agriculture	√	√	√
Dept. of Science & Technology	√	√	√
Dept. of Health	√		
National Commission for Culture & the Arts	√		
MARINA-DOTC	√	√	√

5.1.3. Other Key Players

Non-government organizations (NGOs) at the local, national, and international levels also play important roles in the management of fisheries and aquatic resources in the SCS countries, particularly in Indonesia and Philippines and to a lesser extent in Malaysia. These non-government stakeholders are usually involved in many phases of fisheries management, such as project planning and implementation and receive funding from local, national, and international sources.

In addition to NGOs, numerous private entities such as fisheries stakeholder organizations and community groups actively involved in fisheries management exist particularly in Indonesia and Philippines at both the local and national level. Moreover, private fishing companies' participation in the SCS fisheries management is also increasing.

5.1.4. Stakeholders' Challenges and Considerations

Despite the ecological and economic importance of the SCS-LME, several threats, obstacles and considerations that impede the effective stakeholder participation in the SCS-SFM were identified, such as: fund and time constraints; limited facilities and power; rapid staff turnover; language barrier; large area coverage; limited training; large bureaucracy, and; conflicting objectives and mandates.

Though national governance institutions are in place for fisheries management in the three SCS countries, overlapping duties and functions among institutions remain to be a concern. This hinders the efficient discharge of overall government services in the fisheries sector in the SCS countries. Efforts to streamline these institutions for a more efficient and cost effective management have been initiated, but remains to be an issue.

5.1.5. Mechanisms for Stakeholder Participation

To allow for strengthened stakeholder participation, the respondents of the Stakeholder Participation Review and Analysis preferred the following modes of their participation in the SCS SFM Project:

a) ***Information access and sharing***- The stakeholders in general want to be kept informed and updated on the progress and developments in the implementation of the SCS-SFMP. They also want these updates on a timely basis through the best available means of communication.

This can be achieved through various mechanisms such as: project website; project newsletter; regional/national/local meetings and symposia; regional/national working groups; e-mail list-serves/group e-mail lists; on-line discussion forums; and web-based information sharing tools, among others.

b) ***Opportunities to provide inputs***- The local and national stakeholders want to be given the opportunity to provide inputs and comments on processes related to the

implementation of the Project particularly those which result to outputs that they can significantly impact or can impact them.

At the local level, the processes that are vital to the stakeholders are those that relate to the implementation of the Project demonstration sites and the strengthening of local institutions. At the national level, the stakeholders are particularly interested to provide inputs into the policy-making processes as well as those involving the strengthening of national institutions. At the regional level, the stakeholders are particularly interested in the strengthening of regional institutions and regional collaborative agreements. In achieving this, stakeholders' participation must be ensured during meetings and consultations from regional to the local level.

c) ***Involvement in project activities***- Stakeholders are also interested in direct involvement in some activities of the Project such as participation in research and training activities for the academe and involvement in training and other capacity building activities for the local NGOs. Finally, participation in the implementation of the demonstration sites was also suggested, while collaboration with existing players on project implementation is also encouraged.

5.1.6. Stakeholder Participation, Monitoring and Evaluation

The stakeholders of the project preferred a combination of mechanisms for generating and providing feedback regarding their participation in the Project. The proposed mechanisms included, among others, e-mail queries through the project newsletter. Feedback will be generated and provided through periodic meetings among stakeholders.

5.2. General framework of governance and environmental protection

5.2.1. Indonesia

Indonesia is a democratic republic with a presidential form of government. The Indonesian political system is based on the *Trias Politica* that recognizes the separation of the legislative, executive, and judicial powers. The legislative power is vested in the People's Consultative Assembly (Majelis Permusyawaratan Rakyat or MPR) that consists of two houses namely the House of Representatives (Dewan Perwakilan Rakyat or DPR) - composed of representatives of political parties; and the Regional Representatives Council (Dewan Perwakilan Daerah or DPD) - composed of representatives from each province. Each province is represented by four delegates that are elected by the people in the respective region. The executive branch is centralized on the president, vice president, and the cabinet of ministers. The judicial powers - since the reform era and after the amendment of the 1945 Constitution - are administered by the Supreme Court, the Judicial Commission, and the Constitutional Court, including the administration of the judges. However, the presence of the Minister of Justice and Human Rights is retained.

The central government is the highest level in government structure while the province is the highest tier of local government headed by a governor with its own legislative body. Provinces

and districts have local fisheries offices and local fisheries regulations can be made at the provincial and district levels of government.

In the context of national laws and regulations, and in terms of conservation and environment, the discussion on the hierarchy of domestic laws and regulations and the issue of decentralization should also be considered. According to Article 7(1), Law number 12 of 2011 concerning the Making of Law, the type and hierarchy of regulations consist of:

a) 1945 Constitution;
b) MPR (People's Consultative Assembly) Decree;
c) Laws or Government Regulations in Lieu of Laws;
d) Government Regulation;
e) Presidential Regulation;
f) Provincial Regulation;
g) Regional/Municipal Regulation.

The 1945 Constitution of Indonesia, amended four times, has provided for the protection of the environment in Article 28H. The Constitution was then followed by Law Number 32 Year 2009 regarding the protection and management of environment. The vision of Indonesia's government for the period 2009-2014 is that of a country which is prosperous, democratic, and just. The mission is to continue with the development towards a prosperous Indonesia, to strengthen the pillars of democracy and justice dimension in all fields. The vision and mission are formulated and elaborated more operationally into the 13th priority action programmes. Amongst those action programmes, the Government of Indonesia considered the environment as its 11th priority, i.e., Field Environment Sector. In pursuing this environmental priority, the government has three measures:

a) Fix the damaged environment and prevent natural disasters by conducting afforestation, reforestation, and watershed improvement;
b) Develop sustainable and environment-friendly strategies with the purpose of reducing the threat and impact of global climate change; and
c) Involve and engage the entire community, households, and businesses to actively protect the environment to ensure sustainable economic growth.

In recent years, laws, policies, and institutions in general have been focused on the issues of democracy and decentralization. According to the World Bank report, numerous environmental management and natural resource management aspects have been incorporated into decentralization at the local level. Positive and negative impacts of decentralization on these issues have been identified. More control by local authorities lead to more political will, better programmes, cooperation amongst agencies, empowerment of public, and environment integration in spatial planning are some of the positive implications. Lack of funding and capacity are the main drawbacks of decentralization.[1]

[1] World Bank, "Investing in a More Sustainable Indonesia", Report No. 50762-ID, Country Environmental Analysis, 2009. Josef Leitmann et al. 2009. Investing in a More Sustainable Indonesia: Country Environmental Analysis. CEA Series, East Asia and Pacific Region. Washington, DC: World Bank. Page xii, Executive Summary.

5.2.2. Malaysia

Malaysia is a federal parliamentary democracy headed by a constitutional monarch. The powers of state governments are limited by the federal constitution. Malaysia has three branches of government: Executive - headed by a Prime Minister and cabinet members appointed by the prime Minister from among the members of Parliament with consent of the paramount ruler; Legislative -the Malaysian parliament that consists of elected House of Representatives (*Dewan Rakyat*) and appointed Senate (*Dewan Negara*) members; Judicial - comprised of the Supreme Court with judges appointed by the *Duli Yang di Pertuan Agong* on the advice of the Prime Minister. The legal system practiced in Malaysia is based on the English Common Law, with judicial review of legislative acts in the Supreme Court at the request of the Head of the federation.

In Malaysia, Part VI of the Federal Constitution governs the relations between the federation and the states. Article 74 together with the Ninth Schedule of the Constitution deal with the distribution of legislative powers between federal and state governments. The Federal Constitution provides Federal, State, and Concurrent Legislative Lists that distribute legislative powers. The Federal Constitution prescribes laws that may be made by Parliament Legislatures and laws that may be made by State Legislatures based on the Federal and State Lists. Laws that could be made by either the Parliament or State Legislative Assemblies are stated under the Concurrent List. However, the Federal Constitution does not explicitly demarcate the boundaries of federal and state powers over environmental issues.

Environmental protection is a relatively recent character and is not mentioned as a subject in any of the three Legislative Lists. Environmental issues could be related to various subjects in the Federal, State and Concurrent Legislative lists. All matters related to land, including land under water are under state jurisdiction. Pertaining to land matters, the State List includes land improvement and soil conservation, agriculture and forestry; and water, including rivers, canals, riparian rights, turtles and riverine fishing. The Concurrent List includes the protection of wild animals, birds, national parks, drainage and irrigation and rehabilitation of land that has suffered soil erosion. This multi-dimensional character of environmental issues has led to various grey areas on the distribution of responsibility for combating air and water pollution. Further, air and water pollution, whether federal or state subjects, endanger the same environment throughout a certain state or even the country. Thus, it is difficult to ascertain the extent to which air and water pollution is caused by the activities that come under federal jurisdiction or by the activities of the state governments on subjects in the State List. Subsequently, it is not possible to determine exactly the extent of responsibilities that the federal and state governments should act on. This has also contributed to the fragmentation of enforcement bodies among federal and state agencies.

Under the terms of the federation, Sabah and Sarawak are self-governing states that retain certain constitutional prerogatives. The State Government of Sabah has autonomous authority over its land resources including forestry, wildlife and marine areas. There are 24 districts and each is administered by a District Officer. The District Officer and the Assistant Collector of Land Revenue at the district level enforces the Land Ordinance Cap.68 and Land Acquisition Ordinance Cap.69. What is unique in the local governance is that the system also caters for a Native Court system, (one of only three Native Courts in the world) headed by the *Ketua Daerah*. The local village heads (*Ketua Kampung*) in the district are accountable to the *Ketua Anak Negeri*.

5.2.3. Philippines

Philippines is a unitary, democratic and republican state. The Constitution, adopted in 1987, is the highest law of the land. A bicameral Congress enacts national laws, which the President, as head of the Executive Branch, implements. The Supreme Court heads the judiciary, which is the final arbiter of legal conflicts and interpretation of the Constitution. All national laws and executive regulations implementing such laws must be consistent with the Constitution.

The Constitution guarantees the right of the people to health and a "balanced and healthful ecology consistent with the rhythm and harmony of nature." All natural resources, including minerals, waters, fisheries, belong to the State, and utilization is generally reserved for Filipinos, except for large-scale financial and technical assistance agreements involving mineral and petroleum resources.[2] In the case of fisheries, utilization is reserved exclusively for Filipino citizens, with priority given to subsistence fishermen and protection against foreign intrusion.[3] Philippines has passed a comprehensive set of environmental laws covering, among others, environmental impact assessment, biodiversity, wildlife, fisheries, pollution, waste management, climate change and disaster risk reduction and management. The lead environmental agency is the Department of Environment and Natural Resources; other government agencies are responsible for specialized fields (such as fisheries), or specific areas (such as Laguna de Bay). The Supreme Court has recently promulgated new Rules of Procedure for Environmental Cases.

Philippines is divided geographically and politically into local government units (LGUs) – i.e. provinces, cities, municipalities and *barangays* (villages) - created by law. LGUs enjoy constitutionally guaranteed autonomy under the general supervision of the President. The Local Government Code of 1992 (Republic Act No. 7160) sets the general powers and functions of LGUs, including levying taxes, generating other revenues and sharing in benefits from the use of natural resources. Congress may delegate other powers and functions to LGUs by special laws, such as specific responsibilities to manage natural resources and protect the environment. Local legislative councils (*Sanggunian*) may enact ordinances and resolutions consistent with the powers and functions delegated by Congress in the relevant national laws. Special provisions in the Constitution recognize autonomy in Muslim Mindanao.[4] The Autonomous Region in Muslim Mindanao (ARMM) currently includes the provinces of Lanao del Sur, Maguindanao, Basilan (except Isabela City), Sulu, and Tawi-Tawi. The municipal waters under the jurisdiction of ARMM local governments are all part of the SCS-LME.

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[2] Philippine Constitution, Art. XII, Sec. 2

[3] Philippine Constitution, Art. XII, Sec. 2; Art. XIII, Sec. 7.

[4] Philippine Constitution, Art. X, Sec 15.

5.3. Policy Analysis

Some of the identified priority transboundary problems may be localized and may be addressed independently through national policies that follow international best practices and experiences that the three countries can share. Other identified priority transboundary problems require closely coordinated, but separate, national policies (e.g., law enforcement against destructive fishing methods). This section looks at these common problems and the corresponding independent and coordinated national strategies used by the three countries. Still other problems can be addressed only by targeted international cooperation or agreement (e.g., management of shared fish stocks). A list of international cooperative mechanisms is given in Table 5.3-1, to which SCS countries are signatories, that addresses the 5 transboundary problems identified.

Table 5.3-1. List of international cooperative mechanisms addressing the transboundary problems (TP) (1=unsustainable exploitation of fish; 2=habitat and community modification; 3=freshwater shortage; 4=pollution; 5=climate change) to which Indonesia (I), Malaysia (M), and Philippines (P) are signatories.

#	International Cooperative Mechanisms	Country			TP
1	Convention Concerning the Protection of the World Cultural and Natural Heritage, 1972	I	M	P	1
2	United Nations Convention on the Law of the Sea (UNCLOS 1982)	I	M	P	1
3	Convention on the Territorial Sea & Contiguous Zone	I			1
4	Convention for the Conservation of Bluefin Tuna	I		P	1
5	Basel Convention on the Transboundary Movement of Toxic and Hazardous Wastes and Their Disposal	I	M	P	2
6	Convention of Migratory Species of Wild Animals (The Bonn Convention) (1983)	I	M	P	2
7	Convention on the International Trade of Endangered Species of Wild Flora and Fauna (CITES) (1973)	I	M	P	2
8	United Nations Convention Relating to the Status of Refugees			P	2
9	Convention on Biological Diversity (CBD)	I	M	P	2
	* Nagoya Protocol	I			2
	* Cartagena Protocol on Bio-Safety				2
10	Ramsar Wetlands Convention	I	M	P	3
11	International Convention of 1973 for Pollution Prevention caused by Navigation and Protocol of 1978 (MARPOL)	I	M	P	4
12	International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea, 1996 (HNS Convention)		M		4
13	Stockholm Convention on Persistent Organic Pollutants (POPs)	I	M	P	4
14	International Convention on Civil Liability for Oil Pollution Damage, 1969	I	M	P	4
15	United Nations Framework Convention on Climate Change UNFCCC)	I	M	P	5
	*Kyoto Protocol				5
16	Montreal Convention	I	M	P	5
	* Montreal Protocol on Substances that Deplete the Ozone Layer				5
	* Vienna Protocol				5
17	Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade	I	M	P	5

18	London Convention (Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter, 1972)	I	M	P	5
19	Association of Southeast Asian Nations (ASEAN)	I	M	P	5
	* Treaty of Amity and Cooperation in Southeast Asia	I	M	P	1-5
20	World Trade Organization (WTO)	I	M	P	1-5
21	BIMP-EAGA	I	M	P	1-5
22	The Asia-Pacific Fishery Commission Agreement	I	M	P	1-5
	*IPOA Management and Conservation of Sharks		M		1
23	Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea, of 10 December 1982, relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks.	I	M	P	1
24	Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security	I	M	P	1,2,4
25	Manila Declaration on Strengthening the Implementation of Integrated Coastal Management for Sustainable Development and Climate Change Adaptation in the Seas of East Asia Region	I	M	P	2,5
26	SEAFDEC Regional Guidelines of Fisheries Management for Responsible Fisheries in the Southeast Asia	I	M	P	1-5
27	International Plan of Action for the Management of Fishing Capacity (IPOA-Capacity)	I	M	P	2
28	The Turtle Island Heritage Protected Area (TIHPA)		M	P	2
29	ASEAN Agreement on the Conservation of Nature and Natural Resources	I	M	P	2
30	ASEAN Agreement on Transboundary Haze Pollution	I	M	P	5
31	FAO Code of Conduct for Responsible Fisheries (the FAO Code of Conduct)	I	M	P	1

Identified Priority Transboundary Environmental Problems

5.3.1. Unsustainable exploitation of fish

Transboundary relevance

For tuna and other small pelagic fishes (e.g., sardines and mackerels), studies have shown that stocks are shared among the three countries in the SCS-LME. Thus, management interventions have to be complementary and/or integrated across borders. On the socio-economic side, the tuna and sardine industries in the Philippines are more advanced than those of Indonesia and Malaysia in the SCS LME. However, Philippine fleets have traditionally crossed borders, legally or otherwise; even Indonesian and Malaysian fishing vessels are manned by Filipino captains and crew.

The regional fisheries management organizations have been effective forums for sharing of information regarding shared or straddling stocks, and for developing and implementing conservation measures. The Philippine government and private fishing industry have been very active in the meetings of the various Commissions. Philippines is pushing for the lifting of the ban on tuna fishing activities in Western Pacific high seas. The Western and Central Pacific Fisheries Commission (WCPFC) imposed a fishing ban (2008-2011) to allow populations of tuna

species and other marine life to recover. Last year, Philippines called for the establishment of a Special Management Area in High Seas Pocket 1 where Philippine fishing vessels may be allowed.

Existing national policy responses

Indonesia

Indonesia has Law Number 31 of 2004 as amended by Law Number 45 of 2009 as legal instrument for fisheries arrangement. Article 9 (1) of Law Number 45 of 2009 provides the prohibition of any person to possess, control, carry, and use fish catching means and/or auxiliaries on fish catching ships in the fishery management zones of Indonesia that disturb and damage the sustainability of fish resources. In order to control the fish catching activities, the license is compulsory except for small-scale fishers. Article 35A (1) states that fishing ships flying Indonesian flags to catch fish in Indonesia's fishery management zones shall employ master and crew from Indonesia. Article 35A (2) states that fishing ships flying foreign flags catching fish in Indonesian EEZ (IEEZ) shall have at least 70% of the total ship's crew as Indonesians. The related domestic laws on IUU fishing cover activities within territorial seas and IEEZ, but not in high seas. The management of IUU fishing activities by Indonesia fishing vessels shall be strengthened through the amendment of Ministerial Regulation Number PER.03/MEN/2009 regarding the catching and/or transporting fish in the high seas. Indonesia is a member of the Commission for the Conservation of Southern Bluefin Tuna (CCSBT), Indian Ocean Tuna Commission (IOTC) and a non-cooperating member of Western and Central Pacific Fisheries Commission (WCPFC).

It was hoped that the enactment of Law No. 31 of 2004 as amended by Law Number 45 of 2009 regarding Fisheries and the Autonomy Law (Law No. 32 of 2004 regarding Local Government), would give better legal basis in managing and governing marine affairs and fisheries in Indonesia in an effort to promote sustainable fisheries management and governance. Moreover, the latter adopts and implements the principle and process of "decentralization" which is hoped to be better than the centralized approach. However, many problems and conflicts have arisen in implementing the process of decentralization, specifically in terms of the relationship between central and provincial government in governing fisheries -- aquaculture, processing, controlling, and capture fisheries, among others.

The authority of the regions to manage resources in the sea territories as meant in paragraph (a) of Law No. 32 of 2004 covers:

a) exploration, exploitation, conservation and management of marine resource;
b) administrative control;
c) spatial layout control;
d) law enforcement related to the regulations issued by the regions or delegated by the government;
e) participation in maintaining security; and
f) participation in defending the state sovereignty.

The authority to manage resources in the sea territory as meant in paragraph (c) must not exceed twelve nautical miles measured from the coastline to the open sea and/or to the waters of islands for provinces and one-third of the territorial jurisdiction of a province for regencies/municipalities.

If the sea territory between two provinces is less than twenty four nautical miles, the authority to manage resources in the sea territory will be divided at the same distance or measured in accordance with the principle of median line from the area between the two provinces, with the regencies/municipalities receiving one-third of the territorial jurisdiction of the said province.

Law No. 33 of 2004 complements Law No. 32 of 2004 regarding Financial Balance between Government and Local Government. Article 14.d states that, of the revenues from fisheries received on a national basis, the Government shall receive twenty percent (20%) while eighty percent (80%) shall be apportioned to all districts.

Besides the two laws mentioned earlier, Indonesia enacted Law No. 31 of 2004 regarding Fisheries which was amended by Law No. 45 of 2009. It also has provision on the possibility of delegating some of fisheries affairs to local government as stated in article 65 that the government could give co-governance fisheries tasks to local governments.

The following are several related domestic laws and regulations:

a) Law Number 5 Year 1983 regarding Indonesia Economic Exclusive Zone;
b) Law Number 6 Year 1996 regarding Indonesian Waters;
c) Government Regulation Number 38 Year 2002 as amended by 37 Year 2008 regarding the List of Geographical Coordinates of the Base Points of Indonesia Archipelago;
d) Regulation of the Minister of Marine Affairs and Fisheries, Number PER.5/MEN/2007 regarding Vessel Monitoring System;
e) Regulation of the Minister of Marine Affairs and Fisheries, Number PER.1/MEN/2009 regarding Fisheries Management Zone (WPP);
f) Regulation of the Minister of Marine Affairs and Fisheries, Number PER.03/MEN/2009 regarding the catching and/or transporting of fish in the high seas;
g) Regulation of the Minister of Marine Affairs and Fisheries, Number PER.07/MEN/2010 regarding Fishery Vessel Seaworthiness License.

The policies taken by the Government of Indonesia in dealing with the issue is the management of marine and fisheries resources in a sustainable manner by, *inter alia*, making Indonesia free from IUU fishing and other destructive activities. The targeted percentage reduction of IUU fishing practices in fisheries management areas has been set by the government until 2014. The management of marine and fisheries has been placed as one of the strategic goals of Ministry of Marine Affairs and Fisheries of Indonesia (MMAF).

In order to achieve the goal as mentioned in point b above (Law No. 6 of 1996), MMAF established the Director General of Surveillance of Marine and Fisheries Resources (PSDKP). Its programs are:

a) The enhancement of Fisheries Resources Surveillance Activities;
b) The enhancement of Marine Resources Surveillance Activities;
c) The enhancement of Maintenance and Activities of Observers on Board;
d) The development of Superstructure and Infrastructure of Surveillance of Fishing Vessels;
e) The Cessation of Criminal Acts on Marine and Fisheries; and
f) Support Enhancement for Management and other Technical Duties of Ditjen PSDKP.

Malaysia

Fisheries management in Malaysia is governed by the Malaysian Fisheries Act (1985). Under this Act, provisions pertaining to fishing effort regulations include limited entry through licensing, minimum mesh sizes, minimum harvesting of cockles, prohibition of destructive fishing gears, and fishing zones defined by vessel size, engine power, and method of fishing.

The fisheries industry in Malaysia can be divided into three sectors: marine fisheries, aquaculture and public water bodies. For management purposes, the marine fisheries sector has two subsectors: inshore and off-shore (or deep-sea) fisheries. The inshore fishery subsector comprises fishing vessels below 70 gross tons (GRT) operating various types of gears in both inshore and coastal waters. The deep-sea fishery subsector includes fishing vessels more than 70 GRT which operates beyond 30 nautical miles from the coast and uses various types of gears including trawl, purse seine, long lines, and drift nets. With the declaration of the 200 nautical miles EEZ in 1984, fishing grounds in Malaysia increased by almost 3.5 fold from 47,000 square nautical miles to 162,000 square nautical miles.

At the federal level there are two government institutions dealing with marine fisheries namely the Department of Fisheries Malaysia (DOFM) and Malaysian Fisheries Development Board (LKIM or Lembaga Kemajuan Ikan Malaysia). Both agencies are under the Ministry of Agriculture. Department of Fisheries Malaysia is entrusted with the development and management of the fisheries industry, and LKIM is entrusted to increase the living standards of small scale fishing communities in the country including provisions of infrastructure for fish landings, ecotourism, marketing of fish and fishery products and licensing for imports and exports. However, in the case of Sabah, the development and management of fisheries fall under the jurisdiction of the Department of Fisheries Sabah (DOFS) and *Ko-Nelayan* (that has the same role as LKIM), under the state Ministry of Agriculture and Food Industry of Sabah. In Sarawak, marine fisheries is under the purview of DOFM except the inland and estuarine fisheries, which is a concurrent state matter that comes under the state Department of Agriculture.

While, the management and development of fisheries in Sabah is strictly a state matter, the Fisheries Act has certain provisions for the management and conservation of fisheries (Biusing 2001). This is desired and targeted by the Government and guided by several major policies. At the national level, the Third National Agriculture Policy, which covers the period 1999 to 2010, is the main policy whose main thrust is to seek the transformation of the agriculture sector to be one that is modern, dynamic, and competitive. This policy seeks to modernize the smallholder sector and ensure sustainable agriculture and forestry, sufficiency in the supply of high quality food, increase private-sector participation, and maximize the utilization of finite resources such as land and water. At the state level this national policy is given effect through the Second Sabah Agriculture Policy (DPNS2), which covers the same period. This state policy aims to turn Sabah into one of the major food production centers in Malaysia as well as transform the agricultural sector into a modern, efficient, sustainable, dynamic and commercially-oriented and competitive sector.

The two policies above are guided by the more encompassing policies such as the National Vision Policy and the Third Outline Perspective Plan. The Second Sabah Agriculture policy focuses on the development of three main subsectors, namely agriculture, fisheries and livestock. The deep sea fisheries, aquaculture and fish processing sector are emphasized as key growth areas.

Sustainable use and development of natural resources and fisheries stocks are also stressed. Human resource development as well as the improvement and upgrading of the livelihood of fishers and farmers are also important policy priorities. The increased production of food in the local fisheries and aquaculture sector is also given equal emphasis.

Philippines

The legal framework for managing fisheries in Philippines is the Fisheries Code of 1998 (Republic Act No. 8550) that declares, among others, the following priorities:

a) to achieve food security as the overriding consideration in the utilization, management, development, conservation and protection of fishery resources in order to provide the food needs of the population;
b) to limit access to the fishery and aquatic resources of the Philippines for the exclusive use and enjoyment of Filipino citizens;
c) to ensure the rational and sustainable development, management and conservation of the fishery and aquatic resources in Philippine waters including the Exclusive Economic Zone (EEZ) and in the adjacent high seas, consistent with the primordial objective of maintaining a sound ecological balance, protecting and enhancing the quality of the environment; and
d) to protect the rights of fishers, especially of the local communities with priority to municipal fishers, in the preferential use of the municipal waters. Such preferential use, shall be based on, but not limited to, Maximum Sustainable Yield (MSY) or Total Allowable Catch (TAC) on the basis of resources and ecological conditions, and shall be consistent with commitments under international treaties and agreements.

Enhancing fisheries stocks by protecting habitats is also a major thrust of the Fisheries Code, including:

a) Regulation of conversion of mangroves (Sec. 94), with current emphasis on the reversion of abandoned or non-producing fishponds;
b) Establishment of closed seasons (Sec 9), such as the annual closed season for sardines and mackerels in the Visayan Sea (FAO 167, s. 1989); and
c) Establishment of fish refuge and sanctuaries (Sec. 81), implemented by local governments.

Policy gaps, weaknesses, and challenges

The Coral Triangle Initiative facilitates the preparation of National Plans of Action (NPOA) formally adopted in containing specific goals, targets and actions for protection and sustainable use of coral reefs and fisheries for food security. Philippines, Malaysia and Indonesia have committed to implement the NPOA as part of their contributions to the CTI.

Overall, the SCS countries place priority in formulating policies to ensure sustainable fisheries' stock. Complementary to habitat restoration and management, countries are allocating more resources and personnel for regular and intensified law enforcement against illegal fishing activities and habitat destruction through strengthening of deputized fish wardens, providing financial incentives, patrol boats and other equipment.

Addressing IUU Fishing practices in Indonesia is not only through law enforcement but also through public involvement by adopting Ministerial Regulation Number 58/MEN/2001 concerning the System of Public Monitoring (Sistem Pengawasan Masyarakat or SISWASMAS) which then establishes the Assemblage of Public Monitoring (Pos Pengawasan Masyarakat or POSWASMAS) as a mechanism for community-based management of resources. In Philippines, local governments intend to further enhance fisheries law enforcement through inter-agency and local government coordination using agreed protocols. High cost of law enforcement greatly limits the ability of the government to curb destructive fishing and overfishing. At present, the burden of law enforcement is borne by volunteer local groups known as Bantay Dagat. The success of such volunteer groups hinges on effective training (partnership with civil society advocates, academe, and BFAR), logistics support by LGUs, and armed support by police or military forces.

In Malaysia, statistics from the Department of Fisheries show that the number of cases of illegal activities that were reported and prosecuted do not tally with the sightings and occurrences of illegal activities. Communities and fishery managers recognize that the illegal activities under prosecution are only a fraction of the actual situation, apparent from the extensive impact to the environment by blast fishing. For example, between 2009 and 2010, the number of cases of fishing with explosives and poisons or found in possession of prohibited fish was thirty-one and four, respectively—a very conservative number.

Complementary to addressing the environmental concerns, countries are pursuing policies to develop and implement a comprehensive framework for alternative or supplemental livelihood for marginal fishers to reduce fishing pressure in depleted fishing grounds. In Philippines, BFAR is to initiate the formulation of this framework in partnership with DENR, LGUs and the academe.

Malaysia is involved in the Code of Conduct for Responsible Fisheries (CCRF) that also leads to the implementation of codes of conduct for aquaculture practices and fishing. New policy thrusts in agriculture (including fisheries and aquaculture) production and processing, and market development are also included in the new Third National Agriculture Policy (NAP3). The Sabah Development Corridor Blueprint has identified the development of mariculture and sustainable techniques for local fishers.

There is an urgent need to develop strong science-based policy formulation and monitoring and evaluation (M&E) systems. Given the government's lack of resources and the emergence of expertise in academe and industry, scientific studies and monitoring should be done in partnership among stakeholders. Despite the clear mandate in the Fisheries Code, the Philippine government has yet to determine the total allowable catch or maximum sustainable yield for even the most important fisheries stocks. Without this reference numbers, regulators cannot set catch limits either by limiting fishing effort of fleets or reducing the number of issued permits. As stated in Indonesia Fisheries Book 2011, the maximum sustainable yield is approximately 6.4 million tons per year while its total allowable catch is estimated about 80% amounting to about 5.12 million tons annually. The Malaysian government has not determined the total allowable catch or maximum sustainable yield for important stocks. There is just insufficient data to derive the figures.

Recent studies on sardines (e.g., Willette and colleagues 2011) show that different sardine species have different distribution ranges, often beyond the particular fishing ground being

managed with closed season regulations. The implication is that geographic or temporal fishing regulations have to consider the life cycles and distributions of the targeted species. In the absence of scientific studies, management interventions may not be effective.

In light of the frequent reports of poaching by fishers from as far away as Vietnam and China, the governments should step up development of untapped fishing grounds and support technologies that will allow the local fishing industry to develop high value products for new markets. Indonesia is signatory to Port State Measure on IUU Fishing and is in the process of ratification. The measures to combat IUU fishing would be more effective if this effort is also followed by Philippines and Malaysia.

Corruption is also cited as a major barrier to policy responses. There are no official data, but there are many anecdotes that describe how local officials connive with illegal fishing operators. There are also reports of extortion by law enforcement groups and local officials. In the ARMM region of the Philippines, "official receipts" are issued by incumbent officials for "permits" that turn out to be unauthorized and rejected by succeeding officials. In Indonesia, the cases disclosed are fake licenses and unlicensed foreign vessels doing fishing related activities. These reports are undocumented and unverified, especially when corruption is at the borders.

5.3.2. Habitat loss and community modification

Transboundary relevance

Habitat loss and community modification is a common problem faced by all three countries of the SCS-LME. With few exceptions, the problem appears to be localized and can be addressed through national policies. However, the cumulative effects of localized problems contribute to the deterioration of the entire large marine ecosystem. Therefore, the three countries could adopt common strategies or approaches to address the issues, tailored to their respective local policy frameworks.

The Turtle Island Heritage Protected Area (TIHPA) was established in 1996 and is possibly the first entirely marine transboundary conservation initiative in the world.[5] Administered by Sabah Parks (Malaysia) and Department of Environment and Natural Resources (Philippines) with technical assistance from the Institute of Biodiversity and Environmental Conservation at the University Malaysia Sarawak, Malaysia, TIHPA is aimed at protecting sensitive turtle nesting beaches and surrounding coral reefs, seagrass beds, and other marine ecosystems (COBSEA 2010).

Coastal habitats are also affected by migration and settlement. There is a special concern on migrating indigenous groups that traditionally move from one area to another, and sometimes establishing permanently. The Badjaos of the Sulu archipelago have historically been moving across the boundaries of the three countries. There is a need to support measures to protect their rights to their cultural practices, livelihood and security as a people, rather than as alien citizens of the three countries.

[5] http://www.arbec.com.my/sea-turtles/tihpa2.php

Existing national policy responses

Indonesia

The establishment of the Ministry of Marine Affairs and Fisheries of Indonesia (the name of institution has changed several times) was relatively new, in 1999. This marked the recognition of the Indonesian Government to the potentials of marine and fisheries sector contributing to, among others, the economy. As an archipelagic state with approximately 17,480 islands, 95,181 km coastline, and 2,914,978 km^2 EEZ, Indonesia harbors marine ecosystems that are among the richest in the world. The country's configuration offers opportunities for exploring natural resource potentials while overcoming the challenges in protecting its waters and high seas.

The Ministry of Marine Affairs and Fisheries established the Director General of Marine, Coastal and Small Islands (Direktorat Jenderal Kelautan Pesisir dan Pulau-pulau Kecil or Ditjen KP3K) with the following programs:

a) Management and Development of Species and Areas Conservation;
b) Space Management and Planning of Management of Sea, Coastal and Small Islands;
c) Developing Coastal and Seas; and
d) Developing Small Islands.

The establishment of conservation areas aims to address transboundary impacts to biodiversity and fisheries caused by degradation of habitats. The objective for conservation is to ensure balance between utilization of fishery resources and protection of ecosystems in the region. As stated in Indonesia Fisheries Book 2011, the total coverage of conservation areas at the end of 2009 has reached 13,529,067.99 ha. The MMAF in collaboration with local governments have initiated the Waters National Park of Sawu Sea. The Ministry of Forestry of Indonesia also initiated seven marine national parks, 18 marine tourism parks, seven wildlife reserves and nine marine nature reserves. The declaration of Sawu Sea Waters National Park is based on Ministerial Decree of Marine Affairs and Fisheries Number 38 Year 2009 regarding the Provision of National Waters Conservation Area of Sawu Sea and its Surrounding Areas in East Nusa Tenggara Province.

Moreover, the Strategic Plan of the Ministry of Marine Affairs and Fisheries 2010-2014 cited the decrease of fish resource in Indonesian waters in the last decade. In response to this matter particularly on habitat and community modification, the Ministry of Marine Affairs and Fisheries has set, among others, strategic goals in managing marine and fisheries resources in a sustainable manner by. These are:

a) Utilizing marine and fisheries optimally and in a sustainable manner; and
b) Conserving protected areas and living resources in a sustainable manner.

One of the future direction principles of MMAF in implementing the national policy is pro-sustainability. This approach is attained through restoration and conservation of environment, waters, coastal areas, small islands and mitigation and adaptation to climate change. Within the perspective of international law, Indonesia has decided to be bound by the following instruments:

a) Manila Resolution on Coral Triangle Initiative (CTI) on Coral Reefs, Fisheries and Food Security;

b) MoU between the Government of the Republic of Indonesia and the Government of Malaysia and the Government of the Republic of the Philippines on the Adoption of the Conservation Plan for the Sulu-Sulawesi Marine Ecoregion (SSME);
c) Manila Declaration on Strengthening the Implementation of Integrated Coastal Management for Sustainable Development and Climate Change Adaptation in the Seas of East Asia Region resulting Partnerships in Environmental Management in the Seas of East Asia;
d) Convention on Wetlands of International Importance especially as Waterfowl Habitat (The Ramsar Convention) (1971);
e) Declaration on Strengthening the Implementation of Integrated Coastal Management for Sustainable Development and Climate Change Adaptation in the Seas of East Asia Region resulting in the Partnerships in Environmental Management in the Seas of East Asia; and
f) Code for Responsible Fisheries.

As part of its commitment, and according to the Indonesia Fisheries Book 2011, the Ministry of Marine Affairs and Fisheries has initiated to establish 24 local marine conservation areas - 19 candidates for local marine conservation areas, two marine/mangrove protected areas, and three fisheries sanctuaries. Law Number 31 Year 2004 as amended by Law Number 45 Year 2009 has provided provisions relating to small-scale fishers' protection, water conservation and all related aspects of fisheries. On the decentralization issue, Law Number 32 Year 2004 regarding Regional Government defines decentralization as the delegation of government authority from central government to the autonomous local government to regulate and administer governance affairs within the Unitary State of the Republic of Indonesia system. Article 3, Law Number 27 Year 2007 adopts the definition of decentralization as one of the main principles to manage coastal zone and small islands.

The Government of Indonesia has also put particular attention to the outermost small islands near the border with other countries through Government Regulation Number 62 Year 2010 concerning the Utilization of Outermost Islands. Article 7 of the Government Regulation states that the utilization of outermost small islands can only be used for national defense and security, community prosperity, and environmental sustainability. The other regulations concerning conservation are:

a) Ministerial Decree Number Kep.18/MEN/2004 concerning General Guidance of the Implementation of Economic Empowerment Program of Coastal Community;
b) Ministerial Regulation Number Per.17/MEN/2008 regarding Conservation Area in Coastal and Small Islands;
c) Ministerial Regulation Number Per.18/MEN/2008 regarding Accreditation for the Management of Coastal and Small Islands;
d) Ministerial Regulation Number Per.26/MEN/2008 regarding the Management Planning of Coastal Area;
e) Ministerial Regulation Number Per.08/MEN/2009 regarding the Participation and Empowerment of Community in Managing Coastal and Small Islands; and
f) Ministerial Regulation Number Per.30/MEN/2010 regarding the Plan of Management and Zoning of Waters Conservation Area.

Specific interest with regard to the community can be found in Ministerial Regulation Number Per.18/MEN/2008. The regulation has objectives to enhance the effectiveness and sustainability in utilizing coastal and small islands, to apply knowledge and capabilities of communities in the

Management of Coastal and Small Islands, to ensure and protect community interest, to realize community independence enabling it to participate effectively and work collectively. Other local regulations dealing with environmental issues are as follows:

a) Provincial Regulation Number 5 Year 2004 regarding the Management of Environment in the Province of Gorontalo;
b) The Decree of Head of Region of Berau Number 70 Year 2004 regarding the Kakaban Island as Local Conservation Area;
c) Regulation of Head of Region of Berau Number 31 Year 2005 regarding Marine Conservation Area of Berau Region;
d) Provincial Regulation 01/2006 regarding the Management of Integrated Coastal Areas in the Province of Gorontalo;
e) Ministerial Regulation Number PER.18/MEN/2008 regarding Accreditation for Coastal and Small Island Planning Management Programmes; and
f) Ministerial Regulation Number 20Men/2008 regarding the Utilization of Small Islands and Surrounding Waters.

Malaysia

The territorial waters of the state extend to 12 nautical miles from shore. Malaysia's offshore territory (EEZ) extends to 200 nautical miles from the coastline or until the surface of the continental shelf exceeds a depth of 200 m below the surface of the sea, whichever is farther. All land including foreshore up to three nautical miles seaward from the low water mark is controlled by the state. The seabed and water beyond this limit up to the continental shelf boundary falls under federal jurisdiction. Under Emergency (Essential Powers) Ordinance No. 7/1969, the territorial sea extends to 12 nautical miles measured from the low-water mark in all states. There are a number of legal instruments relevant to coastal management including fisheries in Sabah. Among the important legislations are the following:

a) Merchant Shipping Ordinance 1960
b) Pearl Oyster Fisheries Ordinance 1965
c) Environmental Quality Act 1974
d) Exclusive Economic Zone Act 1984
e) Fisheries Act 1985 (amended 1993)
f) Wildlife Conservation Enactment 1997 (six subsidiaries pertaining to turtle conservation)
g) Environment Protection Enactment 2002
h) Fisheries Ordinance of Sabah (two subsidiaries-pertaining to fish bombing and destruction of marine resources and certain licensing)

Aside from the laws mentioned above there are other state and federal legislations, regulations and policies that apply. In addition to these legislations there are also existing government development plans and policies:

a) Outline Perspective Plan Sabah (OPPS) covering a period of 1995-2010. It was formulated based on the second Outline Perspective Plan, Vision 2020 and the National Development Policy.
b) Sabah Development Corridor (SDC) (2008-2025) is a blueprint initiated by the government to enhance the quality of life of the people by accelerating the growth of Sabah's economy, promoting regional balance and bridging the rural-urban divide.

c) Economic Transformation Programme – A roadmap for Malaysia that will lift Malaysia's gross national income per capita, propelling the nation to the level of other high-income nations.

In Malaysia, a marine park is a protected area of sea zoned one or three nautical miles from the shore at the lowest low tide. The total area of Sabah marine parks is 57,546.5 ha (Sea: 54350.8 ha, Land: 3195.7 ha) covering 20 islands and their surrounding waters.

MPAs in Sabah are under Sabah Parks Enactment 1984 and Wildlife Conservation Enactment 1997. These include:

a) Tunku Abdul Rahman Park, established in 1974;
b) The Turtle Islands Park, established in 1997(protected area for the nesting sites of green and hawksbill turtles);
c) Pulau Tiga Park, established in 1978 (protection for unique island ecosystem which includes mud volcanoes, coral reefs and nesting habitats for sea snake);
d) Sugud Islands Marine Conservation Area (SIMCA);
e) Tun Sakaran Marine Park, established in 2004; and
f) Pulau Sipadan, which is under the authority of National Security Council is now a proposed MPA under the management of the Sabah Parks with two proposed sites: Tun Mustapha Park (established in 2003) and Ligitan (established in 2010).

Malaysia, also through national policies, has advocated the Integrated Coastal Zone Management (ICZM) and Integrated River Basin Management (IRBM) studies. In Sabah, the ICZM and IRBM for certain areas have been conducted. However, these management plans are yet to be implemented. In Sabah, the Environment Protection Department (EPD) already conducted a Shoreline Management Plan (SMP) that focuses on development in the coastal areas.

Philippines

The Philippine Constitution requires Congress to delineate the boundaries of forests and national parks. The National Integrated Protected Areas System Act (NIPAS Act, R.A. No. 7586) is the framework for delineating these sites and conserving key biodiversity areas. NIPAS Act provides the procedure for designating and managing protected areas of national and global significance. DENR and local governments jointly manage a protected area through a multi-sectoral Protected Area Management Board (PAMB). Outside of protected areas under NIPAS, DENR has designated river basins and priority watersheds for protection to ensure supply of water and protect critical aquatic resources and habitats.

The Wildlife Resources Conservation and Protection Act (R.A. No. 9147) was passed to align with the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in protecting threatened species and critical habitats domestically. The law regulates the harvesting, transport and trade of wildlife, both domestically and internationally. There are more than 1,300 marine protected areas (MPAs) established in the country covering 22,540 sq. km. but only 10-15% are functional (NEDA 2011). In a study by Weeks et al. (2010), 85% of the protected (no-take) coastal waters are only in two National Integrated Protected Areas System (NIPAS) sites (Tubbataha and Apo Reefs), while the rest of the 15% of the no-take areas are in the remaining MPAs. The study projects that at the rate of establishment of MPAs, it will take until 2076 to protect at least 10% of existing coral reefs, and it may be unrealistic to meet the

target of establishing 15% of the municipality's coastal zone as fish sanctuaries (~no-take areas) set under the Philippine Fisheries Code (R.A. No. 8550).

Philippines has, through Presidential Executive Order No. 533, adopted Integrated Coastal Management (ICM) as the national strategy to ensure sustainable development of the coastal and marine environment and resources. However, after five years, the country still has to adopt the required comprehensive National ICM Programme that will account for all sectoral, local, and transboundary initiatives under a common agenda of goals, targets, outputs, and measurable outcomes.

Policy gaps, weaknesses, and challenges

Habitat loss is the most complex issue because the drivers and pressures come from many sources. There are pressures that have direct and immediate impacts on the habitats such as the conversion of mangroves into fishponds and pressures that are more chronic such as pollution. The root causes of habitat loss include complex interaction of economic, environmental, social, political, and cultural factors that cannot be addressed easily by sectoral policy-making. The policy response should be comprehensive, strategic, and consistent.

Ongoing studies are being conducted on island development in Sabah through the Sabah Environmental Policy. Policies such as the Sabah Land Use Policy Study (SLUPS) have been produced but have yet to be to be adopted by the Cabinet. Similar to Philippines, Malaysia needs to set measurable targets, actions and allocate budget and human resources in support of these policies. Moreover, Sabah needs to establish a strategic and holistic environmental assessment on marine and coastal resources that take into account all future issues. Although policies like the Integrated Coastal Zone Management and Shoreline Management Plan exist, there are barriers that impede the implementation of such policies. Enabling governance mechanisms need to be set up to aid the implementation.

Unregulated land-use conversion and unplanned development appear to be the most urgent issues relevant to the problem of habitat and community modification. The Philippine Congress is still debating on a proposed national land-use law. However, local governments (both at provincial and city/municipal levels) have sufficient powers at present to guide long-term planning in the Comprehensive Land-Use Plan (CLUP). Already, many local government units are incorporating forest land-use planning and coastal zone planning in the CLUPs.

Policy formulation and monitoring should be backed by science and regular data collection. IIn Philippines, for example, the study of Weeks et al. (2010) clearly shows a need to review the policies on MPA declaration given that the present target is unlikely to be achieved, and better selection of MPAs and NIPAS areas might improve the chances of attaining the goal of conserving fragile coastal ecosystems. According to the ICZM Assessment of Environmental Management in Sabah, the present monitoring is inadequate as it is only done to achieve certain agency's requirements. The monitoring system also does not provide ample data to establish an overview of the environment and natural resources situation in the coastal areas as well as for the whole state of Sabah.

5.3.3. Marine Pollution

Transboundary relevance

Oil pollution is a serious problem as international maritime transport increases. Philippines is a major shipping route, where sea lanes cut through highly sensitive marine ecosystems. There have been several incidences of maritime accidents that caused serious oil pollution, mostly by domestic ships. As economic and social interactions among the three countries increase across the borders of the SCS-LME, pollution from transportation, migration and trade are expected to increase.

International shipping increases the chance of introducing alien and invasive species through ballast water. Large cargo and passenger vessels may be easier to monitor because of strong international regulations. However, compliance may be more difficult among smaller vessels, such as fishing vessels that move across the borders in the SCS-LME. Weak quarantine regulations can also cause the transfer of diseases and live organisms with cargo (personal and commercial) following trade across the islands. Smuggling or illegal trade is more difficult to monitor as quarantine is altogether absent.

Existing national policy responses

Indonesia

The Government of the Republic of Indonesia has determined 11 national priorities as implementation areas of its vision, mission, and main agenda. One of the 11 priorities is on pollution, i.e., Environment and Disaster Management. This is implemented through conservation and environment utilization to support sustainable economic growth and prosperity, along with the management and ability of risk disaster to anticipate climate change. The focal point for this issue is Ditjen KP3K.

Indonesia is also a major shipping route. The protection of marine environment resources is provided in the Ministerial Regulation of Transportation Number 68 of 2011 regarding the Lane Passage in the Sea. Article 52 (4) of the Ministerial Regulation states that foreign ship shall not sail very close to prohibited zone while Article 54 (1) of the Ministerial Regulation states that foreign ships shall not dispose oils and the other hazardous materials to the marine environment, or conduct activities contravening international standards and regulations. Article 54 (2), in addition, prohibits foreign ships exercising Right of Archipelagic Sea Lane to dump wastes in Indonesian waters.

In Government Regulation Number 21 of 2010 regarding the Protection of Marine Environment, the prevention of pollution from ships is defined as the measures that shall be conducted by the ship's master and crew as soon as possible to avoid or reduce oil spill and pollution from liquid toxic substances in containers, sewage, garbage, and exhaust gas (from ship to water and/or air). Article 14 is on the management of ballast water in ships. The disposal of waste water shall not be done in, among others, national parks, coral reefs, mangroves, fisheries and aquaculture, and housing complexes. More detailed regulation relating to environmental protection can be found in Ministerial Regulation of Transportation Number 4 of 2005 regarding Pollution Prevention from Ship.

Several regulations enacted by the Ministry of Environment concerning environmental protection include measures such as Law Number 18 of 2008 (Garbage Management), Law Number 19 of 2009 (Ratification of Stockholm Convention on Persistent Organics Pollutants) and Law Number 32 of 2009 (Management and Protection of Environment).

Indonesia has provided further some related domestic laws and regulations as follows:

a) Law Number 32 Year 2009 regarding Environmental Management and Protection;
b) Law Number 18 of 2009 regarding Waste Management;
c) Law Number 19 of 2009 regarding the Ratification on Stockholm Convention on Persistent Organics Pollutants;
d) Government Regulation Number 21 of 2010 regarding Maritime Environmental Protection;
e) Government Regulation Number 27 Year 1999 regarding Analysis of Environmental Impacts;
f) Government Regulation Number 74 Year 2001 regarding Management of Toxic and Hazardous Materials;
g) Government Regulation Number 19 Year 1999 on the Management of Sea Contamination and/or Damage;
h) Transportion Ministerial Regulation Number 17 of 2008 regarding Shipping;
i) Transportion Ministerial Regulation Number 68 of 2009 regarding Lane Passages in the Sea;
j) Transportion Ministerial Regulation Number 4 of 2005 Pollution Prevention from Ship;
k) Regulation of Environment Minister Number 17 of 2010 on Environmental Audit;
l) Regulation of Environment Minister Number 01 of 2010 on Procedures of Controlling Water Contamination;
m) Regulation of Environment Minister Number 3 of 2010 on Quality Standard for Waste Water of Industrial Area;
n) Regulation of Environment Minister Number 12 of 2008 on Quality Standard for Waste Water for Commercial and/or Processing Seaweed Activities;
o) Regulation of Environment Minister Number 06 of 2007 on Standard for Commercial and/or Fish Products Processing Activities;
p) Regulation of Minister of Marine Affairs and Fisheries Number 12 of 2008 on Fishery Products and Means Aquaculture Production from Japan Entering Indonesia;
q) Regulation of Minister of Marine Affairs and Fisheries number 12 of 2011 on Fisheries Products and Aquaculture Production Equipment from Japan to Indonesia;
r) Regulation of Minister of Marine Affairs and Fisheries number 20 of 2007 on Monitoring of Drugs Residue, Chemical, Biological and Contaminant on Aquaculture;
s) Regulation of President number 109 of 2006 on the Mitigation on Emergency Circumstance of Oil Spills on the Sea;
t) Presidential Decree number 18 of 1978 on the Ratification of Convention on Civil Liability for Oil Pollution Damage and Presidential Decree number 52 of 1999 as Ratification to the Protocol of 1992; and
u) Presidential Decree number 46 of 1986 on the Ratification of International Convention for the Prevention of Pollution from Ships, 1973 and the Protocols of 1978;

Malaysia

At the national level, the 10th Malaysian Plan on Waste Management has identified a sewerage treatment system using green technology to be initiated in the country's capital with the rest of the country to follow.

Philippines

The institutional and regulatory framework for pollution control has been considerably improved with recent laws on water and air quality, solid waste management, marine pollution and coast guard laws. The new laws provide the regulatory agencies the means to design appropriate regulations and incentive systems to reduce pollution loading from both land- and sea-based sources. The Clean Water Act (R.A. No. 9275) applies to water quality management in all water bodies and in the control and abatement of pollution from land-based sources. The law applies an ecosystem approach, and provides financing mechanisms (e.g., pollution charges) and a mechanism for retaining the funds for water quality improvement interventions. For domestic sources, sewerage and septic waste management are also key to reducing pollution. Because of the huge capital needed to build the necessary infrastructure, the challenge is in providing incentives for private or local government investments in sewerage management systems.

Solid waste management is the responsibility of local governments under the Ecological Solid Waste Management Act (R.A. No. 9003). Regulations for garbage collection and disposal are generally provided in local ordinances passed to complement the national law. Local ordinances require segregation, proper collection and disposal, as well as the collection of fees for garbage disposal.

The transport and disposal of toxic and hazardous wastes are strictly regulated under the Toxic Substances and Hazardous and Nuclear Waste Control Act (R.A. No. 6969). The Oil Pollution Compensation Act (R.A. No. 9483) is the domestic implementation legislation of the International Convention on Civil Liability for Oil Pollution Damage (CLC and FUND) for recovery of losses resulting from oil spills. The law was passed in 2007 in response to the increasing number of disastrous oil spills from shipping accidents.

In addition, the Philippine Coast Guard Law (R.A. No. 9993) strengthened the PCG as the armed service of the Department of Transportation and Communication. The PCG is tasked, among others, to implement international maritime conventions, promulgate regulations for the protection of the marine environment from offshore pollution, and to develop oil spill response, containment and recovery capabilities from ship-based pollution.

Policy gaps, weaknesses and challenges

A bill is pending in Philippine Congress with the intention of designating archipelagic sea lanes for the safe passage of foreign vessels in the country's EEZ, and internal waters. Under the proposed law, foreign ships are prohibited from discharging oil and wastes in Philippine waters. The bill proposes specific sea lanes for traversing Philippine waters connecting:

a) Philippine Sea to South China Sea, via Balintang Channel;
b) Philippine Sea to South China Sea, via Surigao Strait, Bohol Sea, Sulu Sea, Nasubata Channel and Balabac Strait; and

c) Celebes Sea to the South China Sea, via Basilan Strait, Sulu Sea and Mindoro Strait.

Government must also provide incentives for private investments in needed infrastructure (e.g., water and sanitation). The Philippine Water Revolving Fund (PWRF) has been very successful in catalyzing private investment in water and sanitation projects (www.pwrf.info) through loan guarantees and technical assistance. PWRF advocated for the institutional framework for encouraging investments and provided learning experiences to potential borrowers (e.g., LGUs) and investors (e.g., banks) to facilitate packaging and financing of infrastructure investments.

In the absence of a comprehensive program for mitigating pollution from non-point sources (e.g., agricultural run-off), government and environmental advocates should develop and disseminate technologies that minimize the impact of pollution from pesticides, fertilizers and soil erosion such as organic farming, sloping agriculture, and land technology, among others.

The drivers and pressures of pollution are complex. Barriers to mitigating the impacts of pollution are cross-cutting, including: fragmented institutional arrangements, lack of budget for necessary infrastructure, lack of incentives to change individual and corporate behavior to reduce pollution, and ineffective law enforcement.

Regulations and institutional arrangements often do not match the scale of the environmental problem. For example, siltation has to be regulated from the uplands (where forests are cut and converted to farms), to lowland farms (where agricultural runoff is a leading source of siltation), and to urban areas (where construction and other development activities contribute to soil erosion). However, forests, agriculture, and urban development are managed separately. Water pollution and sanitation are also managed separately by different agencies across different geographical jurisdictions.

5.3.4. Climate Change

Transboundary relevance

Anecdotal reports from the sardine bottling companies in Zamboanga City, Philippines state that total production dropped by half in 2010. Operators suspect increased in sea surface temperature (SST) as the culprit (rather than overfishing) especially since the El Niño Southern Oscillation (ENSO) has been shown to affect the sardine production in the area. Because of the highly migratory nature of pelagic fishes and the potential effect of climate change to stock connectivity and other ecological aspects of the fisheries, relevant mitigating measures by the SCS countries should be implemented collectively.

Existing national policy responses

Indonesia

Climate change is one of the major concerns of the Government of Indonesia, as one of the countries that is vulnerable to its impacts. To help address climate change issues, Indonesia made a strong commitment to reduce greenhouse gas (GHG) emissions in the energy sector, rationalization of Land-Use, Land-Use Change and Forestry (LULUCF), as well as enhancing

carbon absorption. The country has set a target to reduce emissions to 26% in 2020 by its own effort and 41% if international assistance is provided.

The Indonesian government has determined the strategy of national sustainable development based on the principle of pro-growth, pro-poor, pro-job and pro-environment. Aside from its National Action Plans (e.g., National Action Plan on GHG Reduction and Indonesia Climate Change Sectoral Map) the government has established the National Council of Climate Change based on Government Regulation Number 46 of 2008. The council particularly has the duty to convene different stakeholders in the country to create consensus around the opportunities and challenges related to climate change. To that effect, the council has commissioned this greenhouse gas (GHG) abatement cost curve analysis to provide a quantitative basis for a national discussion on the opportunities for reducing GHG emissions in Indonesia consistent with national development goals.

Indonesia has actively participated and conducted various international meetings on climate change such as hosting the 2007 United Nations Framework Convention on Climate Change Conference of Parties (COP-13) in Bali. Thereafter, Indonesia organized a series of high-level discussions to address the issue of reducing GHG emissions from the forestry sector (which includes the Forestry-11 grouping), the Informal Working Group (IWG) on Interim Finance for Reducing Emissions from Deforestation and Degradation (REDD) and meeting of Heads of State convened in April 2009 by the Prince's Rainforest Project. At the September 2009 G-20 summit in Pittsburgh, President Susilo Bambang Yudhoyono voluntarily committed Indonesia to an ambitious roadmap for reducing carbon emissions by 26% against a business-as-usual estimate of emissions in 2020. As the first large developing country to do so, Indonesia reaffirmed its commitment to the reduction target at the COP-15 round of UN Climate Change negotiations in Copenhagen in December 2009 and subsequently associated itself with the Copenhagen Accord in January 2010.

With regards to the sector of marine and fisheries, the implementation of National Action Plans on Climate Change is divided into mitigation and adaptation measures (Table 5.3-2).

Table 5.3-2. Climate change mitigation and adaptation plans of Indonesia for 2007 to 2050.

Measure/Field	2007-2009	2009-2012	2012-2025	2025-2050
Mitigation (The enhancement of carbon absorption)	• Mangrove cultivation and coastal vegetation • Rehabilitation of coral reefs through coral transplantation and artificial reefs • The expansion of Management Protected Areas up to 9.5 million hectares			• Mangrove cultivation and coastal vegetation • Rehabilitation of coral reefs through transplantation and artificial coral reefs
Adaptation (In Marine, Coastal and Fisheries)	• Determining integrity of all infrastructures in coastal areas • Cultivation of Mangroves and other coastal tree species in the coastal areas • Guidance and sharing to fishers and coastal communities regarding early warning system • Installation of wave breakers	• Conducting Integrated Coastal Management (ICM) • Design and develop fishing gears (vessels) that withstand climate change impacts, e.g., big waves • Research on the impact of climate change to aquaculture • Conduct national research to analyze the potentials and enhancement of CO_2 absorption from marine sector • Installation of wave breakers	• Design and develop housing to anticipate sea level rise	

In responding to the climate change problem, Indonesia has provided several domestic laws and regulations, as follows:

a) Law number 6 of 1994 on the Ratification of United Nations Framework Convention on Climate Change;
b) Law number 17 of 2004 on the Ratification of Kyoto Protocol to the United Convention on Climate Change;
c) Government Regulation number 18 of 2008 on the Program of Management of Coastal Areas and Small Islands; and
d) Government Regulation number 64 of 2010 on Disaster Mitigation on Coastal Zone and Small Islands.

One of the future directions of MMAF in implementing the national policy is pro-sustainability. This approach will be attained through restoration and conservation of the environment of waters, coastal areas, and small islands and instituting mitigation and adaptation measures to climate change impacts. The institutional focal point dealing with this issue is Ditjen KP3K, MMAF.

Malaysia

In the 10th Malaysian Plan, the country will adopt a dual strategy to address climate change impacts, categorized into Adaptation Strategies and Mitigation Strategies. The adaptation strategies will look into the effects of climate change to economic growth and development. Measures mentioned in this strategy include the development of risk framework to calculate the risks faced by the economy from climate change, and capacity enhancement and implementation of policy decision frameworks to ensure that future infrastructure investments are climate resilient. The mitigation strategy is in place in order to trim down greenhouse gas (GHG) emissions. Mitigation efforts include creation of stronger incentives for investments in renewable energy, promotion of energy efficiency, improvements on solid waste management, forest conservation, and improvement of air quality by reducing emissions.

Philippines

In 2009, the Philippine Congress enacted the Climate Change Act (R.A. No. 9729) creating a National Climate Change Commission (NCCC) headed by the President. The NCCC has the mandate to lead policy formulation and institutional coordination for international negotiations and domestic actions on climate change. The Commission prepared the National Framework Strategy on Climate Change (2010-2022) and the National Climate Change Action Plan (NCCAP) to provide details to the National Framework Strategy with specific programs, activities and budgets, providing incentives for green growth, and increase climate resilience in the country. The Congress also passed the Disaster Risk Reduction and Management (DRRM) Act in 2010 (R.A. No. 10121) to strengthen institutional arrangements for responding to natural disasters from national to local level. The law actively promotes incorporation of DRRM in policy and development planning of local governments. Local governments, especially in the Bicol Region (Albay, Sorsogon, Camarines Sur), are at the forefront of DRR management. The Albay in Action on Climate Change of the Province of Albay is a pioneering local initiative on local climate change mitigation and adaptation. It is being replicated by other LGUs throughout the country.

Policy gaps, weaknesses and challenges

Climate change and DRRM programs are still at the formative stage of strategy setting and institution building, even as the impacts of natural disasters are growing. There are still only a few scientific institutions providing the necessary technical inputs for policy and planning. These technical services are still largely geared towards adaptation and disaster management. There are no studies, for example, to support decision-making in the fishing industry.

Governments should provide incentives for accessible and cost-effective insurance mechanisms to cushion the economic impacts of natural disasters especially on poor sectors such as small farmers and fishers.

There is lack of integration of coastal management initiatives in the context of climate change. A multi-sectoral approach should be adopted, where the national government leads governance and policies; local governments focus on implementation in collaboration with the academe (technical support), non-government organizations (advocacy, information, education, and communication), private, and financial institutions (financial assistance). Macro and micro-level adaptation measures should be defined and evaluated to ensure effective dissemination and implementation (Capili et al. 2005).

5.4. Proposed Common National Policy Response

5.4.1. Policy formulation and institutional arrangements

Fragmentation in institutional arrangements and mandates is the major challenge in management of coastal and marine areas, including the SCS LME. On one level, the problem is about compartmentalization of land and sea use activities, and assigning to different agencies the management/regulation of these activities. There are separate agencies responsible for fisheries, biodiversity conservation, pollution control, sanitation, land-use planning, agriculture, shipping, ports management and so on. Each agency operates independently of each other and may have different goals, even for the use of the same area or resource. The challenge of fragmentation of agencies and mandates can be addressed by a mechanism for the joint determination of common goals, outcomes and strategies. Activities and interventions by the different agencies must also be synergistic. The river basin approach is designed to link together the agencies, local governments, private sector and local communities towards agreed common goals and strategies for the area. Each agency should first focus on the effectiveness in performing its own mandate before it can engage in interagency coordination. Otherwise, coordination is pointless if the agency tasked to contribute its own programs/activities, as a component of the agreed interagency framework or plan, is unable to perform its own function.

In the Philippines, there have been several attempts to create a comprehensive strategy for coastal and marine area management. In 1994, the government developed the National Marine Policy (NMP) that was focused on the rights and obligations of the country under the UN Convention on the Law of the Sea (UNCLOS). The Department of Environment and Natural Resources, on the other hand, also led an initiative to prepare a framework for a sustainable archipelagic development (ArcDev). In contrast to the NMP, ArcDev has detailed targets and proposed actions. Though like NMP, it does not have a mechanism to ensure that the responsible agencies actually align their programs and activities to support the archipelagic development

framework. Despite its comprehensive framework and proposals for specific actions, ArcDev has not been officially adopted.

Similarly, in Malaysia, overlapping jurisdiction of managing agencies currently enforcing various regulations and policies within an area is anticipated to pose a challenge towards establishing a coordinated management system. Conservation of resources within Sabah lacks a comprehensive framework with clear, agreed and shared objectives that can resolve conflicts and competing interests and identify management and planning gaps. Better coordination of sectoral policies and decision-making processes across local, state and federal levels of government are required to provide increased certainty for both industry investment and long term environment protection. Sabah's marine environment includes diverse, unique, and spectacular coral reefs, estuaries and bays, sea grass beds, mangroves, and open ocean habitats. The government, community and all users have a shared responsibility to ensure the long-term viability of the biological diversity, marine system function and resource use of the ocean.

Devolution of environment and natural resources (ENR) management has to accelerate and go beyond rethorics. Local government participation in environmental management has increased dramatically in the past decade in the SSME countries. Local autonomy is a double-edged sword in implementing ICM. It presents a problem if local governments sharing a common coastal area do not have a common vision and go on to implement conflicting programs. It is also a problem if local governments and national agencies do not agree on coastal development strategies and plans.

On the other hand, the broad mandates of local governments covering all aspects of social and economic development in the area, and their power to generate resources, give them the potential to implement integrated programs effectively. Inter-local government cooperation model is starting to become mainstream. Philippines reported initial successes in Central Visayas (CLEAR 7, Camotes Sea) and Panay (e.g., Banate Bay), which have spread to Mindanao (e.g., Iliana Bay Alliance), Negros Occidental and the Ilocos Region. LGUs enter into agreements to develop a common management plan and share the costs of management. These examples are encouraging, albeit few. The arrangement can drastically change when the political climate or leaders change. See for example the extensive experience of the FISH Project (2010).

The judicial courts are taking a more active and direct involvement in environmental issues. The Philippine Supreme Court adopted the new Rules of Procedure for Environmental Cases in 2010.[6] The courts have become, in effect, the compelling force for the various agencies to cooperate and comply with soft directives (strategies, implementation plans), based on their legal mandates. The activism of the courts in getting involved in specific operational issues is controversial for overstepping the functions of the Executive (Gatmaytan 2010).

In Malaysia, fisheries policy design, decision-making, planning, and implementation are centralised either by federal or state departments. The process also may lack consultation with external stakeholders. In addition, there appears to be uncoordinated economic development on

[6] A.M. No. 09-6-8-SC, effective April 29, 2010.

the coastal and marine zone between state and federal projects or non-extractive versus extractive activities (Sabah Shoreline Management Plan 2005).

5.4.2. Financial and human resources

The GIWA report noted that key government departments are hampered by a lack of qualified and experienced staff, and also by funding shortfalls and cutbacks. Despite considerable recent progress, there is insufficient capacity for effective improvement, in part related to currency depreciation and shifts in government spending. There are, however, many national, regional, and international actors in government and non-government sectors actively pursuing sustainable development initiatives.

The key to sustainable financing lies in providing the framework for incentives to local governments and the private sector to embark on long-term investments in health and sanitation, infrastructure, education, capacity-building, and in monitoring and evaluation. The financial returns from these investments, if any, are not encouraging enough for private investment, and therefore may have to be paid for by government and indirectly by the public through fees and taxes. Local governments in Philippines have poured their own resources into biodiversity conservation. The USAID-EcoGov2 Project (in Philippines) reported an increasing number of LGUs allocating support for protected area management from their own Internal Revenue Allotment (IRA). LGUs have also shown capacity to support local activities such as MPAs and MPA networking and provide support to holders of certificate of ancestral domain titles and community-based forest management, especially those related to water, livelihood, and agroforestry systems. LGUs draw part of the 20% of the IRA of PhP133 billion for environment and natural resources management.

However, private financing of government infrastructure spending is viable, as shown by the experience of the Philippine Water Revolving Fund, which was created with initial donor money to catalyze private sector financing of water and sanitation projects. The current framework for financing of initiatives with high social benefits but low financial returns is complicated and bureaucratic at best, especially for local governments that want to raise revenues or borrow against revenues to finance these initiatives. Philippines requires centralized approval and demonstrated capacity of local governments to shoulder counterpart funding upfront. For local officials who are conscious of their short three-year terms, the process is just too cumbersome and the outcome too long to realize in order to be worth applying.

Philippines has likewise demonstrated strong private sector involvement through various public-private partnerships for implementing environmental programs. Several companies that practice Corporate Social Responsibility (CSR) programs have pooled their resources to form partnerships for environmental stewardships, effectively complementing and supplementing the public sector's budget for environmental expenditures. In addition to the Bataan Coastal Care Foundation, which has pioneered efforts on ICM in Bataan province, the Cavite CSR Council has been established recently and has in fact expressed its commitment to provide support for the rehabilitation of Manila Bay through the CSR programs of its member companies.

There are a lot of studies that have and are being conducted in Malaysia; land use, water quality, ICZM, SMP, waste studies, and IRBM, among others. However, the implementation of these studies has either not taken place or that implementation is slow on the ground due to lack of

funding, human resources, capacity or the necessary enabling governance. Budgetary cuts and the fact that government departments are no longer taking on staff are also considerations that need to be taken. To address the impact of the increasingly challenging external environment, the Malaysian government has stipulated that efforts will be taken to strengthen the domestic economy. To support the economic growth, the Government will implement a Special Stimulus Package through Private Financing Initiative.

5.4.3. Law enforcement mechanisms

Philippines has a comprehensive regulatory framework with rules and penalties for every kind of activity that causes environmental harm. However, this appears to have been a poor deterrent as shown by the continuing decline of the state of natural resources. Ineffective law enforcement results in low probability of apprehension and punishment, rendering any regulation useless. Studies conducted by NGOs disclose a low number of cases being filed in court, despite the high number of violations (Dalabajan 2005, see also analysis in Kuperan and Sutinen 1998).

Participation of citizens in law enforcement in Philippines appears to be the norm, given the multitude of community-based law enforcement teams (*bantay dagat, bantay gubat,* etc.). Because of the lack of law enforcement personnel, local communities carry the weight of implementing environmental laws to protect their livelihoods.

In Malaysia, current pressures include those associated with fish bombing, use of cyanide in live reef fish trade, wastes and run off from land, agricultural and industrial pollution, and increasing beach pollution. While marine and coastal habitats are in danger of degradation, increasing numbers of people are using the sea and coastal environments for food, income, and recreation. Similarly, some of Sabah's fish stocks have declined over the past years. Serious over-fishing of coral reef fish has occurred. Both fishers and fisheries managers, with support of better science are increasingly becoming aware of the unintended environmental and economic impacts of some of these practices. These include, for example, overfishing of target species with incidental catch of other species (bycatch) and disposal of fishing litter and debris. All of these distort predator-prey interactions and damage to habitats such as mangroves and coral reefs. There is growing recognition of the importance and need to protect marine biodiversity for both conservation and economic reasons.

5.4.4. Market based incentives for behavioral change

In Malaysia, there is insufficient understanding of marine biodiversity and its relationship with ecological processes that sustains the fishery resources. There is an increasing loss of natural capital from the ecosystems like mangrove forests, seagrass beds, coral reefs, coastal waters, and other resources especially marine fishes. This is caused by:

a) Inadequate regulatory mechanisms;
b) Poor implementation of existing mechanisms for conservation and development;
c) Inadequate human resources for implementation; and
d) Low revenues for use of coastal and marine areas.

Policies that favor resource exploitation over sustainable use are another typical root cause. Resources that are exploited tend to be harvested exhaustively and the national and state policies appear to increase production without having much knowledge of existing stocks. Sustainability

is mentioned in these policies. However, in order to achieve the projected production levels, sustainability is not addressed in the translation of policies to ground level. Specific and integrated policies concerning sustainable land use are yet to be developed. Integrated approaches to land or marine particularly based on sustainable development principles are urgently needed in order to enhance the efficiency and effectiveness of resource utilisation in the state. To organise and manage such diverse resource uses and administrations, it requires a single set of policy guidelines to manage resources in an integrated approach. In the past, extraction of resources was conducted with a lack of long term sustainable management and planning. In the last decade, agencies dealing in the extraction business have been trying to correct past mistakes of exhaustive resource extraction. Changing from an "extractive" mindset to a "sustainably managed" mindset requires a major paradigm shift. The question now is "is it too late?"

One of the more glaring gaps in Philippines's existing policies is the lack of a systematic market-based approach in implementing its environmental programs. Most environmental policy instrument used by governments are of the regulatory or command-and-control type, which imposes environmental standards and punishes violations through fines or imprisonment. However, environmental law enforcement entails huge costs that are often not reflected in the regulations. Because of this, there is a need to utilize market-based approaches to achieve environmental objectives while internalizing the costs such as tradable quotas for fisheries, pollution charges, and tax incentives for clean technology, among others.

Existing laws already incorporate market-based instruments, but these have not been implemented, such as provision for catch limits and pollution charges. BFAR has difficulties in setting catch limits that could be the basis of limiting and setting a price for permits. DENR still has not approved the regulations to implement pollution charges because of administrative or procedural issues regarding the collection and allocation of the proceeds.

Underlying the problem of incentives is the lack of proper valuation of natural resources and ecosystem services. There have been past attempts to include environmental valuation and accounting in the national system of accounts, but this was not sustained because of challenges to the methodologies used.

The next generation environmental policies should include a comprehensive system to capture payment for ecosystem services that can be the basis of plowing back investments in conservation. At present there are a few examples of *ad hoc* schemes, for example, where water districts in the lowland "pay" upland communities to fund forest law enforcement and watershed rehabilitation programs. In the coastal areas, several LGUs are imposing fees for diving and other leisure activities to generate funds for coastal conservation programs.

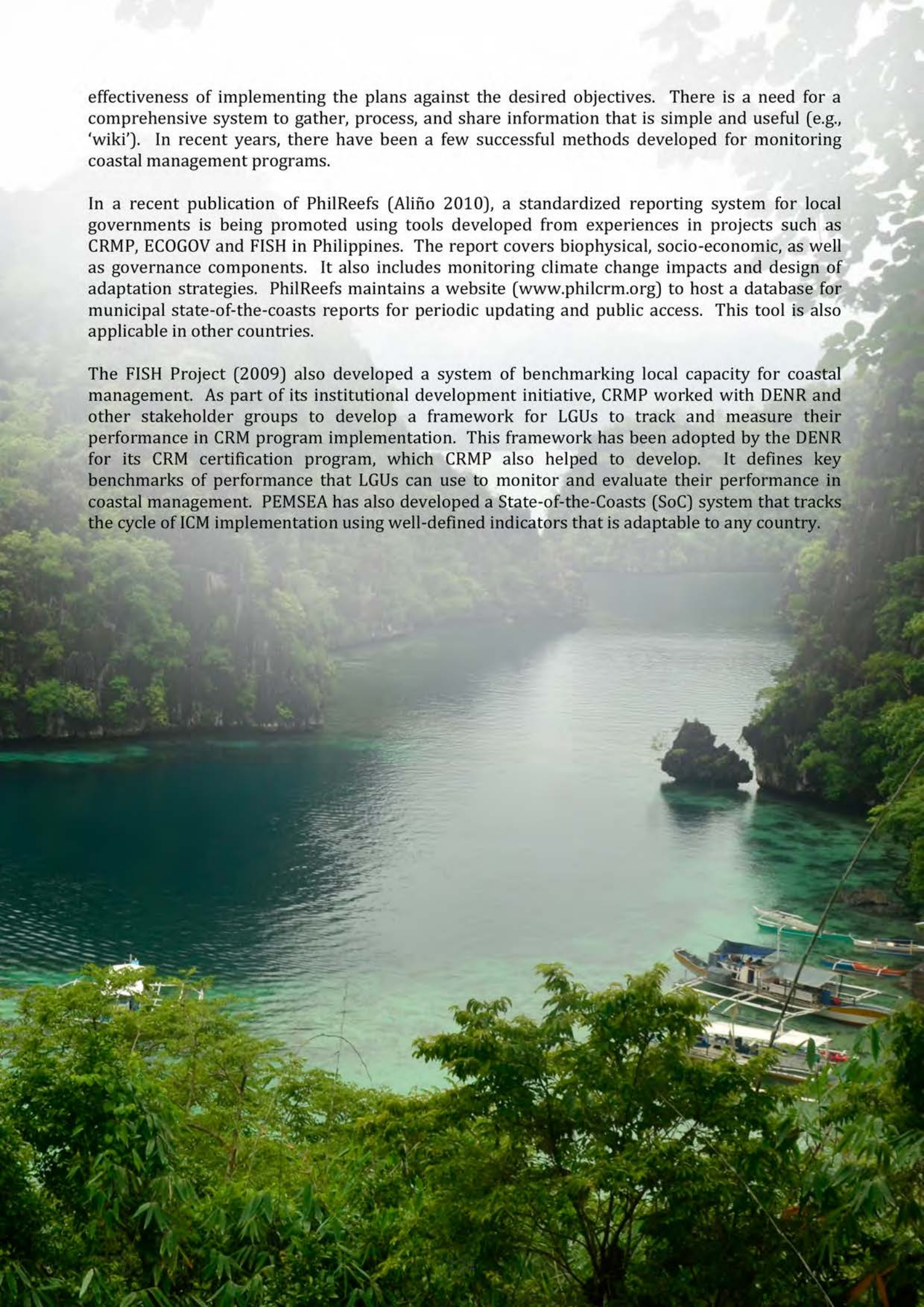
5.4.5. Monitoring and evaluation

The most urgent gap in environmental policy that needs to be addressed is establishing an integrated environmental monitoring and reporting system. There is a wealth of information gathered by government, academic, civil society, business and community groups. However, the data is often fragmented, dated and/or unavailable to general users. Helpful databases are created but not used, and because of disuse and high cost of data gathering, these databases are not updated. A robust M&E system is vital for planning and for feedback on the progress and

effectiveness of implementing the plans against the desired objectives. There is a need for a comprehensive system to gather, process, and share information that is simple and useful (e.g., 'wiki'). In recent years, there have been a few successful methods developed for monitoring coastal management programs.

In a recent publication of PhilReefs (Aliño 2010), a standardized reporting system for local governments is being promoted using tools developed from experiences in projects such as CRMP, ECOGOV and FISH in Philippines. The report covers biophysical, socio-economic, as well as governance components. It also includes monitoring climate change impacts and design of adaptation strategies. PhilReefs maintains a website (www.philcrm.org) to host a database for municipal state-of-the-coasts reports for periodic updating and public access. This tool is also applicable in other countries.

The FISH Project (2009) also developed a system of benchmarking local capacity for coastal management. As part of its institutional development initiative, CRMP worked with DENR and other stakeholder groups to develop a framework for LGUs to track and measure their performance in CRM program implementation. This framework has been adopted by the DENR for its CRM certification program, which CRMP also helped to develop. It defines key benchmarks of performance that LGUs can use to monitor and evaluate their performance in coastal management. PEMSEA has also developed a State-of-the-Coasts (SoC) system that tracks the cycle of ICM implementation using well-defined indicators that is adaptable to any country.



CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The transboundary diagnostic analysis (TDA) of the Sulu-Celebes Sea Large Marine Ecoregion (SCS-LME) is based on secondary data and information collected by the TTTs of Indonesia, Malaysia, and the Philippines, and validated and enhanced by the National Coordinating Units and stakeholders of the respective countries. This TDA is a revision of the transboundary assessment of the SCS-LME that was conducted in 2002 (GEF/UNEP/GIWA Report 56). The updating of the TDA followed the process endorsed in the GEF IW-LEARN. The prioritized transboundary problems (TPs) are: 1) unsustainable exploitation of fish; 2) habitat loss and community modification; 3) climate change; 4) marine pollution; 5) freshwater shortage; and, 6) alien and invasive species.

The first (unsustainable exploitation of fish) and second (habitat and community modification) TPs in 2002 remained the two highest priorities for management intervention in the SCS LME. The impacts of climate change are now being observed more and projected to worsen in 2020 unless mitigation efforts are increased in high carbon-producing countries. This is ranked third among the priorities from fifth in 2002. Alien and invasive species is a new TP (ranked sixth), primarily because of the increasing mariculture activities and maritime traffic within the Southeast Asian region and to and from Europe, America, Australia, and New Zealand.

The root-causes of these TPs are in the areas of governance and socio-economics. The SCS countries have signed into several international conventions, regional treaties/cooperations and programs, and initiatives to be able to implement a concerted effort to address these problems. Ratified by Indonesia, Malaysia and Philippines in 2006, the SSME Ecoregion Conservation Plan, its governance structure, and the "*Comprehensive Action Plans of the Sulu-Sulawesi Marine Ecoregion: A Priority Seascape of the Coral Triangle Initiative*", are platforms to implement regional actions. A strengthening of the governance structure and capacity-building are recommended for consideration.

Some gaps in the data and information were observed in the prioritization of the transboundary problems and quantification of the ecological impacts and socio-economic consequences. Nonetheless, the TDA report still can be the basis for the formulation of recommendations for legal, policy and institutional reforms at the national and regional levels for improved fisheries management. The Ecosystem Approach to Fisheries Management, which the project adheres to, allows the refinement of the TDA with current findings.

6.2 Recommendations on how to strengthen the SSME mechanism to better address the priority TPs

The Governments of Indonesia, Malaysia and Philippines entered into a Memorandum of Understanding (MoU) on 13 February 2004 to ensure effective protection and sustainable development of the Sulu-Sulawesi Marine Ecoregion (SSME). The signing of the MoU was one of the highlights in the Side Events of the 7th Conference of the Parties (COP7) of the Convention on Biological Diversity (CBD) held in Kuala Lumpur, Malaysia. The three countries essentially agreed to adopt the ecoregion approach to conservation embodied in the SSME Ecoregion Conservation Plan (ECP) that facilitates the realization of the four fundamental goals of biodiversity conservation, which are, representation, sustainability of ecological processes, viability of species, and resiliency. The Tri-National Committee of the SSME was formed in 2006 immediately after the ratification of the MoU by Indonesia, Malaysia and Philippines. The Tri-National Committee then formed the Sub-Committee on Threatened, Charismatic, and Migratory Species; Sub-Committee on Sustainable Fisheries; and Sub-Committee on Marine Protected Areas and Networks. Each Sub-Committee is led by a country and guided by its own Terms of Reference (TOR).

At the East Asian Seas Congress of 2009 in Manila, Director Theresa Mundita Lim (Parks and Wildlife Bureau, Philippines), Chair of the Tri-National Committee for 2009-2010, together with Conservation International, reported on the progress and effectiveness of governance in the SSME based on the MoU. Dir. Lim noted that the spirit of regional cooperation is strong and getting stronger as evidenced by regular annual meetings of the Tri-National Committee and Sub-Committees, support from donors (e.g., GEF funding for sustainable fisheries management), active sharing of experiences and best practices, implementation of joint activities, and strong linkages with other regional conservation programs.

At the CBD COP 10 in Nagoya in October 2010, the three countries presented at a forum the report entitled "Making Transboundary Conservation Work in the Coral Triangle: A Report from Indonesia, Malaysia, and the Philippines on the Sulu-Sulawesi Marine Ecoregion." The forum underscored the significance of a successfully managed seascape within the bigger context of the Coral Triangle.

In 2011, the Tri-National Committee published the three-volume Comprehensive Actions Plans of the Sulu-Sulawesi Marine Ecoregion, with each volume corresponding to the comprehensive action plan (CAP) of each Sub-Committee. The CAPs contain complete information on the strategies, actions, indicators, estimated costs and financing options to implement the programs. The CAPs also include lessons learned from country-level experiences.

Based on the results of the Transboundary Diagnostic Analysis (TDA), it is recommended that the existing SSME MoU be reviewed and amended to address priority transboundary problems and provide basis for SAP implementation. The amended MOU could also reflect how the plans, projects, and programs will enable the three countries of Indonesia, Malaysia and Philippines to deliver on their commitments to international conventions such as CBD, UNFCC, CITES, CMS as well as regional cooperative mechanisms such as CTI-RPOA, PEMSEA-SDS-SEA, ASEAN, BIMP-EAGA, and APEC, among others.

A dynamic synergy between the three Sub-Committees of the SSME (Threatened, Charismatic and Migratory Species; Marine Protected Areas and Networks; and Sustainable Fisheries) should be developed and maintained. This could be achieved by designing, implementing and monitoring projects that will compel the three sub-committees to address their respective thematic issues, i.e., fisheries, MPAs and MPA networks, and threatened species in a complementary and synergistic approach. The SSME is strategically positioned to demonstrate this synergy and complementation by building on existing plans and strategies, e.g., MPA Network for Sea Turtles, which could simultaneously address fisheries by-catch issues involving threatened sea turtles

6.3 Recommendations on the other international cooperation mechanisms to better address the priority TPs

As the most advanced initiative in the Coral Triangle, the SSME has been identified as the first priority seascape of the CTI. It is recommended, though, that the SSME should be more aggressive in communicating and demonstrating how the CAPs are actually aligned with the Regional Plan of Action (RPOA) of the CTI. Specifically:

1. The Sub-Committee on Threatened, Charismatic and Migratory Species has an Action Plan that is consistent with CTI RPOA Goal # 5 (Threatened species status improving). The implementation of activities in this SSME Action Plan contributes to meeting the CTI Target of "improved status of sharks, sea turtles, marine mammals, and other identified threatened species." The Sub-Committee can provide technical advice and recommendations in designing a science-based network of marine protected areas for conservation of target species. The Tri-National Committee for SSME has adopted, in July 2009, the Action Plan for Conservation of Sea Turtles in Sulu-Sulawesi and the Design of Network of Marine Protected Areas (Pilcher 2008) that encompass critical sites in the transboundary Sea Turtle Corridor. The network builds on the world's first transboundary protected area for marine turtles – the Turtle Islands Heritage Protected Area of Philippines and Malaysia.

2. The Sub-Committee on Marine Protected Areas and Networks has a Comprehensive Action Plan that is consistent with CTI RPOA Goal #3 (marine protected areas established and effectively managed). The implementation of activities in this CAP contributes to meeting the Target of establishing a fully functional region-wide Coral Triangle MPA System. The activities under each Strategy provide detailed direction towards setting in place "comprehensive, ecologically representative and well-managed" MPAs in the SSME – the apex of the Coral Triangle region. The Sub-Committee abides by the Framework for Establishing Networks of Marine Protected Areas for conservation of species, fisheries enhancement, and for integrated coastal and marine ecosystems. The Framework was very relevant in preparing the Comprehensive Action Plan and Design of a Network of Sea Turtle MPAs in the Sulu-Sulawesi Seascape.

3. The Action Plan of the Sub-Committee on Sustainable Fisheries is consistent with CTI RPOA Goal #2, which is the full application of the ecosystem approach to management of fisheries and other marine resources. The Action Plan promotes ecosystem-based management of fisheries (see Objectives in earlier section) and contains specific activities that contribute to implementing steps to consider the ecosystems that support marine fisheries, research and monitoring for fisheries policies and regulations, as well as the livelihood of coastal communities and fishing industry. The Action Plan is a holistic response of the governments of Indonesia, Malaysia, and the Philippines to meet the targets of the CTI and the United Nations Millennium Developmental Goals (MDGs) towards improving status of marine fish stocks by 2015 and improving the socio-economic condition of coastal communities dependent on them, respectively. The GEF-approved SCS SFM Project will be implemented under the CTI.

The Sub-Committee on Threatened, Charismatic and Migratory Species aims for the conservation of species for sustainable use. The Action Plan can be viewed as part of the response of the governments of Indonesia, Malaysia and Philippines to honor their commitments to international agreements. The Sub-Committee will engage with the Association of Southeast Asian Wildlife Enforcement Network (ASEAN-WEN). It will also be beneficial for the Sub-Committee to work closely with the Survival of the Species Group of International Union for Conservation of Nature (IUCN) in assessing the conservation status of species in the region and in designing conservation activities to improve population levels of endangered species.

There is a need to increase the leveraging potential of SSME with other donors to secure financing for the implementation of its CAPs. Linkage and leveraging can be facilitated through reporting of the SSME projects and activities as part of the regular agenda in the meetings of international cooperative mechanisms such as Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) and CTI.

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TRANSBOUNDARY DIAGNOSTIC ANALYSIS

2014