National State of Oceans and Coasts 2018:

Blue Economy Growth

THAILAND

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National State of Oceans and Coasts 2018:
Blue Economy Growth of Thailand

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Acronyms and Abbreviations

ADB	–	Asian Development Bank
AEDP	–	Alternative Energy Development Plan
AIT	–	Asian Institute of Technology
ARDA	–	Agricultural Research and Development Agency
ASC	–	Aquaculture Stewardship Council
BOBLME	–	Bay of Bengal Large Marine Ecosystem
BOI	–	Board of Investments
CBD	–	Convention on Biological Diversity
COBSEA	–	Coordinating Body on the Seas of East Asia
CPUE	–	Catch per unit effort
CSR	–	Corporate social responsibility
DASTA	–	Designated Areas for Sustainable Tourism Administration
DAEDE	–	Department of Alternative Energy Development and Efficiency
DMCR	–	Department of Marine and Coastal Resources
DMF	–	Department of Mineral Fuels
DNP	–	Department of National Parks, Wildlife and Plant Conservation
DOF	–	Department of Fishery
DPT	–	Department of Public Works and Town and Country Planning
EEAT	–	Environmental Engineering Association of Thailand
EEZ	–	Exclusive economic zone
ECNEQ	–	Enhancement and Conservation of the National Environmental Quality Act
Eco-DRR	–	Ecosystem-based disaster risk reduction
ENSO	–	El Niño Southern Oscillation
ESI	–	Environmental Sensitivity Index
FAD	–	fish aggregate devices
FAO	–	Food Agricultural Organization
Fe	–	iron
FIP	–	fisheries improvement project
FRC	–	fiscal reform committee
FTI	–	Federation of Thai Industries
GDP	–	gross domestic product
GEF	–	Global Environment Facility
GNI	–	gross national income
GVA	–	gross value added
IUU	–	Illegal, unreported, and unregulated
HDI	–	Human Development Index
ITOPF	–	International Tanker Owners Pollution Federation
IUCN	–	International Union for Conservation of Nature
LME	–	Large marine ecosystem

MARPOL – International Convention for the Prevention of Pollution from Ships
MNRE – Ministry of Natural Resources and Environment
MPAs – Marine protected areas
MSC – Marine Stewardship Council
MSY – Maximum sustainable yield
MTI – Market Transformation Initiative
MTJDA – Malaysia-Thailand Joint Development Area
NDEWC – National Disaster Early Warning Centre
NESDB – Office of the National Economic and Social Development Board
NOAA – National Oceanic and Atmospheric Administration
NSO – National Statistical Office
NSOC – National State of the Oceans and Coasts
NSTDA – National Science and Technology Development Agency
ONEP – Office of Natural Resources and Environmental Policy and Planning
OHI – Ocean health index
OSRL – Oil Spill Response Limited
PAT – Port of Authority of Thailand
PCD – Pollution Control Department
PEMSEA – Partnerships in Environmental Management for the Seas of East Asia
PSHEMS – Port, Safety, Health and Environmental Management System
PTT – Petroleum Authority of Thailand
PMCRM – Promotion of Marine and Coastal Resources Management Act
RDP – Royal Development Projects
RFID – Radio Frequency Identification Card
SDGs – Sustainable Development Goals
SDS-SEA – Sustainable Development Strategy for the Seas of East Asia
SEAFDEC – The Southeast Asian Fisheries Development Centre
TAT – Tourism Authority of Thailand
TCC – Thai Chamber of Commerce
TCPG – Thai Crab Product Group
TEI – Thailand Environment Institute
TFFA – Thai Frozen Food Association
TRF – Thailand Research Fund
TSFR – Thai Sustainable Fisheries Roundtable
TWG – Technical working group
UNCLOS – The United Nations Convention on the Law of the Sea
UNFCCC – United Nations Framework Convention on Climate Change
VCMS – Vessel Cargo Management System
WMA – Wastewater Management Authority

FOREWORD

The *National State of Oceans and Coasts (NSOC) Report of Thailand 2015* is part of the initiative to assess country and regional progress in implementing the Sustainable Development Strategy for the Seas of East Asia (SDS-SEA). The report presents a comprehensive description and analysis of the state of oceans and coasts, covering both the ocean economy (e.g., fisheries, tourism, shipping and ports, etc.) and ocean health (e.g., coral reefs, mangroves, seagrass, and marine water quality). It also covers blue economy development in Thailand and its innovations as well as opportunities for investments and ocean governance.

The Department of Marine and Coastal Resources (DMCR), Ministry of Natural Resources and Environment (MNRE) is the key agency in preparation of the reort, with technical support from the Thailand Environment Institute. In preparing the report, a technical working group comprising of representatives from DMCR and other concerned government agencies, academic institutions, and experts was set up. A stakeholder consultation workshop was organized to review the report and provide inputs.

Thailand is in the process of reforming the government sector, including organizations involved in marine and coastal resource management. The outcome of this report will be useful for Thailand in improving marine and coastal resource management as well as guiding the development of blue economy in the country. Furthermore, it helps us strengthen our implementation of international conventions and agreements related to oceans and seas, and promote cooperation at the regional and international levels. The Government of Thailand appreciates the financial support from the Global Environment Facility (GEF) and United Nations Development Programme (UNDP) through PEMSEA Resource Facility for the preparation of this report.

Mr. Sopon Thongdee
Director-General
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Koh Tao. (Photo by TEI)

EXECUTIVE SUMMARY

1. Background

The ministers of the East Asian Seas (EAS) Region adopted the Da Nang Compact during the East Asian Seas (EAS) Congress 2015 held in Da Nang, Viet Nam in November 2015. One of its targets is the development of a Regional State of Oceans and Coasts (RSOC) report. Thailand prepared this National State of Oceans and Coasts (NSOC) report as its contribution to the regional report. The theme of the SOC reports is blue economy.

Although Thailand is not a country partner of PEMSEA, there was an agreement to participate in the development of the NSOC Report as this report will be useful to the management of the marine and coastal areas of Thailand. The NSOC report also aims to contribute to the blue economy assessment and monitoring of progress on the implementation of the Sustainable Development Strategy for the Seas of East Asia (SDS-SEA), the UN Sustainable Development Goals (SDGs), other international agreements subscribed to by Thailand, and related national laws and policies on oceans and coasts.

The NSOC report provides a comprehensive picture of the ocean economy and its contribution to national economy, incomes, jobs, and well-being as well as the transition towards blue economy – emphasizing the best practices, innovations, investment opportunities, and challenges. It contains information on the state of ocean health upon which the blue economy relies on, in particular, marine water quality; coastal and marine resources; the existing and potential uses of such resources; and the pressures. The report also presents the governance structure – policies, laws, plans, capacity development, and institutional arrangements – and on-going actions to mitigate habitat destruction, pollution, destructive and overfishing, climate change, and other pressures on the coastal and marine environment and ecosystems. Gaps and recommendations are pointed out to improve ocean governance and support a more innovative, inclusive, sustainable and climate-resilient blue economy development.

The NSOC Report applied the drivers-pressures-state-impacts-response (DPSIR) framework for the analysis. It also involved review of literature, existing studies and reports, as well as consultations with key government agencies and other stakeholders. Their participation, ideas and perspectives had been crucial to the preparation of this report.

The NSOC report is therefore supportive of evidence-based policy-making and planning as it shows the benefits derived from the oceans as well as the tradeoffs, impacts of human activities, effects of the changing environment and climate, and outlook for blue economy.

2. The Seas and People of Thailand

The Kingdom of Thailand is located in the Indo-Chinese peninsula between the latitude 5.610 N to 20.470 N and longitude 97.350 E to 105.640 E. The neighboring countries of Thailand include Myanmar in the west, Lao People's Democratic Republic (Lao PDR) and Cambodia in the east, and Malaysia in the south.

The coastline, which is 3,148 km long, is divided into two parts: (a) Gulf of Thailand on the eastern part of the country (2,055 km), considered the innermost part of the western Pacific Ocean, and (b) Andaman Sea on the western part (1,093 km), the easternmost part of Bay of Bengal of the Indian Ocean. The Thai coastal zone extends from the coastal shoreline of 23 provinces and Bangkok toward the exclusive economic zone. The maritime zone of Thailand covers an area of 323,488.40 km^2. The Gulf of Thailand has an area of 202,676.20 km^2, while the Andaman Sea covers an area of 120,812.20 km^2.

Figure 1: Map of Thailand.

Source: Thailand-map-CIA-en.jpg

Table 1: Geographical and Socioeconomic Indicators (2017).

Thailand in Context	Population Density
Land area (1000 square kilometres or km²)	511
Coastline	3,148 km
Sea area	53,068 km² (territorial waters up to 12 nautical miles) 323,488.40 km² (EEZ waters up to 200 nautical miles)
Population[1]	68 million
Coastal population	15,410,429 people or 23.44% of total population (as of 2015)
Gross domestic product[1] (GDP, in constant 2010 US$ prices)	US$ 422.9 billion
Human development index (HDI)[2]	0.755 - high human development category, with rank of 83 out of 189 countries and territories
Gross national income (GNI) per capita[2] (at 2011 PPP prices)	US$15,516
Life expectancy at birth[2]	75.5 years
Mean years of schooling[2]	7.6 years
Access to safely managed water supply[1]	People using the *least basic drinking water* services: 99% of urban population, and 97% of rural population
Access to safely managed sanitation[1]	People using the *least basic sanitation* services: 93.8% of the urban population, and 96.2% of the rural population
Wastewater treatment[3]	26.9% of wastewater generated
Ocean health index (OHI)	71, with ranking of 75 among 221 countries and territories
Percentage of coastline with ICM[3]	5.46% (will extend to 11.3% in the future)
Marine protected area (percentage of territorial waters)	5.2%[1] to 34.18% (=18,138 km²) [3]

A number of important factors and recent developments have been shaping the coastal and marine areas of the Pacific. The coastal and marine sectors like all other sectors respond to macro-level factors. These include: (a) population growth and changes in demographic attributes; (b) economic growth, including urbanization, and coastal land- and sea-use changes due to increased settlements in coastal areas, conversion of coastal habitats, reclamation, infrastructure development, etc.; and (d) changes in social dimensions, such as education and health.

[1] World Bank. Development indicators – Accessed from https://data.worldbank.org/country/thailand. No data on access to safely managed water supply and sanitation services.
[2] United Nations Development Programme (UNDP). 2018. Human Development Indices and Indicators: 2018 Statistical Update.

Population. Coastal province population in 2015 was 15,410,429 people or 23.44% of total population (65,729,098). During 2011–2015, the coastal population was slightly increasing at 0.1% each year. The population density was 128.1 people per km^2. The top five provinces with highest population density were Bangkok, Nonthaburi, Samut Prakarn, Pathum Thani and Phuket.

Economy. In 2017, Thailand's Gross Domestic Product (GDP) was US$422.9 billion (in constant 2010 prices), with a 3.9% growth rate from the previous year.

Human development.[4] Thailand's human development index (HDI) value for 2017 is 0.755—which put the country in the high human development category—positioning it at 83 out of 189 countries and territories. The HDI is a summary measure for assessing long-term progress in three basic dimensions of human development: a long and healthy life, access to knowledge and a decent standard of living. In 2017, the GNI per capita is US$15,516 (at 2011 purchasing power parity or PPP prices). The life expectancy at birth is 75.5 years. The expected years of schooling is 14.7 years while the mean years of schooling is 7.6 years.

Access to water and sanitation. There are currently no available data on percentage of population using safely managed drinking water services and safely managed sanitation services. In 2015, people using the *least basic drinking water services* were 99% of urban population, and 97% of rural population.[5] People using the *least basic sanitation services* were 93.8% of the urban population, and 96.2% of the rural population.[5] Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene was 3.5 per 100,000 population in 2016.[3]

Wastewater treatment. Treated wastewater was only 26.9% of wastewater generated in 2017. The north-eastern region has the highest volume of wastewater generated, but the least percentage of treatment (10.9%). The eastern region has the highest percentage of treated wastewater (43.3%).

Poverty. The percentage of population under the poverty line or poverty rate for the country has continuously decreased since 2011. It decreased from 13.22% in 2011 to 7.21% in 2015. The poverty rate of 23 coastal provinces during 2011–2015 decreased from 1.95% in 2011 to 1.52% in 2015.

3. Harnessing the Oceans: Benefits and Impacts

3.1 Ocean Economy: Contribution to Economy, Income and Employment

The contribution to ocean economy in Thailand was estimated using the NESDB's National Income as a framework. The estimated contribution of ocean economy was calculated from sum of Gross Provincial Product (GPP) in 23 coastal provinces (excluding Bangkok) minus production in non-

[3] NSOC Report.
[4] United Nations Development Programme (UNDP). 2018. Human Development Indices and Indicators: 2018 Statistical Update. Accessed from http://hdr.undp.org/sites/all/themes/hdr_theme/country-notes/THA.pdf
[5] World Bank. Development indicators – Accessed from https://data.worldbank.org/country/thailand

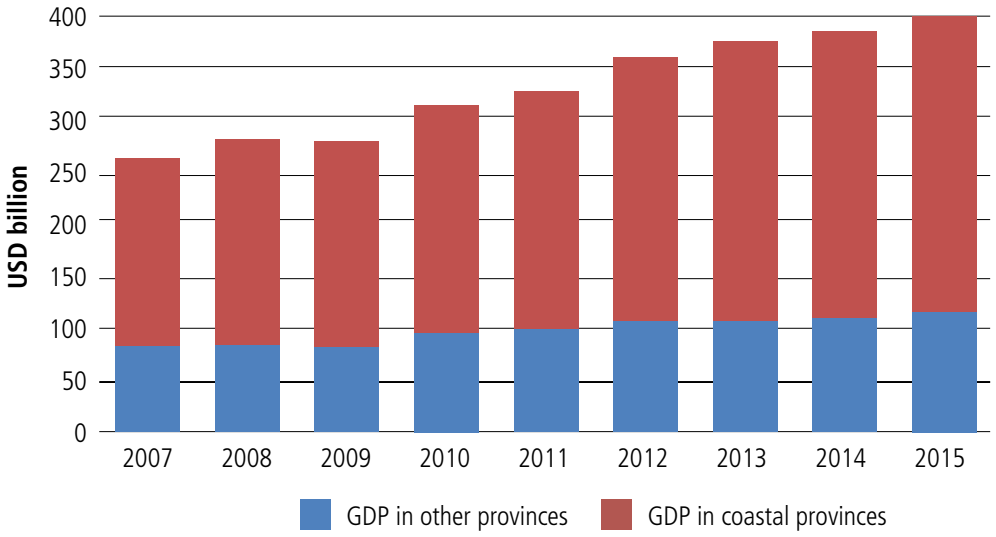
marine sectors, e.g., agriculture and forestry. The contribution to ocean economy in Thailand is shown in **Table 2**. The total value of ocean economy was **US$118.19 billion**, which is around **30% of the GDP**. The main contributing sector during 2007-2015 was manufacturing, which was almost 50% of the value. **Figure 2** shows the total GDP and GPP (in current prices) of coastal and non-coastal provinces from 2007 to 2015. In 2015, there were 9,969,331 employees in 23 coastal provinces (National Statistics Office of Thailand). Thus, employment in coastal economy was 26.22% of total employment (38,016,170).

Table 2: Ocean-related Gross Provincial Product in 23 Coastal Provinces, 2015 (in US$ billion, at constant prices).

Economic Activity	GPP	Employment
Agriculture (agriculture in land, hunting, forestry, fisheries)		2,767,744
Fishing		
Mining and quarrying	10.08	33,793
Manufacturing	49.45	2,266,037
Electricity, gas, and water supply	5.50	39,927
Construction	3.07	534,588
Wholesale and retail trade; repair of motor vehicles; and personal and household goods	13.89	1,618,572
Hotels and restaurants	5.83	839,422
Transport, storage, and communications	10.42	334,322
Financial intermediation	4.16	99,976
Real estate, renting, and business activities	5.13	56,438
Public administration and defense; compulsory social security	3.92	331,823
Education	3.39	266,545
Health and social work		159,920
Other community, social, and personal service activities	0.74	236,823
Private households with employed persons	0.11	36,252
Others: information and communication, professional, scientific and technical activities, administrative and support service activities, arts, entertainment and recreation and unknown		347,151
GPP and employment of marine sectors	118.19	9,969,331
Gross Domestic Product (GDP)	399.21	38,016,170
	29.61%	**26.22%**

Source: Thailand-map-CIA-en.jpg

Figure 2: GDP and GPP in 23 Coastal Provinces, 2007-2015 (at current prices).



The GDP and GPP do not fully capture the value of ecosystem services and their contribution to the economy and social welfare.

The economic value of marine and coastal resources using the total economic value (TEV) approach was estimated at **US$36 billion**. The marine and coastal resources evaluated were coral reefs, seagrass, mangroves, and endangered species (**Table 3**).

Table 3: Economic Value of Marine and Coastal Resources.

	Value (USD million)	Source
1. Use value		
1.1 Direct use value		
1.1.1 Fisheries value	4,438.59	Department of Fishery (2013)
1.1.2 Tourism value		
- Tourism	12,679.07	Ministry of Tourism and Sports (January – September 2013)
- Marine national park	5.69	Department of National Parks, Wildlife and Plant Conservation (2013)
1.2 Indirect use value		
1.2.1 Mangrove		
- Carbon sequestration	1,570.70	Social cost of carbon (2012)
- Coastal protection	4,040.93	Adapted from Edward Babier (2012)
- Fish nursery	563.82	Investment of restoration/ rehabilitation at Koh Mai Thon, Phuket (DMCR, 2013)
1.2.2 Coral reefs		
- Replacement cost	63.47	Investment of restoration/ rehabilitation at Koh Mai Thon, Phuket (DMCR, 2013)
- Coastal protection	946.71	Investment of coastal protection (DMCR, 2013)
1.2.3 Seagrass		
- Carbon sequestration	1,981.84	Social cost of carbon (2012)
2. Non-use value		
2.1 Mangrove	-	There is no report in Thailand
2.2 Coral reefs	51.52	Adapted from Na Bangchang, 2013 (Evaluation of coral reef from climate change phenomenon in 2013)
2.3 Seagrass	162.22	Calculated by benefit transfer method from Na Bangchang, 2012 (Studies and analysis of economics of seagrass for sustainable development)
2.4 Endangered species		
2.4.1 Sea turtle	152.58	Calculated by benefit transfer method ["Willingness to Pay for The Conservation of Endangered Species in Four Asian Countries" (Mobilizing Resources for Marine Turtle Conservation in Asia : A Cross-Country Perspective) Economy and Environment Programmeme for Southeast Asia, 2008]

Table 3: Economic Value of Marine and Coastal Resources (cont.)

	Value (USD million)	Source
2.4.2 Irrawaddy dolphin	37.05	Calculated by benefit transfer method from Na Bangchang, 2010 (Evaluation of Dolphin in Thailand)
2.4.3 Manta ray	13.56	Calculated by benefit transfer method ("Valuation Assessment of Icon Species in Lanta Marine National Park: Willingness to Pay for Conservation"; WWF Thailand Office, 2011)
2.4.4 Whale shark	11.43	
Total	**36,007.42**	

Source: Na Bangchang, 2014

Figure 3: Ocean-related Coastal Economy, 2015

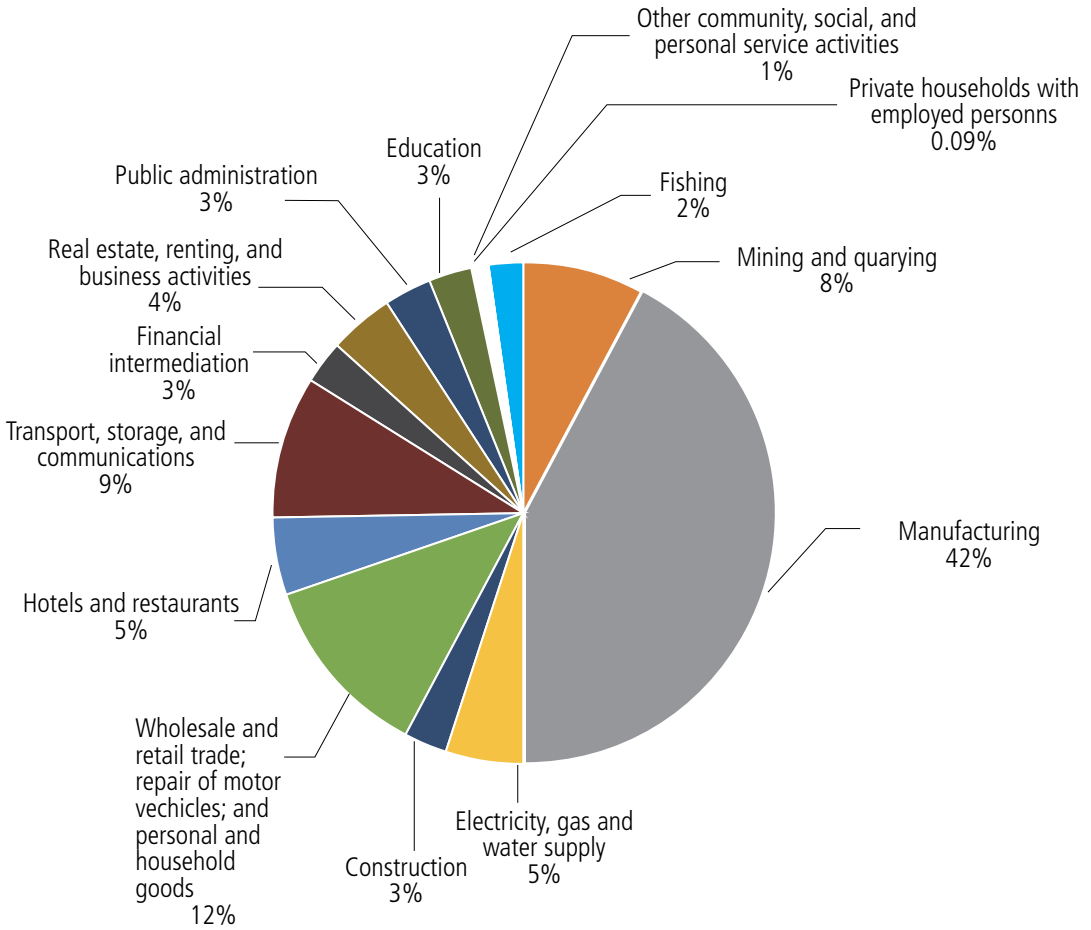
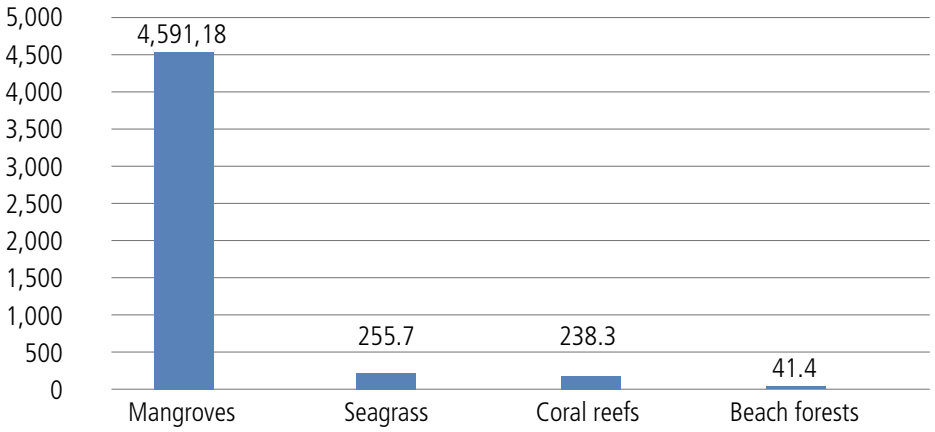


Figure 4: Area of Coastal and Marine Habitats.



3.2 Fisheries and Aquaculture

Photo from: Chonburi ICM

Production. Thailand is among the top marine fisheries producers and exporters for several decades, however the production started to decline since 2006 and dropped to less than 1.5 million tonnes in 2008. This was mainly due to overfishing and IUU fishing. Most of the marine capture fisheries production is consumed within the country while aquaculture production, mainly shrimp farming, is for export.

Food security. Thailand has no problem in term of food security, with consumption of fish and fish products at 24.83 kg/capita/yr (in 2003) compared to the world consumption of 18.98 kg/capita/yr.

Sustainability. The estimated catch per unit effort (CPUE) for the Gulf of Thailand and the Andaman Sea are 25 and 140 kg/hr, respectively. The actual harvest in 2016 of demersal fish, anchovies and other pelagic fish in both maritime areas were below the maximum sustainable yield (MSY) as a result of stricter regulations.

Pressures and threats.

- Overfishing and IUU fishing directly affected the abundance of targeted and by-catch species. Some mechanised fishing gears, such as bottom trawlers and push nets, are destructive to sea floor, and important benthic habitat like coral reefs and seagrass areas.
- Destruction of breeding, nursery and feeding grounds (e.g., mangroves, coral reefs)
- Pollution

- Increasing marine debris, especially plastic waste, have recently become threats to fisheries and endangered marine species Degraded plastic particles can be accumulated in the environment and passed through the natural food chain.
- Threats from aquaculture involves the release of nutrient-rich effluent, conversion of mangrove forests into aquaculture farms, and the release of non-native species.

Response

- **Fisheries Act, 2015; Royal Ordinance for Fisheries, 2015; Fisheries Management Plan:** to regulate illegal fishing activities; facilitate sustainable fisheries practices; and integrate habitat restoration and protection.
- **Crab seed bank initiatives** are widely practiced in coastal communities because blue swimming crab and mud crab are important commodities (Coastal Fisheries Research and Development, Department of Fisheries, 2015). The goal of these initiatives is to allow gravid females to reproduce by releasing gravid females from fishermen's crab traps (either by cooperation or trading) in protected areas. A successful example is the 'crab condominium' initiative in Sri Racha District, Chon Buri Province, which commenced in 2006 as part of the ICM program (PEMSEA, 2016). It is a collaboration between Sri Racha Municipality, Chon Buri Fisheries Association, and local fishing villagers, with appropriate financial and technical supports from various organizations.

Table 4: Crab Bank Model.

Location	Chumporn and Surat Thani
Innovations and best practices	Educating and empowering local fishing communities to ensure their food security; applying economic instruments; and collaborative community management
Benefits and outcomes	Achieved sustainable management of Blue Swimming Crab
Supporting policies and institutional arrangements	Policies and laws: Royal Ordinance on Fisheries B.E. 2558 (2015) The Thai Crab Product Group (TCPG) was formed in 2012 under the umbrella of the Thai Frozen Food Association (TFFA) Department of Fisheries is responsible for fisheries resources
SDGs being achieved	SDG 7 (Affordable and clean energy); SDG 13 (Climate action); SDG 14 (life under water); SDG 17 (Partnerships for the goals)

3.3 Coastal and Marine Tourism

Contribution to income and employment. Major marine and coastal tourism sites are Phuket, Pattaya, and Ko Samui. The natural conditions of these sites attract many tourists each year. In addition, Thailand's marine national parks are popular tourist destinations because of the coral reefs. Tourism in 23 coastal provinces contributed to about USD24 billion in 2015. Tourism also provides 820,713 people with employment in hotel and food sector in the coastal provinces.

Pressures and threats. Marine and coastal tourism has increased the country's revenues, and it is growing at an accelerated pace. However, further increase in this sector can lead to a lot of problems related to carrying capacity of habitats and pollution, which significantly harm the marine environment and resources. Major threats due to tourism include:

- degradation of coastal ecosystems, particularly coral reefs and seagrass beds – due to conversion, coastal development, pollution, etc.
- pollution due to wastewater discharges from tourism establishments and marine litter
- coastal construction, which cause chronic sedimentation
- multiple resource-use conflicts, for instance, between fisheries and tourism.
- illegal fishing in the national parks
- degradation of marine environment due to mass tourism affecting carrying capacity of fragile ecosystems
- Poorly informed and careless divers could harm corals by touching or trampling, anchoring on corals, etc.

Response

- **National policy and plans.** The 12th National Economic and Social Development Plan (NESDP), the 4th Tourism and Sport Development Plan and Policy (2017-2021), and the 2nd National Tourism Development Plan (2017-2021) were formulated by the Ministry of Tourism and Sports. These national plans will provide guidance for tourism development in the regional, provincial, and local plans. Notable sustainable tourism initiatives are given below:
- **Marine national park.** Tarutao National Park is the largest marine national park in Thailand. Its diversity is extremely high. Marine species include dugong, Irrawaddy dolphin, sperm whale, and minke whale. The island was previously used as penal colony for Thai political prisoners in the late 1930s.
- **Green Fins.** The UNEP's Green Fins Programme was started in 2004 in Thailand by the Phuket Marine Biological Centre (PMBC), and the Department of Marine and Coastal Resources (DMCR). The main objective of the programme is to assist dive operators to ensure that they minimize the environmental impacts of diving and snorkeling. A key outcome is that Green Fins members become a network for protection, conservation, and sustainable use of coral reefs. Dive operators undergo training and follow a code of conduct. Moreover, the dive operators help with the monitoring of coral reefs when they take customers on dive trips.
- **Promoting corporate social responsibility (CSR) with hotels.** Since many private sector actors in coastal areas are dependent on coastal resources for their business, it is logical to engage the private sector. The Marriott company is an example of how a private sector entity can contribute to coastal conservation and integrate local economies and livelihoods in coastal areas near the Marriott properties. The IUCN-Marriott partnership has three main components at this stage:
  - *Mangrove restoration:* Marriot collects donations from hotel guests to support mangrove restoration in four target areas in Thailand. Seven hectares were reforested in 2016.

- *Sustainable seafood sourcing:* IUCN works with Marriot to identify and source sustainable seafood directly from local communities nearby their properties. For example, in 2016, two Marriot properties sourced more than USD45K in seafood from 40 families in 3 villages around the properties.
- *Sourcing of local products as gifts and souvenirs.* IUCN also works with Marriot to source local handicrafts to be used at Marriot properties. Four of their properties present welcome bracelets to their guests. In 2016, Marriot purchased US$30,000 in bracelets from 26 families in a village near their Phukhet property.

- **Bor Hin Farmstay, Amphor Sikao, Trang province.** Recipient of the Award of Excellence in the category of Tourism Support and Promotion Organisation at the 2013 Thailand Tourism Award, Bor Hin Farmstay provides a unique ecotourism experience to visitors amidst peaceful natural surroundings of Trang Province. It is involved in conserving endangered species, particularly dugong, through seagrass preservation. Visitors can spend time learning about seagrass and the importance of their conservation, exploring the local fisherman's cage culture practices, and joining the mangrove reforestation activity.
- **Low carbon destination project in Koh Mak, Trat Province.** As a special area for sustainable tourism development, the objective of the project is to reduce carbon footprint and pollution, and maintain and improve the environment. The project encourages all tourism stakeholders, such as hotels, transport operators, tour agents, and local residents to lower carbon dioxide emissions and pollutants on the island by using alternatives to petroleum-based fuels (e.g., solar cells), implementing water and waste management, and preserving the traditional way of life of the local people.

Table 5: Low Carbon Tourist Destination Project.

Location	Ko Mak, Trat Province
Innovations and best practices	Use of alternative energy; water and waste management; preservation of local activities and traditional way of life; environment-friendly tourist activities (e.g. cycling, kayaking and sailing)
Benefits and outcomes	Reduced carbon footprint and pollution for and maintaining and improving the environment. Cooperation among relevant agencies.
Supporting policies and institutional arrangements	The National Climate Change Master Plan (2015 -2050) DASTA, ISMED
SDGs being achieved	SDG 7 (Affordable and clean energy); SDG 13 (Climate action); SDG 14 (life under water); SDG 17 (Partnerships for the goals)

3.4 Ports and Shipping

Major ports in Thailand are Bangkok Port, Laem Chabang Port, and Map Ta Phut Industrial Port. Bangkok Port and Laem Chabang Port are operated by The Port Authority of Thailand (PAT), which is a state enterprise under the jurisdiction of the Ministry of Transport. Map Ta Phut Industrial

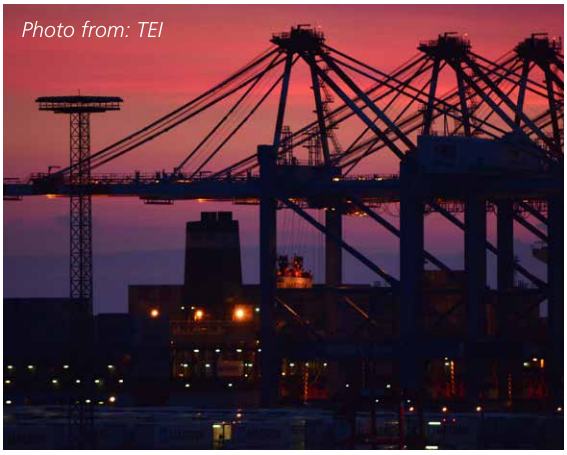


Photo from: TEI

Port is under the responsibility of the Industrial Estate Authority of Thailand, under the Ministry of Industry. These ports provide services to international shipping of goods. Overall performance of Laem Chabang Port is better than Bangkok, based on port performance indicators, such as ship calls, passenger traffic, cargo, and container throughput. Moreover, green port development will be applied for the third phase development of Laem Chabang as well as in Map Ta Phut.

Contribution to income and employment. Ports and shipping generated a total revenue of about **US$280 billion**. The transportation sector, which includes rail and road, employed 395,496 people in 2015. Growth in this sector is expected to increase. The challenge is the management of waste from ships due to the increasing number of ship calls, and container and cargo throughput.

Fish ports

There are 1,043 fish ports in the coastal provinces.

Marina and recreational ports

Thailand has provided port services to cruise ships for more than 30 years. Thai cruise ports are mainly ports of call, not home ports. Cruise ships operate a round trip and return to the original port, which can take a day or a several day trip. Inadequate infrastructure and public utility are obstacles to the development of home ports for cruise ships.

Pressures. One of the major problems in port areas is oil pollution from ships caused by accidents and ship operations. According to the Marine Department, 10 major oil spills (over 20,000 litres) occurred in Thailand in recent years. Most of the oil spills found in port areas were caused by accidents and loading/discharge operations. Although tanker accidents attract much publicity, the overall amount of oil discharges resulting from routine oil tankers and ship operations is greater and more persistent in the longer term.

Response

Green Port. Laem Chabang Port (LCP) initiated a Green Port Programme in 2010 to mitigate its carbon dioxide emissions (Apai and Thammapredee, 2014). The port has setup a wind power plant as a pilot project to increase the proportion of green energy consumption. To address carbon dioxide emission of cargo handling equipment and from ships calling the port, LCP's Low Carbon Port Programme encouraged all private terminal operators to switch from diesel fuel to electric power in operating cargo handling equipment and more electric supply for ships berthing at the quay wall.

Phase III expansion of Laem Chanbang Port is expected to operate in 2019 to accommodate the rapid growth of Thailand's international seaborne trade. The Port Authority of Thailand policy to create a Green Port project, which includes the third phase development of Laem Chabang Port, clearly sets targets to minimize environmental impacts on air, water, and ecological systems. There is also significant focus on energy-use efficiencies in the design and construction of new facilities to achieve the goal of creating a truly modern and green port.

3.5 Offshore Oil and Gas

Contribution to economy. Offshore oil and gas is another major contributor to ocean economy. In 2015, production was equivalent to 293.7 million barrels of oil. The sector provides income for the government consisting of royalty, special remuneration benefits, and petroleum income tax of US$3.8 billion. The government also receives remuneration from the Malaysia-Thailand Joint Development Area (MTJDA) valued at US$0.54 billion.

Pressures


Photo from: TEI

- An increasing trend in oil spill incidents from oil exploration and production activities has also been observed. In July 2013, an oil spill off the coast of Rayong Province raised major public concern in Thailand. More than 50 tonnes of crude oil spilled into the Gulf following a leak in an oil pipe at an offshore platform operated by PTT Global Chemical Public Company Limited, a subsidiary of Thailand's national petroleum company, PTT. This incident represents the largest oil spill in the GoT, resulting in an increasing threat to the coastal and marine resources and coastal communities in the area.
- Thailand is also facing the challenge of decommissioning offshore platform at the end of their production. At present, consultation is going on between oil companies and the government to explore the decommissioning options, including rig-to-reef decommissioning.

Response

- **Environmental standard compliance.** In Thailand, the concessionaire must develop the environment impact assessment (EIA) report, which includes measures for the prevention and mitigation of impacts and monitoring, and comply with occupational health, safety, and environment standards (ISO 14001 and ISO 18000).
- **Mercury monitoring.** As mercury is a by-product of the petroleum production, mercury in tissues of bottom-feeding (demersal) fish around production platforms is randomly monitored. The monitoring conducted by Chulalongkorn and Burapa University showed that the level of mercury was below 0.5 mg/kg (food safety standards by the Ministry of Public Health). The seawater quality around the production platform was also monitored for mercury. The result

showed the concentration level was less than 0.1 microgram/litre of seawater, which is type 1 (seawater quality for natural resource conservation) on the standard of the National Environment Board, No. 27 (2006).

4. Transitioning to Blue Economy

The blue economy, as discussed during the East Asian Seas (EAS) Congress 2012, refers to a sustainable ocean-based economic model; one that employs environmentally-sound and innovative infrastructure, technologies, and practices, including institutional and financing arrangements, for meeting the goals of: (a) sustainable and inclusive development; (b) protecting our coasts and oceans, and reducing environmental risks and ecological scarcities; (c) addressing water, energy, and food security; (d) protecting the health, livelihoods, and welfare of the people in the coastal zone; and (e) fostering ecosystem-based climate change mitigation and adaptation measures.

Table 6 shows the developments in ocean economic activities, and new trends and initiatives in blue economy.

Table 6: Ocean Economy and Development in Blue Economy.

Ocean Economy	Blue Economy Initiatives
Fisheries and aquaculture • Fisheries and aquaculture in 23 coastal provinces generated **US$2.5 billion**. • **Pressures:** Decline in fisheries production due to overfishing, IUU fishing, habitat loss and pollution; Decline in aquaculture production to seafood quality (affected exports), habitat loss, pollution, introduction of non-native species	**Sustainable fisheries** • **Fisheries Management Plan:** integrated with habitat conservation; measures to address IUU fishing; seasonal fishing closure **Sustainable aquaculture** • **Crab Bank:** In Sri Racha, Chumporn and Surat Thani – Increased crab production; includes education, stock assessment and co-management with fisher communities • **Aquaculture auditing system:** more than 10,000 shrimp farms have been certified for Good Aquaculture Practice
Coastal and marine tourism • Tourism in 23 coastal provinces contributed to about **US$24 billion** in 2015, and provides 820,713 people with employment. • **Pressures:** habitat degradation, pollution, over-development; carrying capacity; multiple resource-use conflicts	**Sustainable tourism** • **Low carbon tourist destination:** project in Koh Mak, Trat Province – Using alternative energy, waste management, and preserving traditional way of life • **Green Fins program:** involving diving operators in coral reef monitoring and conservation, and ensuring proper diving practices among tourists • **Ecotourism:** Bor Hin farmstay in Amphor Sikao, Trang Province: includes mangrove reforestation, Seagrass Seeding Bank
Ports and shipping • Ports and shipping generated a total revenue of about US$280 billion. • Pressures: oil spills from operations and accidents; invasive species	**Sustainable ports** • Laem Chabang Port – installed wind power plant; switched from diesel fuel to electric power to lower carbon emissions; improved energy use efficiency • Port Safety, Health and Environmental Management System (PSHEMS) Certification: Bangkok Port and Laem Chabang Port

Table 6: Ocean Economy and Development in Blue Economy (cont.)

Ocean Economy	Blue Economy Initiatives
Oil and gas • In 2015, 293.7 million barrels of oil were produced. • Royalties, remuneration, tax: US$4.34 billion • Pressures: oil spills, mercury	**Renewable energy** • Wind power: In 2015, wind energy production capacity was 16.02 MW.
Water: Seawater utilization	**Desalination** • Three desalination plants in operation, mainly for the islands where freshwater supply is not available or scarce.
Water • Pressures: Only 26.9% of wastewater generated is treated.	**Pollution reduction** • 20-Year Pollution Management Strategy; Pollution Management Plan 2017-2021 • Laem Phak Bia Project in Phetchaburi province: simple, natural, and low cost wastewater and waste treatment models ideal for Thai communities
Pressures: Conversion of mangroves to fish and shrimp ponds; encroachment from coastal and infrastructure development; charcoal production; tin mining; illegal fishing (use of dynamite and cyanide); pollution; marine debris; sedimentation; oil spills; rising temperature	**Habitat and biodiversity conservation** • Mangrove rehabilitation: increasing area of mangroves • MPAs, marine parks: Tarutao National Park • **Coral reef rehabilitation;** Coral cultivation (Samaersan, Chonburi) • Kung Krabaen Bay Royal Development Study Center in Chantaburi Province: Mangrove reforestation; seagrass conservation; sustainable aquaculture; ecotourism

5. State of ocean health underpinning the blue economy

5.1 Marine water quality

A monitoring program has been carried out by the Pollution Control Department (PCD). Water samples are collected twice annually from 202 stations along the coastline of Thailand. The Marine Water Quality Index (MWQI) is calculated from eight parameters:

- Dissolved Oxygen (DO)
- Total Coliform Bacteria
- Phosphate - Phosphorus (PO_4^{3-} - P)
- Nitrate - Nitrogen (NO_{3-} - N)
- Temperature (Temp)
- Suspended Solids (SS)
- Acidity - Alkalinity (pH)
- Ammonia - Nitrogen (NH_3 - N)

The values of the MWQI range between 0 and 100, where a score of 0-25 is considered very poor; 25-50 is poor; 50-80 is fair; 80-90 is good; and 90-100 is excellent. . In 2015, all parameters were acceptable, as shown in **Table 7**. The inner Gulf of Thailand has the worst water quality, where it is poor in terms of phosphates.

Other key findings of the PCD:

- No excellent condition was found since 2006.
- The percentage of fair condition increased, while percentage of good condition of seawater decreased from 52% in 2006 to 16% in 2015.
- The main tourism beaches, which included Kai Bae Beach, Trat and Patong Beach, Phuket have been identified as fair condition since 2014.
- The poor and very poor quality areas were found in estuaries of major rivers, namely, Bang Pakong, Chao Phraya, Tha Chin, and Mae Klong.
- Water quality at Sattahip Pier in the Eastern Seaboard has been in poor condition since 2014.

Figure 5: Marine Water Quality 2015 (Using MWQI).

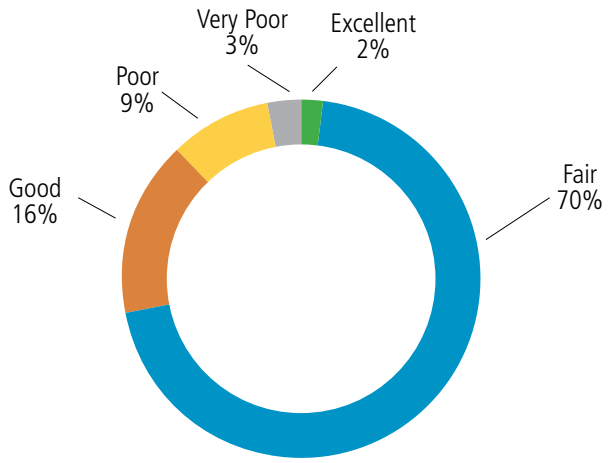


Table 7: Coastal and Marine Water Quality.

Parameters	Rating
pH	Good - Excellent
DO	Good - Excellent
Nitrates	Fair - Good
Ammonia	Excellent
Phosphates	Good*
Total coliform	Fair - Good
Heavy metals**	Excellent

Note:
**Except in the inner Gulf of Thailand, where phosphates is poor*
*** Include arsenic, cadmium, copper, lead and zinc*
Rating is percentage of stations complying with the water quality criteria and standards, and fully support the intended use or classification of the water body:
Excellent: 98-100%; Good: 75-97%; Fair: 50-74%; Poor: less than 50%.

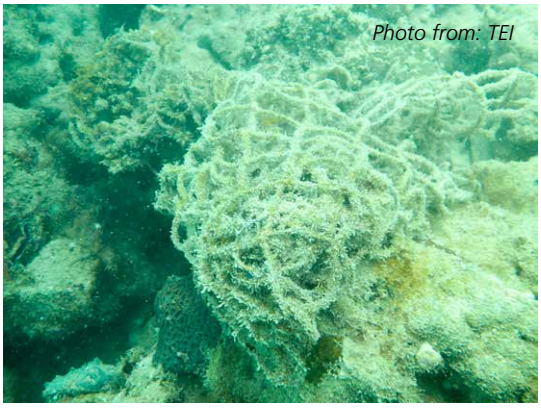
5.2 Coastal and marine ecosystems

Mangrove, coral reefs, and seagrass are important coastal ecosystems in Thailand. The main problems are declining areas and degradation, which significantly reduce the ecosystem services they provide. **Table 8** shows the area (in km^2), species composition and current condition of key habitats in Thailand as well as their economic value and the pressures and threats affecting their sustainability.

Table 8: Status and Value of Key Habitats.

Habitat	Area (km^2)	Valuation (USD million)	Species composition	Status	Pressures and Threats
Mangroves	4,591.18 (2014)	6,175.5 (2012)	81	• decreased mangrove area in 1961-1996 • an increase in area since 2000 due to mangrove planting • increase in fair condition • pristine mangroves in 50% of the area	Causes of past decline: • charcoal production • tin mining • agriculture • fish and shrimp farms • infrastructure development
Seagrass	255.70	2,144.1 (2012)	13	• an increase in area and fair condition • healthy seagrass cover: 46.6%	• illegal fishing, use of dynamite and cyanide • untreated wastewater discharge • pollution • marine debris • sedimentation • oil spill caused by accidents and routine operation • rising temperature and coral bleaching
Coral reefs	238.30	1,061.7 (2013)	280	• Increasing trend of degradation • Most reefs are in fair-poor condition • In 2011-2015: Very healthy and healthy: only 4%	
Beach forests	41.4			• area of beach forest is quite small, and serves only as temporary habitats for some rare animals, such as the Indian muntjac (*Muntiacus muntjak*), small Asian mongoose (*Herpestes javanicus*), and fishing cat (*Prionailurus viverrinus*), etc.	• encroachment from coastal development, such as construction of hotels, restaurants, houses, and piers, etc.

Box 1. Coral Bleaching



The rising temperature in the Gulf of Thailand (GoT) and the Andaman Sea affected marine organisms and ecosystems, especially corals, which are sensitive to warmer water temperature. There were two coral bleaching incidents in Thailand in 1998 and 2010. In 2010, sea surface temperature increased to 30°C-34°C during March-June 2010 in both the Andaman Sea and the GoT. The survey conducted by DMCR, in collaboration with a network of Thai universities and NGOs, reported widespread and severe coral bleaching of over 80% at several reef sites. Coral mortality caused by the bleaching event is estimated at about 50%-60% within the Andaman Sea, and about 30%-40% within the GoT. The 2010 bleaching in GoT is similar to the 1998 event in extent, but with greater severity than that of 1998; while the bleaching in the Andaman Sea was greater both in extent and severity. (Source: Yeemin et al., 2012)

In 2017, Thailand ranked 75th in terms of the Ocean Health Index (OHI) among 221 countries and territories with an overall score of 71 (www.oceanhealthindex.org/). The highest score was 86 in 'coastal livelihoods and economies' and in 'biodiversity', and the lowest score was in the 'sense of place' and 'clean water'.

6. Ocean Governance: Gearing Up for the Challenges

6.1 Major National Laws and Policies

Although Thailand has about 3,100,000 km^2 of marine areas which equal to about 60% of the total land area, the country has no overall national marine policy. The main policy framework is the 5-year national development plan, which guides the country development direction for every 5-year period. This plan, which started in 1961, is used as a guideline for other sectoral policies and plans to be developed by their respective ministries. Thailand has also just ratified the United Nations Convention on Laws of the Seas (UNCLOS 1982). Therefore, all related laws have to be reviewed in order to meet the commitment under UNCLOS.

6.2 Governance Structure and Mechanisms Supporting Blue Economy Development

Overall, the management of Thailand's coastal resources has been governed by several laws (DMCR, 2007). The *Enhancement and Conservation of the National Environmental Quality Act, 1992* covers provisions on standard setting and monitoring of the environmental quality, environmental impact assessment system, and setting up organizations/committees to be responsible for solving natural resources and environmental problems. This act is applied to natural resources and environment, including coastal and marine resources. Thailand has no single ministry responsible for marine affairs. The responsibilities related to the marine sectors are shared by many ministries, such as the Ministry of Agriculture and Cooperatives, Ministry of Transport, Ministry of Energy, and Ministry of Natural Resources and Environment.

The *Promotion of Marine and Coastal Resources Management Act, 2015* establishes a National Committee on Marine and Coastal Resources Management Policy and Planning, responsible for proposing policy and management plans for marine and coastal resources.

6.2.1 Integrated Coastal Management

The Chon Buri Integrated Coastal Management (ICM) Project was initiated by the Provincial Government of Chon Buri with PEMSEA's support to strengthen capacity of local governments on coastal and marine resources management. Central government agencies, local government units, and local stakeholders were involved in project planning and development since the beginning of the project in November 1999. The ICM Project was initiated at a most opportune time after the implementation of the decentralization policy, which delegated responsibility and provided more authority to local governments to manage their natural resources and environment.

The following are the key outputs of ICM in Chon Buri:

- importance of scientific information to support better coastal management was widely recognized
- linkages with scientific institutions and experts have been strengthened
- Management-related scientific studies have been implemented and utilized to guide planning and implementation of various ICM activities, including research on sea turtle disease to support the sea turtle conservation programme, and research on culture of local fish species to support local livelihood. The sea turtle release programme has been an annual event, releasing around 100 turtles yearly.
- Mangroves have also been re-planted in various municipalities.
- Different structures have been set up to protect and conserve blue swimming crabs.
- Beaches and coastlines are cleaner due to the clean-up drives.
- Public participation in waste management has improved with the garbage banks.
- Wide stakeholder participation characterized all activities.

The ecological and socio-economic impacts of these activities may not be immediately evident, but with sustained efforts and proper monitoring, positive impacts are expected. On the whole, the most significant impacts of ICM implementation in Chon Buri ICM programme are the enhanced multi-sectoral, vertical and horizontal integration of efforts, and enhanced ownership for and confidence in ICM implementation, which have been demonstrated by the joint effort in developing and implementing the area-wide Coastal Strategy Implementation Plan (CSIP) and establishment of institutional arrangements for ICM implementation.

6.2.2 Policies and Actions to Protect Ocean Health and Support Blue Economy Development

1. Habitat and biodiversity protection

The government created marine protected areas (MPAs), such as: included Marine National Parks (National Park Act of 1961); Non-hunting Areas (Wild Animal Reservation and Protection Act of 1992); National Reserved Forest (Forest Act of 1941); Biosphere Reserve (UNESCO Man and Biosphere); Environmental Protection Areas (The Enhancement and Conservation of National Environmental Quality Act of 1992); and Plant Conservation Area (Royal Ordinance on Fisheries of 2015).

2. Sustainable fisheries

Fisheries Management Plan. The Department of Fisheries (DOF) has developed a 2015-2019 fisheries management plan recognizing the need to reduce the fishing capacity and fishing effort to limit the catch at or near the MSY, rebuild fisheries resources, eliminate IUU fishing, as well as prevent illegally fished commodities to enter Thailand seafood supply chain. The ecosystem-based fisheries management (EAFM) was adopted as well as exploring science-based management options, e.g., determining total allowable catch (TAC) and individual transferable quotas. The DOF recognized the need for an integrated fisheries plan that includes the protection of important habitats for fisheries resources. To implement EAFM, the Department of Fisheries recognized the need to work across sectors to restore ecosystem health to support the recovery of fisheries resources.

Seasonal closure of fisheries. The Department of Fisheries has imposed a three-month fisheries closure period during the spawning period (February to May for the Gulf of Thailand; April to June for the Andaman Sea). The regulation focuses on commercial fisheries.

Aquaculture auditing system. Since 2003, the Department of Fisheries has encouraged good aquaculture practices for important commodities, such as shrimp and fishes, through a governmental auditing system. The criteria include practices, which are socially and environmentally responsible. In 2015, there are more than 10,000 shrimp farms, which have

been certified for Good Aquaculture Practice (GAP). However, some farmers have taken further steps to meet international standards.

3. Sustainable Ports and Shipping

Institutional arrangements.

- In Thailand, the Marine Department under the Ministry of Transport is the principal agency dealing with the prevention and response of marine-based pollution incidents in the country.
- Other agencies involved in oil pollution prevention are the **Royal Thai Navy, the Provincial Administration, and the Oil Industry Environmental Safety Group**.
- The Committee on the Prevention and Combating of Oil Pollution, established in 1982, incorporates all interested bodies to review the current state of response readiness and provide suitable equipment during an oil spill incident. The Committee, chaired by the Minister of Transport, is responsible for the National Oil Spill Response Plan (OSRP). The Marine Department has sufficient response resources for a 500-tonne oil spill. Equipment used for marine oil spills are stored and maintained at the Channel Development and Maintenance Centre in Songkhla Province, and Merchant Marine Training Centre in Samut Prakan Province.

International agreements.

- Thailand has ratified the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex I and II on 2 November 2007, and these Annexes entered into force for Thailand on 2 February 2008. At present, Thailand is in the preparation process to becoming a party to Annex IV and V of MARPOL.
- The **Joint Statement on Partnership in Oil Spill Preparedness and Response in the Gulf of Thailand** (GOT Programme) was initiated by PEMSEA, and signed on January 12, 2006 in Hanoi by Cambodia, Thailand, and Viet Nam. This coordination mechanism aims to enhance national and regional competences on oil pollution prevention, preparedness, and response by exchanging information, research, and conducting oil spill response (OSR) exercises for capacity building and Gulf-wide implementation. The Marine Department, Ministry of Transport is the National Contact Point in Thailand for this partnership.

Best practices and outputs

- An example of good practice is the implementation of **Port, Safety, Health and Environmental Management System** (PSHEMS) at Bangkok and Laem Chabang Ports. PSHEMS was recognized as an integrated management system, designed to provide port authorities with a management framework for enhancing efficiency, cost-effectiveness, and profit for their operations. Laem Chabang Port and Bangkok Port received PSHEMS Level 1 Certificate of Recognition in 2009 and 2018, respectively. Both ports requested PEMSEA for technical assistance for the PSHEMS Level 2; their goal is to receive the PEMSEA PSHEMS Level 2 certificate by 2019.

- The **ESI Mapping in the Gulf of Thailand Project**, supported by IMO, KOICA and PEMSEA, and involving sub-regional and national technical teams, produced the **ESI Atlas for the Gulf of Thailand**, which guides planning and response to oil spill incidents covering coastal and marine resource along the Gulf. The ESI Atlas for the Gulf of Thailand is being used as reference during oil spill response exercises. It is available for download in the Marine Department website.

4. Pollution reduction

For overall pollution management in Thailand, the government has established the *20-Year Pollution Management Strategy,* and *Pollution Management Plan 2017-2021*.

The percentage of treated wastewater is only about a quarter of the wastewater generated (26.9%). The eastern region has the highest percentage of treated wastewater (43.3%), while the northeastern region has the least percentage of treatment (10.9%) (**Table 9**).

Current measures on water quality management in Bangkok include: implementation of central wastewater treatment projects; improvement of the community wastewater treatment plants, improvement of canal water and canal cleanup campaign, effective enforcement of effluent standards; and, public education and awareness raising.

Table 9: Volume of wastewater generated and treated by region, 2015

Region	Wastewater generated (m^3/day)	Treatment capacity (m^3/day)	Wastewater treated (%)	Provinces with highest volume of wastewater
North	925,569	255,809	27.6	Chiang Mai
Northeast	3,248,977	353,466	10.9	Nakhon Ratchasima
Central	2,942,739	1,253,000	42.6	Bangkok
East	686,411	297,400	43.3	Chon Buri
West	475,742	107,900	22.7	Ratchaburi
South	1,310,929	313,050	23.9	Nakhon Si Thammarat
Total	**9,590,367**	**2,580,625**	**26.9**	

Source: Pollution Control Department, 2015

Notes:
1. Volume of wastewater was referenced from the Community Wastewater Statistics Improvement Project of the Pollution Control Department, 2010. The project uses the population census data collected by the Department of Local Administration, March 2015.
2. Data on Bangkok wastewater volume was evaluated from the census record, not the actual volume generated, since the data cannot distinguish between actual Bangkok residents, residents from other provinces, and tourists.

Similar to wastewater, solid waste is a major problem in Thailand. A significant amount of uncollected and improper disposal of wastes, particularly plastic wastes from inland areas, have been transported into the sea. When these wastes reach the marine environment and become marine debris, they are very difficult to manage. In order to prevent the problem of marine debris from land-based sources, plans and policies related to solid waste management were implemented:

- Roadmap on Waste and Hazardous Waste Management;
- National Solid Waste Management Master Plan (2016-2020); and
- Thailand Zero Waste Action Plan (2016-2017).

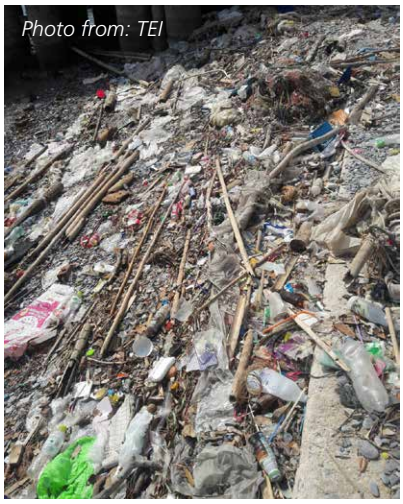


Photo from: TEI

At the high-level United Nations Conference to Support the Implementation of Sustainable Development Goal 14 held at the UN Headquarters in New York on 5-9 June 2017, Thailand made voluntary commitments to mitigate marine debris, which include coastal cleanup in all coastal provinces, implementing plastic waste reduction measures in all 549 coastal municipalities, undertaking researches on situation and impacts of plastic debris in marine environment, and establishing a national database of marine debris.

7. Way Forward

Using the comprehensive information from the NSOC report, the following are recommended for future actions:

National policy and strategy. In response to a lack of an overall national ocean policy, an integrated national marine policy should be developed in order to balance prosperity and sustainability. It is recommended to develop a national marine policy that will:

1. Promote the development of blue economy by integrating the 20-year National Strategy, the 12th National Economic and Social Development Plan, the National Maritime Security Plan and the National Environmental Management Plan and other related plans;
2. Provide a framework for amending existing ocean-related laws to comply with UNCLOS to facilitate the right ocean uses within and outside national jurisdictions.
3. Foster plans for pollution reduction, and conservation and rehabilitation of ecosystems, such as conservation of coral reefs as nursery grounds of marine organisms, rehabilitation of seagrass as feeding ground for dugong, and restoration of mangrove forests. Furthermore, integration of these plans and co-management arrangements should be promoted at the local level.

Blue Economy Development and Growth

1. Application of the concept of blue economy to ocean-based economy, particularly in new and emerging sectors, such as renewable energy, ship building and repair, biotechnology and bioprospecting, ecotourism, and sustainable fisheries and aquaculture
2. Promote economic valuation of marine and coastal resources and environment uses, including the importance of natural capital and ecosystem services. Such evaluation will be used to support decision-making in developing guidelines, policies and plans for ocean-based development activities, decommissioning of oil and gas production installations, deployment of new, climate-smart technologies, etc. in the future.
3. Establish measures and clear approaches to control the use of marine and coastal resources that directly and indirectly affect the ecosystems, resources and environment. For example, Code of Conduct on ecotourism; regulations and incentives on community waste management system; reduction of plastic wastes and marine debris. Effective enforcement of laws and regulations, including penalties and fees, is also critical.
4. Develop a framework of guidelines for each development activity. Such framework will include marine mapping, marine spatial planning, and zoning or delineation of allowed, regulated and restricted uses and specific types and size of activities, as well as mitigation measures for each activity.
5. Apply the User Pays Principle (UPP) and ecosystem-based management. In cases where resource uses are unavoidable, the beneficiary should be responsible for the cost of mitigating environmental impact of those uses. Examples of UPP measures that can be initially done are resource entrance fee for visiting islands, diving fee, and voluntary contribution from hotel guests in protecting marine environment. Another measure is pollution fee, using the Polluter Pays Principle. Collection of such fees can be earmarked as another source of fund for waste management and protection of marine and coastal resources.
6. Enhance knowledge on the management of marine and coastal resources, integrate technical and traditional knowledge, and raise public awareness on conservation of marine and coastal resources, and the problem of marine debris, which has global impact.
7. Promote participation of all stakeholders in the assessment of the problems, identifying mitigation measures, and prevention of the problems in the future.
8. Specific data system should be designed and developed for ocean accounts and valuation of coastal and marine resources in order to provide the necessary information for assessment of the state of the oceans and coasts of the country.

Linkage of science, economics and policy. Growth in social and economic development based on direct and indirect uses of marine and coastal resources has caused continuous degradation of marine and coastal resources. Therefore, it is necessary to establish a decision-making system to create a balance among marine and coastal resource uses, conservation.

1. Scientific research and regular environmental monitoring are needed to assess natural capital and ecosystem services, and impacts of environmental damage and climate change. Make the

results available to policy- and decision-makers to aid in making policy interventions, mix of regulations and incentives, and appropriate plans to achieve sustainable development.

2. Research and development (R&D) is needed for ocean-related areas, such as climate-smart aquaculture, marine biotechnology, green ports, and marine renewable energy. Incentives to support the deployment of R&D products and innovative technologies would facilitate their application in traditional ocean economic activities, and boost the shift from the business-as-usual approach to innovative and sustainable blue economy.

Table 10: State of Ocean Health and Economy.

Indicator	Status	Response		Major issues and challenges
		Key policies/laws; national action plan	Example of best practice or initiative	
State of ocean health				
Mangroves - Area; cover - Condition 1961- 1986 1989 - 1996 1996 - 2014	 ↓ - ↑	- Forest Act of 1941 - Mangrove reclamation measure - Mangrove replanting measure	- Integrated Coastal Management (ICM) : The Kung Krabaen Bay Royal Development Study Centre, Chantaburi Province - MFF	Issues: • Conversion of mangrove area • Wastewater and marine debris • Oil spill • Challenges: • Monitoring of replanted forests • Community management in mangrove forest
Coral reefs - Area; cover - Condition	↓	• PMCRM Act of 2015 • National Park Act of 1961 • Strategies and action plan on coral reef management (2009)	• Seasonal closure of marine national park (e.g., coral bleaching phenomenon) • MFF • Ecotourism • Green Fins	• Seasonal closure of marine national park (e.g., coral bleaching phenomenon) • MFF • Ecotourism • Green Fins
Seagrass beds - Area; cover - Condition	↓	• PMCRM Act of 2015 • Strategies and action plan for seagrass and dugong management (2008)	• Bor Hin Farmstay, Trang Province • The Kung Krabaen Bay Royal Development Study Centre, Chantaburi Province	Issues: • Illegal fishing • Sedimentation from coastal utilization
Fish stock Catch Per Unit Effort (CPUE)	↓ -	• Royal Ordinance on Fishries of 2015 • Marine Fisheries Management Plan of Thailand (2015-2019)	• Andaman Trawl Fisheries Improvement Project • Seasonal regulations • Crab seed bank initiatives	Issues: • Depletion of fish stock • Incomplete database Challenge: • Scientific-based Maximum Sustainable Yield (MSY)
Rare, Endangered and Threatened species	↓	• Wild Animal Reservation and Protection Act of 1992 • Royal Ordinance on Fisheries of 2015	• The marine rescue and monitoring centre • MFF • Bor Hin Farmstay, Trang Province	Issues: • Plastic litters ingestion and entanglement • Fisheries by-catch • Destruction of nesting site and feeding ground

Table 10: State of Ocean Health and Economy (cont.)

Indicator	Status	Response		Major issues and challenges
		Key policies/laws; national action plan	Example of best practice or initiative	
State of ocean health				
Marine water quality (DO, N, P, TSS, etc.)	↓	• ECNEQ Act of 1992 • Public Health Act of 1992	• Laem Phak Bia environmental research and development projects (Wastewater treatment model)	Issue: - Released mass of wastewater without treatment into the rivers - Local impact from coliform bacteria and eutrophication Challenge: - Effective operation of existing treatment plant
Marine protected areas (MPA)	↑	• Forest Act of 1941 • National Park Act, of 1961 • ECNEQ Act of 1992 • PMCRM Act of 2015 • Wild Animal Reservation and Protection Act of 1992	• Marine national parks, e.g., Ko Phi Phi, Ko Surin, Mo Ko Tarutao national park, Ko Kra (Nakhon Si Thammarat Province)	Issue: - Law enforcement Challenges: - Enforcement of carrying capacity - Increasing the number of effective MPAs
Coastal erosion and sedimentation	↑	• PMCRM Act of 2015	• Eco-DRR; Krabi, Nakhon Si Thammarat and Trang Province	Challenge: - Integrated spatial planning for prevention and mitigation - Set back zone
Wastewater management	↓	• ECNEQ Act of 1992 • Public Health Act of 1992 • Factory Act of 1992 • Roadmap on Waste and Hazardous Waste Management • National Solid Waste Management Master Plan (2016-2020) • Thailand Zero Waste Action Plan (2016-2017)	• Laem Phak Bia environmental research and development Projects (wastewater treatment model)	Issue: - Land- and sea-based pollutions Challenge: - Effective water treatment
State of ocean economy				
Ocean economy - Value - Contribution to GDP	↑ -	• The 20-Year National Strategy (2017-2036) • The 12th NESDP (2017-2022)	• National Maritime Policy	Issue: - Lack of appropriate innovation and technology - Lack of awareness as maritime nation Challenge: - Government support and coordination

Table 10: State of Ocean Health and Economy (cont.)

Indicator	Status	Response		Major issues and challenges
		Key policies/laws; national action plan	Example of best practice or initiative	
State of ocean economy				
Fisheries - Volume and Value **Aquaculture** - Volume and Value	↓ ↓	• Royal Ordinance on Fisheries of 2015 • 2015-2019 Fisheries Management Plan	• Crab seed bank initiatives • Andaman Trawl Fisheries Improvement Project • Artificial Reef under South China Sea Fisheries Refugia Initiative • Good Aquaculture Practice (GAP)	Issue: - Overfishing and IUU fishing - Alien species - Wastewater and marine debris - Shrimp farms Challenge: - Effectiveness of action plans - Ecosystem based fisheries management
Tourism - No. of tourists - Value	↑ ↑	• 2nd National Tourism Development Plan (2017-2021) • 4th Tourism and Sport development plan and policy (2017-2021)	• Sustainable tourism (Low carbon tourist destination project) • Increase public awareness on diving and snorkeling practices (Green Fins) • Ecotourism (Bor Hin Farmstay)	Issue: - Deterioration of marine ecosystems - Wastewater and marine debris - Overtourism Challenge: - Sustainable tourism: extend to more tourism areas and establishments
Ports and shipping - Passenger volume - Cargo and container throughput volume	↑ ↑	• Navigation in Thai Waters Act of 1913 • Port Authority of Thailand Act of 1951	• Green port • Implementation of PSHEMS	Issue: - Waste management - Oil spill Challenges: - Green port implementation - PSHEMS continuity
Offshore oil and gas - Production - Value	- ↓	• Petroleum Act of 1971	N/A	Challenge: - Decommisionning of rigs and platforms
Alternative Energy: offshore wind farm - capacity	↑	• AEDP 2015-2036	N/A	Challenge: - Noise; - Effects on birds

1 Introduction

In December 2003, 12 countries in East Asia, including Thailand, signed the Putrajaya Declaration and adopted the Sustainable Development Strategy for the Seas of East Asia (SDS-SEA) as a common regional platform for the implementation of Agenda 21, the Millennium Development Goals, the World Summit on Sustainable Development Plan of Implementation, and other related global and regional environmental instruments concerning coasts, islands, and oceans. The Government of Thailand has since then supported the implementation of programmemes and activities that contribute to regional and national SDS-SEA implementation, including participation in GEF/UNDP regional projects in support of SDS-SEA implementation.

In November 2015, Ministers and Senior Government Officials from 11 PEMSEA Partner Countries signed the Da Nang Compact, thereby adopting the SDS-SEA 2015 and four post-2015 Strategic Targets including establishing a regional State of Oceans and Coasts reporting system to monitor progress, impacts and benefits, and to continually improve planning and management of SDS-SEA implementation. Furthermore, prior to the EAS Congress 2015, work was initiated by the PEMSEA[1] Resource Facility (PRF) on the blue economy assessment aimed to strengthen understanding of the role of the ocean and its contribution to the national economy; impacts of human activities on ocean health and sustainability; potential areas for investments in environmentally-sound technologies and infrastructure; and the interventions and innovative mechanisms needed to respond to changing environments and climate.

Although Thailand is not yet a country partner to PEMSEA, there was an agreement to participate in the development of the National State of Oceans and Coasts (NSOC) Report as this report will be useful to the management of the marine and coastal areas of Thailand. The NSOC report provides a comprehensive picture of the state of oceans and coasts, the blue economy development, innovations, and investment opportunities, as guided by the report outline provided by PEMSEA. The NSOC report is also informative in showing the benefits derived from the oceans as well as the impacts of human activities and the changing environment and climate. The report presents the governance structure – policies, laws, plans, capacity development, and institutional arrangements – and on-going programs and actions to mitigate habitat destruction, pollution, destructive and overfishing, climate change, and other pressures on the coastal and marine environment and ecosystems. Thus, the NSOC report shows how the country is contributing to the implementation

[1] The outline of the SOC Report was developed during the Regional Planning Workshop on Developing A State of Oceans and Coasts Report for the Seas of East Asia held on 31 March - 1 April 2016 in Quezon City, Philippines, and participated by 15 international organizations and regional programmes.

of the SDS-SEA and achievement of the Agenda 2030 and the Sustainable Development Goals (SDGs), and other international agreements. Most of the data and information used in the report is in the year 2015. Data from previous years are also used to show trends and changes over time.

The Department of Marine and Coastal Resources (DMCR), Ministry of Natural Resources and Environment (MNRE) is a key agency in the preparation of the report, with technical support from the Thailand Environment Institute (TEI). The main role of TEI is to assist the DMCR, in collaboration with concerned government agencies, scientific and technical institutions and universities, non-government organisations and other key sectors, to plan, collect, and analyse data and finalise the NSOC report for Thailand. This is carried out by setting up a technical working group (TWG) with representatives from relevant agencies and academic and research institutions. The members of the TWG and scope of work are shown in the Appendix of this report.

1. Concept and Rationale

One of the most important but little noticed change over the past decades is how our perspective on the world's oceans has changed. Oceans were first considered vast and limitless. Following centuries of exploration, oceans became areas for shipping, deep sea fishing, nuclear testing, dumping of wastes, and exploitation for food, minerals, oil and gas, and other resources. Given the current challenges, studies on the state of the marine environment have become more significant. There is now increasing recognition that oceans are finite, with fragile ecosystems and biodiversity under pressure from human activities, and climate and environmental changes. Yet, the benefits derived from the oceans have not been fully quantified as well as the environmental and societal impacts and costs of over-exploitation, pollution, and years of neglect. It has therefore become critical to understand that human activities, whether on land or on sea, have impacts, and each of our uses of oceans involves real or potential tradeoffs with other uses. This means we need a much better and more detailed understanding of the economic values of oceans and coastal and marine resources, and assesment of the state of ocean health underpinning the sustainable development of oceans and coasts.

Within this context, the term "blue economy" has entered into the vocabulary of economic development in all parts of the world. But the meaning of "blue economy" is still evolving, with some emphasizing the possibilities of new ocean-based industries, such as renewable energy or bio-pharmaceuticals, and others emphasizing the need to transform the traditional ocean economy and the emerging ocean industries into a more sustainable and inclusive blue economy, conserving the oceanic natural capital and providing opportunities across society. The blue economy, as discussed during the East Asian Seas (EAS) Congress 2012 and EAS Congress 2015, refers to a sustainable ocean-based economic model; one that employs environmentally-sound and innovative infrastructure, technologies, and practices, including institutional and financing arrangements, for meeting the goals of: (a) sustainable and inclusive development; (b) protecting

our coasts and oceans, and reducing environmental risks and ecological scarcities; (c) addressing water, energy, and food security; (d) protecting the health, livelihoods, and welfare of the people in the coastal zone; and (e) fostering ecosystem-based climate change mitigation and adaptation measures.

All of the socioeconomic developments are taking place in a changing climate that is altering the physical properties of oceans that may dramatically shift the foundations of ocean and coastal economies. Though changes such as sea-level rise and ocean acidification are becoming known, uncertainty still remains about the extent and timing with which these ocean changes will affect resources, coastal areas, and well-being.

2. Objectives and Scope of the NSOC Report

Thailand's National SOC Report aims to provide information on the status of seas and coasts of Thailand, including the national ocean economy; quantity and quality of resources in the coastal areas; and the existing and potential uses of such resources. The report also aims to contribute to the blue economy assessment and monitoring of progress on the implementation of the Sustainable Development Strategy for the Seas of East Asia (SDS-SEA), the UN Sustainable Development Goals (SDGs), other international agreements subscribed to by Thailand, and the related national laws and policies on oceans and coasts.

The SOC report provides the description and assessment of the following:

- *Socioeconomic conditions:* population, economy, social developments
- *Ocean economy:* gross value added of the ocean economy and contribution to national economy; valuation of ecosystem services; key ocean economic activities (contribution to income and employment, pressures and issues, response in terms of policies and best practices)
- *Developments in blue economy:* innovative and sustainable ocean economic activities and best practices; emerging industries; opportunities for investments and partnerships for blue economy development.
- *State of ocean health underpinning the blue economy:* natural conditions (oceanography and physical features of the seas and coasts); marine water quality; ecosystems and biodiversity; pressures (risks and threats from human activities, natural hazards, and climate change; and impacts on the environment and communities).
- *Governance structure supporting blue economy development*:
  - *Institutional arrangements:*
    - Description of key policies, laws, and international agreements adopted that would address the pressures and threats to ocean health and ocean economy, and support blue economy development.
    - Supporting mechanisms (capacity development; research and development;

financing, stakeholder participation; partnerships, etc.) for the implementation of these policies, laws, and international agreements.

- ◆ *Sustainable development strategy and actions:* ocean and coastal management, fisheries management, ecosystem and biodiversity conservation, marine protected areas, pollution reduction, natural hazard management and climate change response to achieve the SDG 14 targets, SDS-SEA targets, other international commitments, and national targets to ensure ocean health and sustainable blue economy.

- *Conclusion and recommendations*

3. Caveats

This report required data related to marine and coastal activities as well as resources and environment. There are some limitations on the availability of the data in preparing this report. Most of the data collected are based on the administrative boundary which is province, district, and sub-district. The details of data limitations are described below:

1. There is no common definition of the coastal zones in Thailand. According to the concept of the Integrated Coastal Management (ICM), coastal zones would be more effectively and efficiently managed if the boundaries are based on the natural process or ecosystems of the area. Therefore, definitions of coastal zones are different from area to area ranging from a narrow strip of the coast, to an area from the low water mark to a river watershed much further inland. Most data used in this report is based on the administrative boundary of the coastal provinces.

2. According to their proximity to the sea, there are 24 coastal provinces in Thailand, including Bangkok. However, each province has different geographical characteristics, and dependence on the sea varies accordingly. For example, Bangkok as the capital city of Thailand, has a high population density, high GDP per capita, but has about only 4.7 kilometres (km) of coastline (2015). Most of data in this report covered 23 coastal provinces only and excluded Bangkok. On the other hand, Pattalung province, which has no coastline, is considered a coastal province as it is located on the shoreline of the Thale Noi Lake, the northern part of the Songkhla Lake Basin, and is influenced by the lake system that is connected to the sea.

3. For each economic sector, coastal provincial data used is in the form of gross provincial product (GPP). The ocean industry might be overestimated as there are no specific records for marine-related sectors. For example, GPP of the fisheries sector include both inland and marine fisheries and aquaculture. Similarly, GPP of tourism in coastal provinces include those contributed from inland tourism in these provinces. Thus, the gross value of the economic activities of the 23 coastal provinces (excluding Bangkok) could be considered coastal economy, rather than strictly ocean economy.

PART 1

THE SEAS, PEOPLE AND ECONOMY OF THAILAND

2 The Seas and Socioeconomic Conditions

2.1 Location

The Kingdom of Thailand is situated in the Indo-Chinese peninsula and Malay Archipelago between the latitude 5.610 N to 20.470 N and longitude 97.350 E to 105.640 E. The neighbouring countries of Thailand include Myanmar in the west, Laos and Cambodia in the east, and Malaysia in the south.

Thai coastal zone extends from the coastal shoreline of 3,148 km in 23 provinces toward the exclusive economic zone. As shown in **Figure 2.1**, this coastal zone is located along the Gulf of Thailand (GoT) – the innermost part of the western Pacific Ocean – on the eastern part of the country, with coverage areas of 202,676.20 square kilometres (km^2), and Andaman Sea – the easternmost part of Bay of Bengal of the Indian Ocean – on the western part of the country, with coverage areas of 120,812.20 km^2 (Department of Marine and Coastal Resources, 2013a). The maritime zone of Thailand (**Figure 2.2**) covers an area of 320,000 km^2 (Office of the National Security Council, 2015). Refer to Section 9 and Annex 2 for more details.

Figure 2.1: Location of the Gulf of Thailand and the Andaman Sea of Thailand.

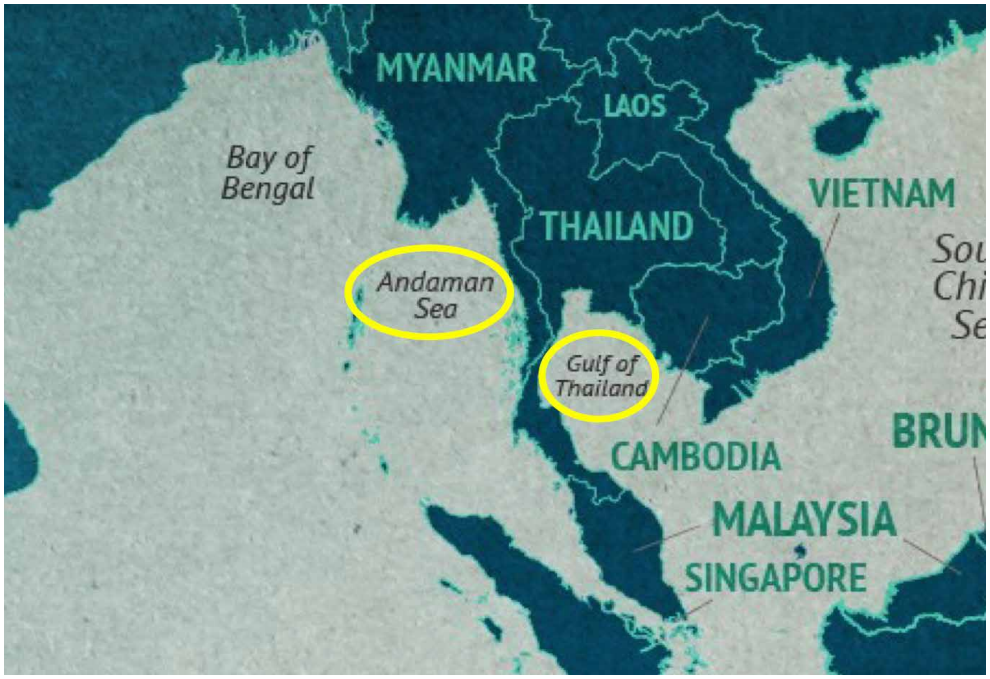
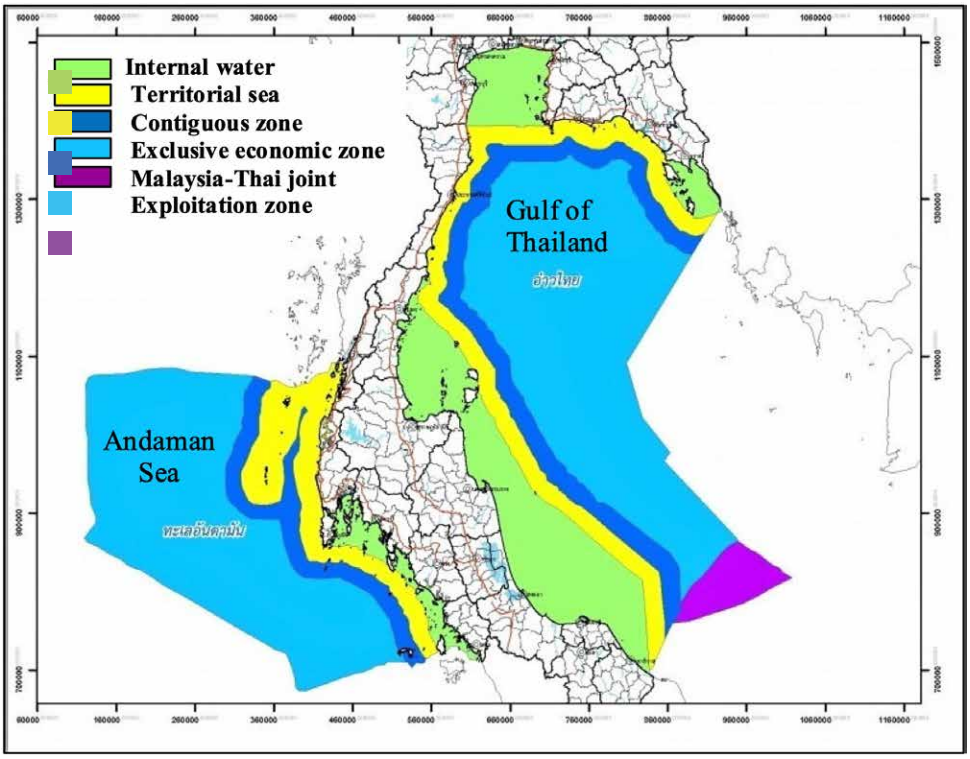


Photo credit: The Asia Maritime Transparency Initiative and The Center for Strategic and International Studies

Figure 2.2: Maritime Zone of Thailand.



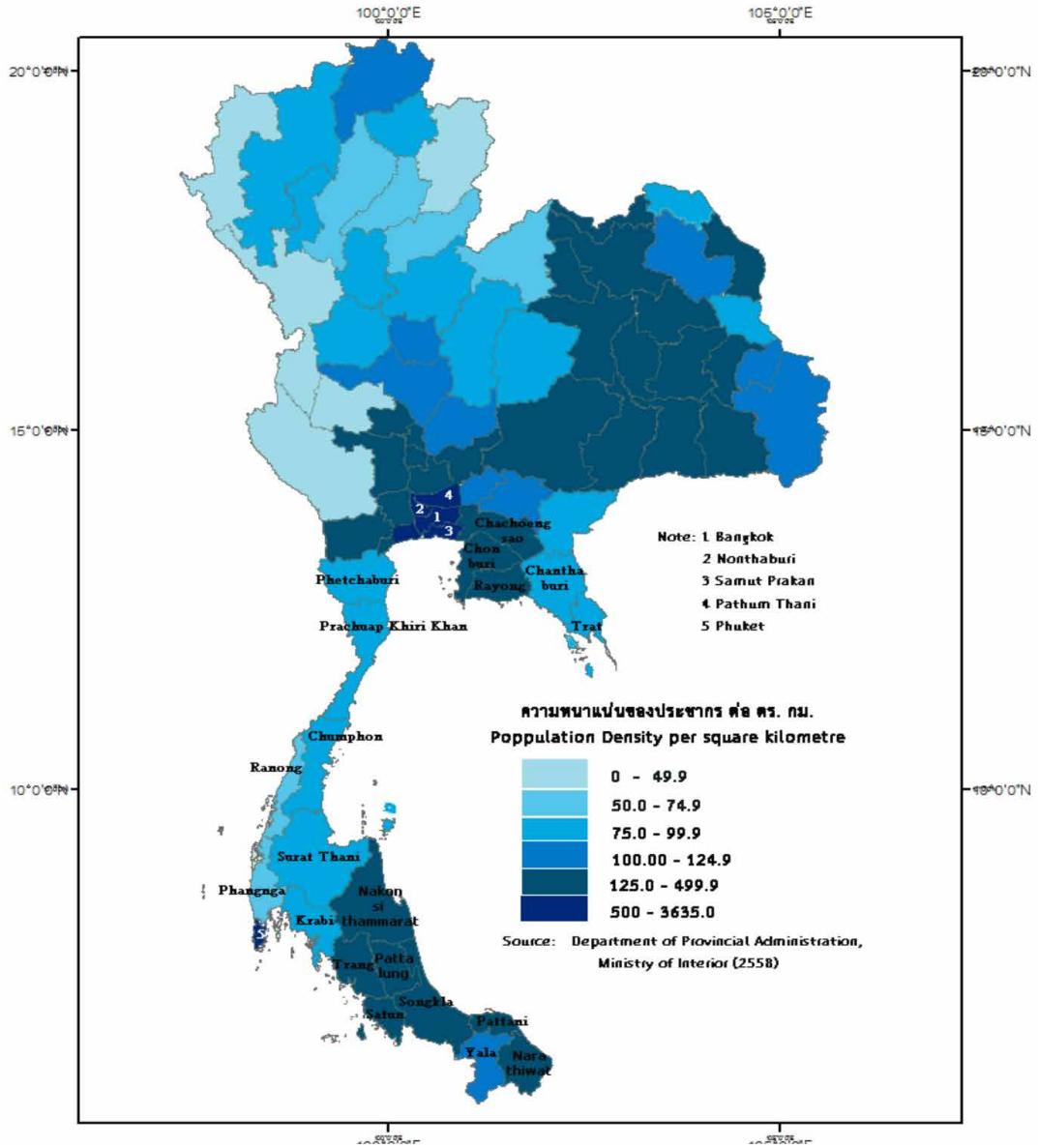
Source: www.mkh.in.th

2.2 Demographic Features

2.2.1 Population

According to the Department of Provincial Administration, Ministry of Interior, the total population in Thailand was 65,729,098 people in 2015. The population density was 128.1 people per km^2. The top five provinces with the highest population density were Bangkok, Nonthaburi, Samut Prakarn, Pathum Thani and Phuket (**Figure 2.3**).

Figure 2.3: Thailand's Population Density in 2015.

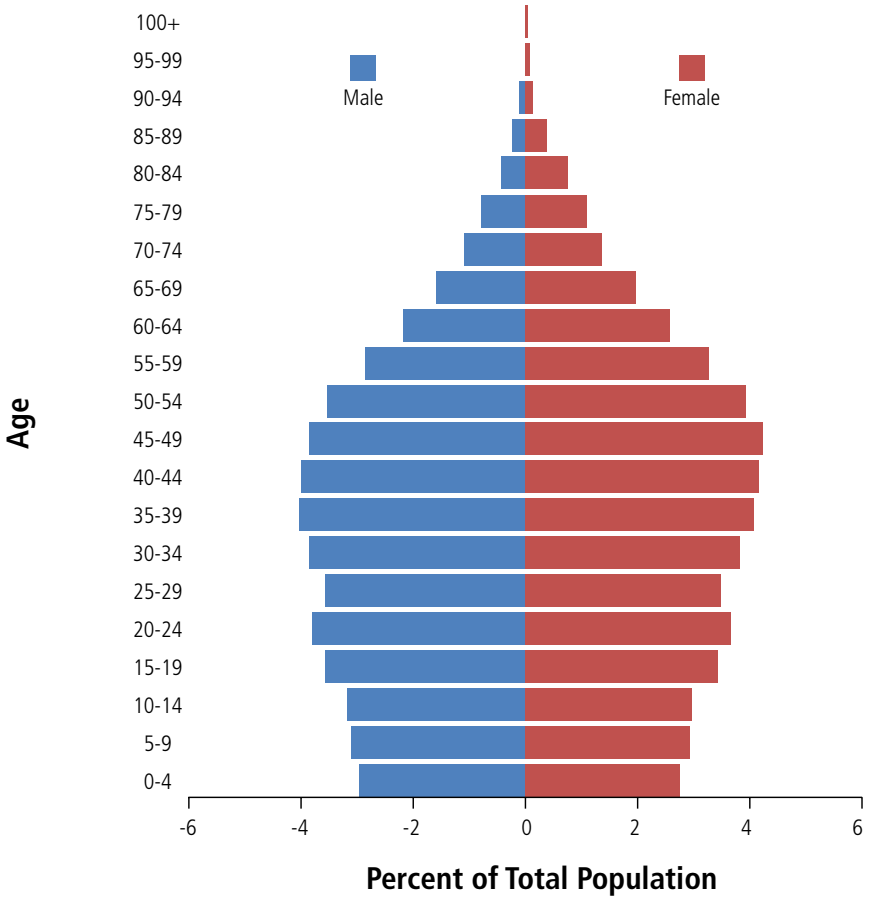


Source: Modified from Department of Provincial Administration, 2016.

Age-sex structure and sex ratio of Thailand's population is shown in **Figure 2.4**. Age-sex structure is in the form of a contracting pyramid. This means the birth rate in Thailand is decreasing. In the future, the elderly people will be the largest population of Thailand. This means Thailand will become an aging society. The sex ratio between male and female during 2010–2015 was approximately 1:1.

For age dependency ratio, 48.6 was the rate in 2015. The number showed that 100 people of the work-force age should support 48.6 people of other ages, including children, youth (below the age of 15 years), and elderly (more than the age of 60 years).

Figure 2.4: Thailand Age-Sex Structure and Sex Ratio in 2015.



Source: Department of Provincial Administration, Ministry of Interior, 2016.

Photo by: M.Ebarvia

2.2.2 Coastal Population

According to the Department of Provincial Administration, Ministry of Interior, the coastal population was estimated based on the population of 23 coastal provinces (**Table 2.1**).

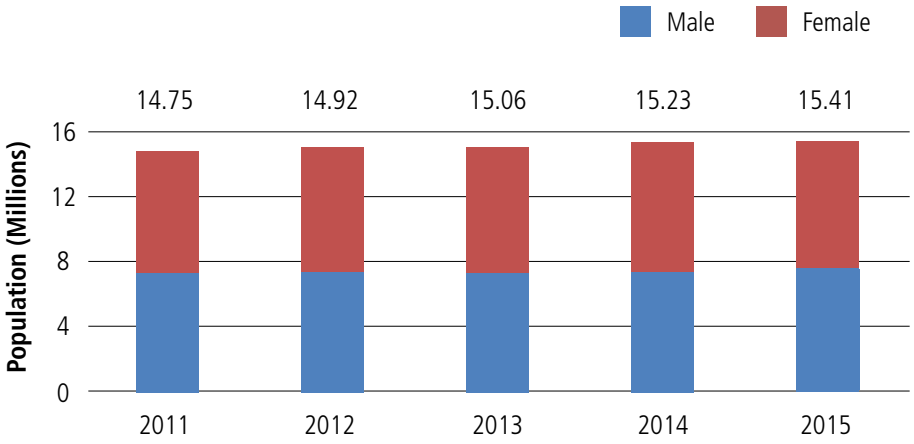
Table 2.1: Population in 23 Coastal Provinces of Thailand.

Province	Area (km^2)	Population	Population Density
1. Trat	2,819.00	229,435	81.39
2. Chantaburi	6,338.00	531,037	83.79
3. Rayong	3,552.00	688,999	193.97
4. Chon Buri	4,363.00	1,455,039	333.50
5. Chachoengsao	5,351.00	700,902	130.99
6. Samut Prakarn	1,004.09	1,279,310	1274.10
7. Samut Sakorn	872.35	545,454	625.27
8. Samut Songkhram	416.7	194,376	466.47
9. Phetchaburi	6,225.14	478,589	76.88
10. Prachuap Khiri Khan	6,367.62	534,719	83.97
11. Chumphon	6,010.00	505,830	84.16
12. Surat Thani	12,891.47	1,046,772	81.20
13. Nakhon Si Thammarat	9,942.50	1,552,530	156.15
14. Phatthalung	3,424.47	522,723	152.64
15. Songkhla	7,393.89	1,410,577	190.78
16. Pattani	1,940.36	694,023	357.68
17. Narathiwat	4,475.43	783,082	174.97
18. Ranong	3,298.05	187,536	56.86
19. Phangnga	4,170.90	264,074	63.31
20. Phuket	543.03	386,605	711.94
21. Krabi	4,708.51	462,101	98.14
22. Trang	4,917.52	640,793	130.31
23. Satun	2,478.98	315,923	127.44
Total	**103,504.01**	**15,410,429**	**5,735.91**

Source: Department of Provincial Administration, Ministry of Interior, 2016.

In 2015, coastal population was 15,410,429 people or 23.44% of the total population (65,729,098 people). During 2011-2015, the coastal population was slightly increasing by 0.1% each year (**Figure 2.5**). The sex ratio between male and female during 2010–2015 was approximately 1:1.

Figure 2.5: Population of Coastal Provinces (2010–2015).



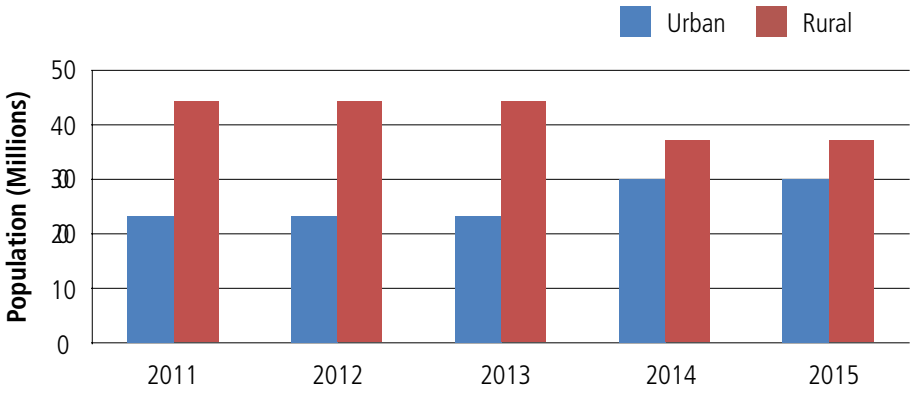
Source: Department of Provincial Administration, Ministry of Interior, 2016

2.2.3 Rural and urban population

In general, rural population are people who live outside the towns and cities. In Thailand, we define rural population as people who live outside municipal areas. Most of the rural people earn their living from agriculture.

According to DOPA, rural population is more than the urban population during 2011–2015 (**Figure 2.6**). Urban population remained the same from 2011-2013. However, urban population started to increase in 2014 and remained the same in 2015.

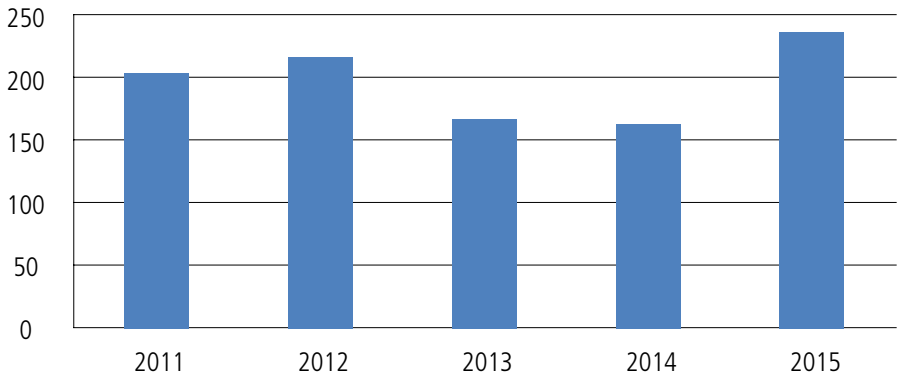
Figure 2.6: Rural and Urban Population in Thailand (2011-2015).



Source: Department of Provincial Administration, Ministry of Interior, 2011-2015.

During 2011-2015, migration from rural to urban areas fluctuated. Migration first increased slightly in 2012 and then decreased in 2013 and 2014. It then increased quite significantly in 2015 compared to the previous years (**Figure 2.7**).

Figure 2.7: Rural to Urban Migration in Thailand (2011-2015).



Source: National Statistical Office, 2015.

As we do not have specific data on rural-urban population and migration in coastal areas in Thailand, some statistics in selected coastal provinces, such as population and GPP in ocean-related sectors (hotel and restaurant, transport, storage, and communications), were used to reflect the trend in urban development and population in coastal areas between 2011 and 2015 (**Table 2.2**). These provinces are the most developed in tourism, shipping, and industry.

Photo by: J.Calayo

Table 2.2: GPP and Population in Main Coastal Provinces in 2011 and 2015.

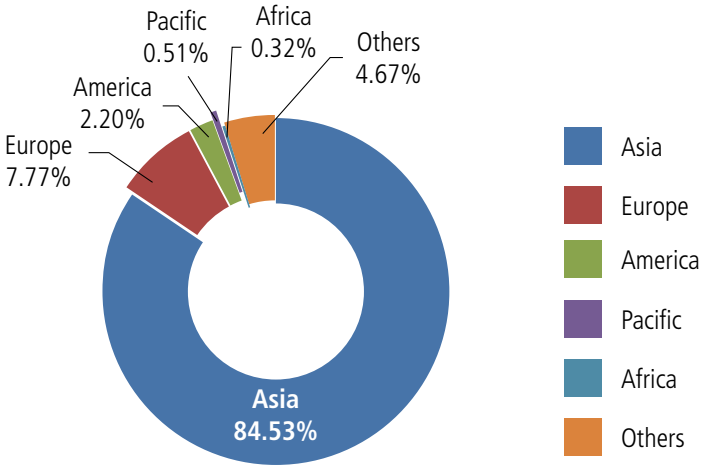
Province	Items	2011	2015	Percentage Increase
Phuket	GPP (USD million)	3,154	4,791	51.90
	Hotels and restaurants (USD million)	1,078	2,008	86.27
	Transport, storage, and communications (USD million)	714	1,200	68.06
	GPP per capita (USD)	5,986	8,957	49.63
	Population* (1,000 persons)	527	535	1.52
Surat Thani	GPP (USD million)	5,164	5,582	8.10
	Hotels and restaurants (USD million)	389	1,012	160.21
	Transport, storage, and communications (USD million)	216	312	44.44
	GPP per capita (USD)	5,084	5,360	5.42
	Population* (1,000 persons)	1,016	1,041	2.54
Chon Buri	GPP (USD million)	18,681	23,634	26.52
	Hotels and restaurants (USD million)	611	962	57.26
	Transport, storage, and communications (USD million)	1,256	1,642	30.71
	GPP per capita (USD)	11,877	14,364	20.94
	Population* (1,000 persons)	1,573	1,645	4.61
Thailand	**GPP (USD million)**	**330,129**	**399,207**	**20.92**
	Hotels and restaurants (USD million)	**10,205**	**17,464**	**71.13**
	Transport, storage, and communications (USD million)	**23,053**	**29,190**	**26.62**
	GPP per capita (USD)	**4,986**	**5,937**	**19.09**
	Population* (1,000 persons)	**66,214**	**67,236**	**1.54**

Source: The Office of the National Economic and Social Development Board, 2015

2.2.4 Composition of People in Thailand

In Thailand, there are 6 groups of other nationalities other than Thai people. These groups amounted to 2,582,689 people. The top two groups of other nationalities were Asian and European (**Figure 2.8**). People from Myanmar and Cambodia have the highest population among ASEAN nationalities in Thailand, with 1,292,862 people (50%), and 281,321 people (11%), respectively.

Figure 2.8: Group of Nationalities (except Thai) in Thailand (2015).



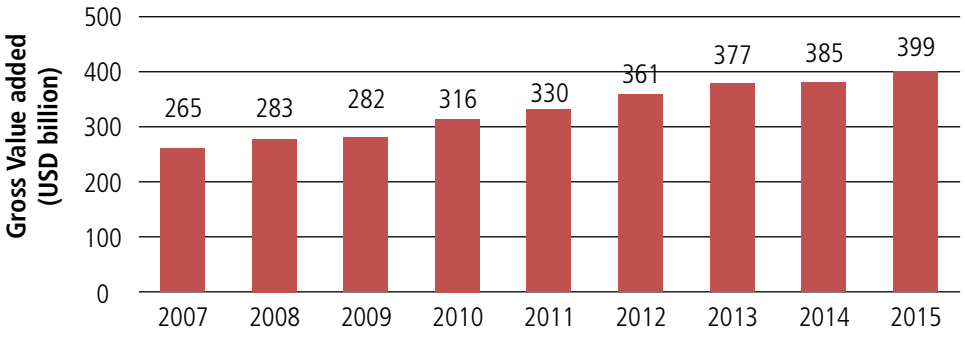
Source: The Office of the National Economic and Social Development Board, 2015.

2.3 Economic Development

2.3.1 Gross National Product and Gross Domestic Product

In 2015, Gross National Product (GNP) and Gross Domestic Product (GDP) were registered at USD256.08 billion and USD399.21 billion, respectively. GDP by economic activities went up sharply from 2007-2012, then rose up gradually from 2012-2015 (**Figure 2.9**). However, the GDP growth rate increased by 50.5% in 2011 to 2015. Similarly, GDP per capita also increased from USD4,090 in 2011 to USD5,937 in 2015.

Figure 2.9: GDP at Constant Prices by Economic Activities (2010-2015).



Source: The Office of the National Economic and Social Development Board, 2015.

2.3.2 Exports and Imports

The Ministry of Commerce reported the exports and imports in 2015. In terms of value, the most recent exports were led by motor cars, parts, and accessories (19%); automatic data processing machines and parts thereof (18%); and precious stones and jewelry (11%). However, the export products were totally different from import products. The imports were led by fuel (crude oil) (17%), machinery and parts thereof (16%), and electronic integrated circuits (13%).

2.3.3 Population and Gross Provincial Product (GPP) Per Capita

The percentage increase of population in three provinces was higher than the overall population increase of Thailand. The percentage increase of population in Chon Buri was the highest (4.61). Meanwhile, percentage increases in Phuket and Surat Thani were 1.52 and 2.54, respectively. It may be assumed from this trend that migration is higher than the whole country.

The percentage increase of the GPP per capita in Phuket was three times more than the national GDP per capita. This showed the rapid development of this province. The percentage increase of the GPP per capita in Chon Buri was about the same as the GDP per capita and percentage increase in Surat Thani was less than GDP per capita.

Hotels and Restaurants

The hotels and restaurants sector was selected to show the development of marine tourist activities. In 2011-2015, the percentage increase of this sector was the highest among all sectors. Phuket in the Andaman Sea and Surat Thani in GoT are popular tourist sites. The two provinces are rich in marine resources, such as beaches and coral reefs, thus, many hotels and restaurants are located in these provinces. The percentage increase during 2011 to 2015 in this sector was 86% in Phuket and 160% in Surat Thani. These percentage increases were more than that of the whole of Thailand (71%). However, the percentage increase in Chon Buri was less than the overall but still more than 50%.

Transport, Storage and Communications

Data in the sector of transport, storage, and communications indicated in **Table 2.2** consisted of land and water. These coastal provinces are locations for important shipping facilities. For example, tourism ports are located in Phuket and Surat Thani, while deep sea ports with high service capacity are located in Chon Buri. The percentage increase of this sector during 2011 to2015 was 68% in Phuket, 44% in Surat Thani, and 31% in Chon Buri. These figures were higher than the overall increase of Thailand (27%).

Summary

Phuket, Surat Thani, and Chon Buri are important coastal provinces. Phuket showed the highest increase in GPP, GPP per capita, and the tourism sector. For Surat Thani, though, the growth rate GPP and GPP per capita were not high. However, the hotels and restaurants (representative of tourist sectors), and the transport, storage, and communications sector in Surat Thani were very high. For Chon Buri, the percentage increase in GPP was not that high, but not below the national growth rate, except for the tourism sector.

2.3.4 Employment

The *Labour Protection Act* (No. 5) of 2017 indicates that the minimum working age requirement is 15 years old. If working at sea, such as shipping and fisheries, the minimum age requirement is 18 years old.

According to the data from the National Statistics Office (NSO), in 2015, the labor force or working age population amounted to 55,238,469 people, with 38,016,170 people or 69% of them being employed. Agriculture and manufacturing were the top employment-generating sectors (**Figure 2.10a**). For employment in 23 coastal provinces, there were 9,969,331 people employed out of the 12,066,239 working age population (**Figure 2.10b**). The trend was the same as the overall employment of Thailand.

Figure 2.10: Employment in Thailand (2.10a) and 23 Coastal Provinces (2.10b) in 2015.

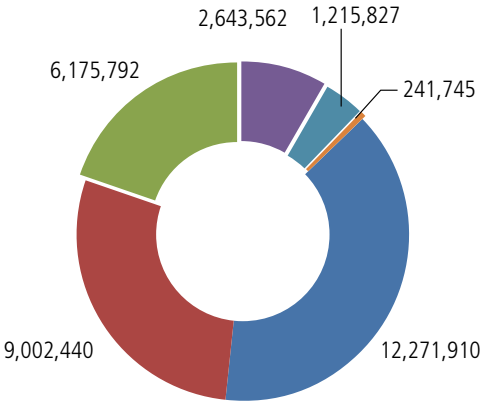


Figure 2.10a

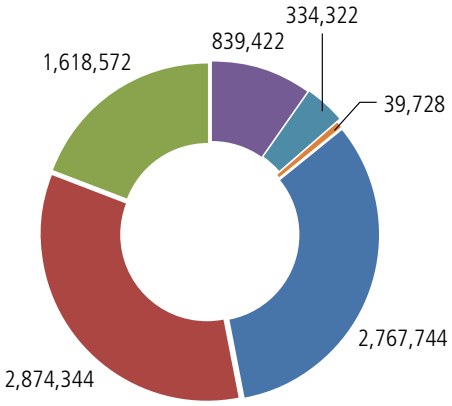
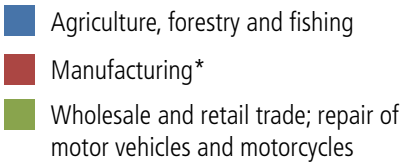
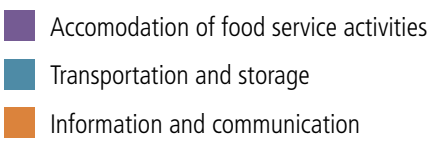


Figure 2.10b





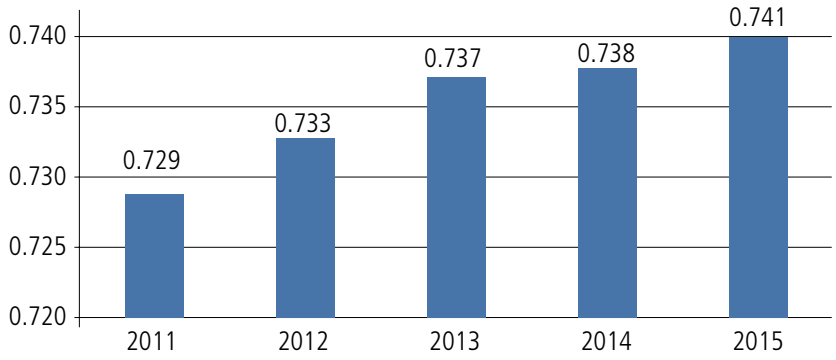
Source: National Statistical Office, 2015.
**Note: Manufacturing includes mining and quarrying; electricity, gas, steam and air conditioning supply; water supply; sewerage waste management; and construction.*

2.4 Social Development

2.4.1 Human Development Index (HDI)

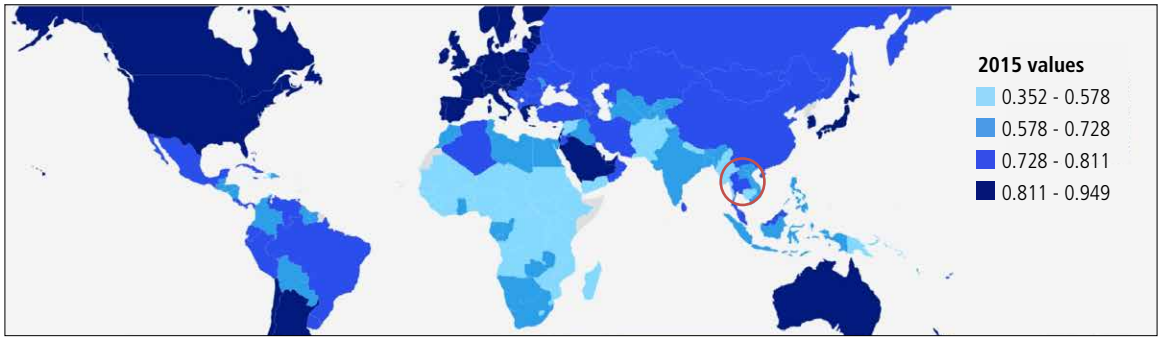
The human development index (HDI) is used to assess the development of a country using criteria other than economic growth. It is a summary measure of average achievements in key dimensions of human development: a long and healthy life (measured by life expectancy at birth), being knowledgeable (mean years of schooling of adults, and expected years of schooling of children), and having a decent standard of living (measured by the Gross National Income or GNI per capta). Data from the United Nations Development Programme (UNDP) shows the increasing trend of Thailand's HDI, from 0.729 in 2011 to 0.740 in 2015 (**Figure 2.11**). Thailand ranked 82nd worldwide in 2015 (**Figure 2.12**) and 4th in ASEAN. In 2017, the GNI per capita was USD 15,516 (using 2011 Purchasing Power Parity or PPP prices), life expectancy at birth was 75.5 years, and mean years of schooling was 7.6 years. **Table 2.3** reviews Thailand's progress in each of the HDI indicators.

Figure 2.11: Human Development Index (HDI) in Thailand.



Source: http://hdr.undp.org/en/countries/profiles/THA.

Figure 2.12: Human Development Index (HDI) in the World.



Source: http://hdr.undp.org/en/indicators/137506.

Table 2.3: Thailand's HDI Trends.

	Life expectancy at birth	Expected years of schooling	Mean years of schooling	GNI per capita (2011 PPP$)	HDI value
1990	70.3	8.4	4.6	6.560	0.574
1995	70.2	9.6	5.0	9.177	0.611
2000	70.6	11.2	6.1	9.003	0.649
2005	72.1	12.7	7.0	11.006	0.693
2010	73.9	13.3	7.7	12.918	0.724
2015	75.1	13.9	7.6	14.455	0.741
2016	75.3	14.3	7.6	14.971	0.728
2017	75.5	14.7	7.6	15.516	0.755

Source: UNDP. Human Development Indices and Indicators: 2018 Statistical Update.

Literacy

Most people in Thailand (about 96%) can read, speak, and write Thai (**Figure 2.13a**). Most of them could not read, speak, and write other languages. (**Figure 2.13b**)

Figure 2.13: Literacy of People in Thailand (2.13a and 2.13b).

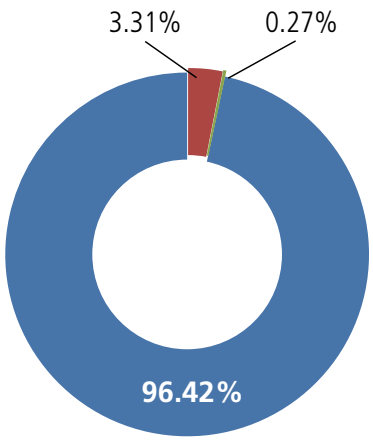


Figure 2.13a

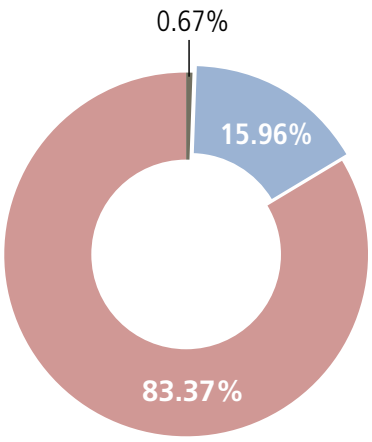


Figure 2.13b

Source: National Statistical Office, 2015

Education

In Thailand, the basic education system includes four levels of school: (1) pre-primary school, (2) primary school, (3) junior high school and senior high school/vocational school, and (4) college. Compulsory education system includes only two levels of school: primary and junior high school. As shown in **Table 2.4**, in 2015, the number of children aged 3-7 years, who had basic education, was 10,943,543 students (91% of all children aged 3-7 years). For compulsory education, there were 7,211,455 students (60 % of all people aged 3-17 years).

Table 2.4: Number and Percentage of Students in Each Level of Education (2015).

Education systems	Basic education	Compulsary education	Total
Level	Pre-primary, primary junior high, senior high/vocational school	Primary school and junior high school	
Age (year)	3-17	6-14	3-17
Number of people	10,943,543	7,211,455	12,022,509
Percantage	91	60	100

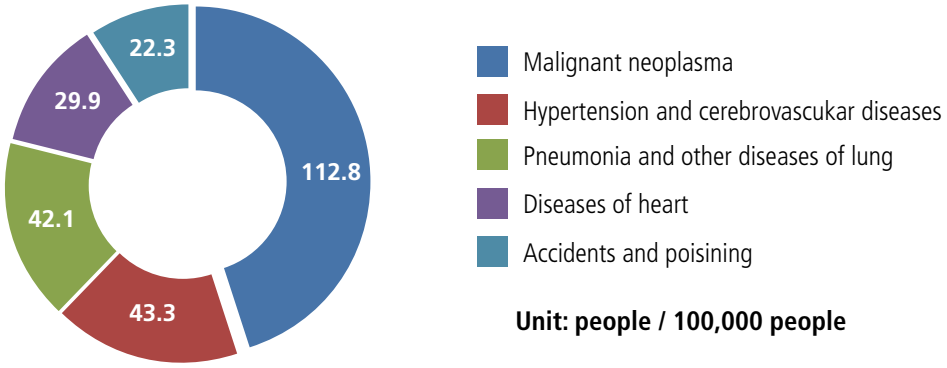
Source: Ministry of Education, 2015.

Health

In 2015, the mortality rate of Thailand was 678 deaths per 100,000 people. The top five causes of death were malignant neoplasm, hypertension and cerebrovascular diseases, pneumonia and other lung diseases, heart disease, and accidents and poisonings (**Figure 2.14**). Life expectancy was 71 for males and 77 for females.

There is no report about waterborne diseases, except related cases of diarrhea and gastroenteritis of presumed infectious origin, which caused 2.8 deaths per 100,000 people. Moreover, the cause of death by accidental drowning and submersion were 5.1 deaths per 100,000 people.

Figure 2.14: Top 5 Cases of Mortality (2015).



Source: Ministry of Public Health, 2015.

2.4.2 Access to Water, Sanitation and Wastewater Management

According to UNICEF/WHO (2015) Joint Monitoring Programme, access to basic water services was a high percentage for both the urban and rural population (98%). Access to basic sanitation was less in the rural areas than in the urban areas. Rural average was 90% while urban average was 96%, with the national average at 93%. Currently, there are no data on access to safely managed sanitation services, and access to safely managed water services.

Access to wastewater management

Table 2.5 shows the report of the Pollution Control Department (PCD) on wastewater management in Thailand. Overall, the percentage of treated wastewater was only about a quarter of the wastewater generated (26.9%). The eastern region has the highest percentage of treated wastewater (43.3%), while the central region has 42.6% of treated wastewater. Chon Buri and Bangkok generated the highest volume of wastewater in their respective regions due to the high population and a lot of industries in these areas. The percentage of treated wastewater in other regions was less than 30%. The northeastern region has the highest volume of wastewater generated, but the least percentage of treatment (10.9%). Nakhon Ratchasima has the highest volume of wastewater in the northeastern region.

Table 2.5: Volume of Wastewater Generated and Volume of Wastewater Treatment Capacity by Region, 2015

Region	Wastewater generated (m^3/day)	Treatment capacity (m^3/day)	Wastewater treated (%)	Provinces with highest volume of wastewater
North	925,569	255,809	27.6	Chiang Mai
Northeast	3,248,977	353,466	10.9	Nakhon Ratchasima
Central	2,942,739	1,253,000	42.6	Bangkok
East	686,411	297,400	43.3	Chon Buri
West	475,742	107,900	22.7	Ratchaburi
South	1,310,929	313,050	23.9	Nakhon Si Thammarat
Total	**9,590,367**	**2,580,625**	**26.9**	

Source: Ministry of Education, 2015.

Notes:
1. *Volume of wastewater was referenced from the Community Wastewater Statistics Improvement Project of the Pollution Control Department, 2010. The project uses the population census data collected by the Department of Local Administration, March 2015.*

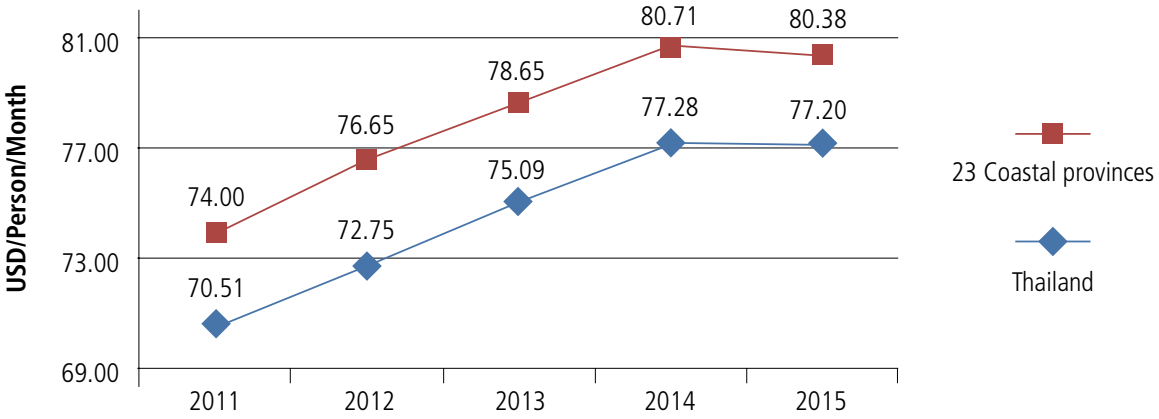
2. *Data on Bangkok wastewater volume was evaluated from the census record, not the actual volume generated.*

2.4.3 Poverty

According to the Office of the National Economic and Social Development Board, the poverty line was calculated using the cost or expense of the individual in the acquisition of food and basic services essential to life.

During 2011–2014, the poverty lines for both the country and 23 coastal provinces had increased, but slightly dropped in 2015. The poverty line of 23 coastal provinces was higher than that of the country during the same period (**Figure 2.15**).

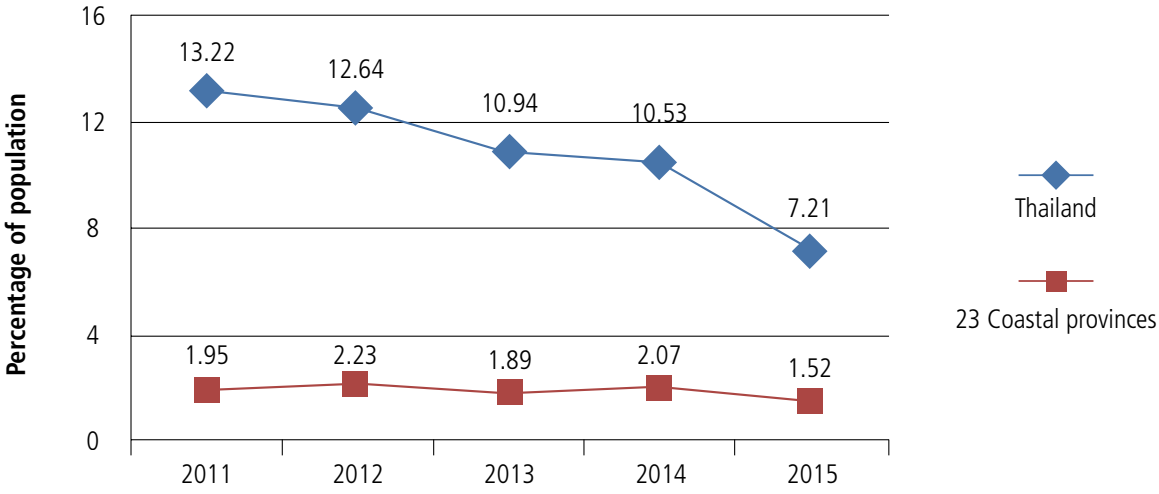
Figure 2.15: Poverty Line in Thailand and 23 Coastal Provinces, 2011-2015.



Source: The Office of the National Economic and Social Development Board, 2015.

The percentage of population under the poverty line or poverty rate for the country has continuously decreased since 2011. It decreased from 13.22% in 2011 to 7.21% in 2015. The poverty rate of 23 coastal provinces during 2011–2015 has slightly fluctuated. The poverty rate decreased from 1.95% in 2011 to 1.52% in 2015 (**Figure 2.16**).

Figure 2.16: Percentage of Population Below the Poverty Line, 2011-2015.



Source: The Office of the National Economic and Social Development Board, 2015).

PART 2

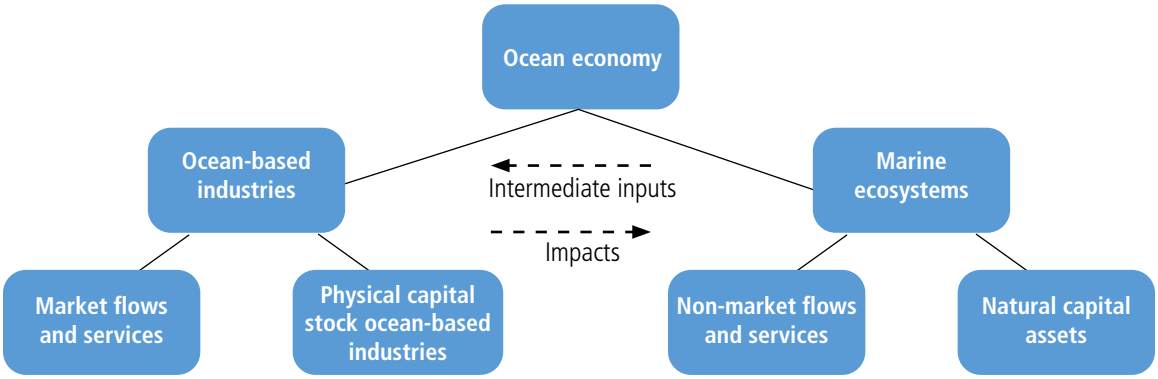
HARNESSING THE OCEANS: BENEFITS AND IMPACTS

3 Ocean Economy

Oceans provide an extensive range of natural assets and resources – natural capital from which humans derive a wide variety of ecosystem services that make life possible and upon which human activities rely.

The entire ocean economy is measured as the sum of: (a) the economic activities with dependence on the ocean and coastal and marine resources, and (b) natural assets, goods and services of marine ecosystems upon which these industries depend on, and people rely on for food, income, livelihood, recreation, shoreline protection, etc. (**Figure 3.1)**.

Figure 3.1: Ocean Economy.



Source: OECD (2016), The Ocean Economy in 2030, http://dx.doi.org/10.1787/9789264251724-en.

The ocean economic activities can be measured using the System of National Accounts (SNA), and include:

- *ocean-based* activities, such as fisheries, marine tourism, shipping, oil and gas, ocean energy, etc.;
- *ocean-related* activities: (a) those that use products from the ocean (e.g., seafood processing, marine biotechnology, salt); (b) produce products and services for the ocean-based activities (e.g., ports, ship-building, communication, maritime insurance); (c) marine education, and research and development; and (d) government agencies with direct maritime responsibilities (e.g., navy, coast guard, marine environmental protection, etc.).

The ocean also provides services that are not usually quantified and captured in the national income accounts, such as *regulating* services (e.g., carbon storage, shoreline protection, waste assimilation, nutrient cycling), *supporting* services (e.g., habitat, nursery), and *cultural* services (e.g., spiritual; aesthetic; bequeath).

3.1 Ocean Economic Activities

The National Economic and Social Development Board (NESDB) is responsible for the National Income Accounts of Thailand, and uses the International System of National Accounts (SNA). The National Income is compiled using chain volume measures (CVM), which covers the overall economic activities namely, production, expenditures, and income of the country.

3.1.1 Gross Value Added (GVA) of Marine Sectors in Coastal Provinces

Figure 3.2 shows the GPP of coastal and other provinces, and total GDP of the country. The GPP of the coastal provinces reporesent the coastal economy. The contribution of the ocean economic activities in Thailand was estimated using the NESDB's National Income Accounts. The estimated contribution of the ocean economic activities was calculated from the sum of GPP in 23 coastal provinces minus production in non-marine sectors (for example, agriculture and forestry) (**Table 3.1**). Contribution of the ocean economic activities was about 30% of GDP during 2011-2015. The main contributing sector during 2007-2015 was manufacturing, which was almost 50% of the value.

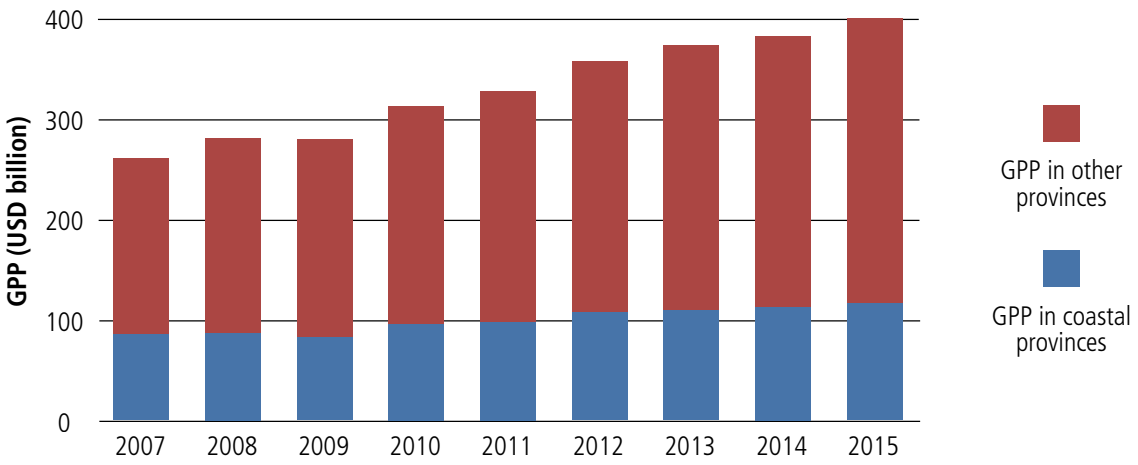
There are several limitations of the data used in the estimate. For example, the manufacturing sector consists of beverage, petroleum refinery, chemical and chemical products, rubber and plastic products, fabricated metal products, machinery and equipment, motor vehicle, and others. There are sub-items in these industries that are not directly related to the marine sector, but there is no specific GPP data breakdown for each of these sub-items. The same situation occurred in the transport, storage and communications sector and mining and quarrying sector. The transport, storage and communications sector includes both land and water transport. Therefore, the gross value added of ocean economic activities calculated based on GPP of coastal provinces used in this report is overestimated.

Table 3.1: GPP of Marine Sectors in Coastal Provinces, 2007–2015 (at constant prices).

Economic Activity	Years (Unit: USD billion)				
	2011	2012	2013	2014	2015
Fishing	2.74	2.81	2.50	2.70	2.50
Mining and quarrying	9.38	11.49	11.83	11.80	10.08
Manufacturing	44.22	46.54	45.83	47.65	49.45
Electricity, gas, and water supply	4.35	4.40	4.87	5.24	5.50
Construction	2.45	2.66	3.07	2.85	3.07
Wholesale and retail trade; repair of motor vehicles; and personal and household goods	12.37	12.47	12.29	12.97	13.89
Hotels and restaurants	3.10	3.54	4.46	4.63	5.83
Transport, storage, and communications	8.52	9.44	9.55	9.63	10.42
Financial intermediation	2.59	2.93	3.46	3.87	4.16
Real estate, renting, and business activities	3.96	5.02	5.02	5.07	5.13
Public administration and defense; compulsory social security	3.61	4.65	4.39	3.78	3.92
Education	2.67	2.94	2.99	3.22	3.39
Other community, social, and personal service activities	0.62	0.67	0.70	0.69	0.74
Private households with employed persons	0.08	0.11	0.11	0.11	0.11
GPP of marine sectors	**100.66**	**109.68**	**111.08**	**114.22**	**118.19**
Gross Domestic Product (GDP)	330.13	360.80	377.26	385.51	399.21
Percentage of GPP of marine sectors in 23 coastal provinces	30.49	30.40	29.44	29.63	29.61

Source: NESDB, 2017.

Figure 3.2: GPP in 23 Coastal Provinces and Other Provinces, 2007–2015 (at current prices).



Source: Jarayabhand, et al., 2018.

3.1.2 Employment in the Coastal Provinces

In 2015, the National Statistics Office of Thailand reported the employment in 23 coastal province (**Table 3.2**). The percentage of employment in the coastal province to total employment was 26.22%. The majority of employment was in the agriculture sector, which included inland agriculture, hunting, forestry, and fisheries. Employment data in fisheries was available in 2008 and 2010, the percentage of which were 2.83% and 3.17%, respectively.

Table 3.2: Employment in 23 Coastal Provinces in 2015.

Acitivity	Employment
Agriculture (agriculture in land, hunting, forestry, fisheries)	2,767,744
Mining and quarrying	33,793
Manufacturing	2,266,037
Electricity, gas, and water supply	39,927
Construction	534,588
Wholesale and retail trade; repair of motor vehicles, motorcycles; and personal and household goods	1,618,572
Hotels and restaurants	839,422
Transport, storage, and communications	334,322
Financial intermediation	99,976
Real estate, renting, and business activities	56,438
Public administration and defense; compulsory social security	331,823

Table 3.2: Employment in 23 Coastal Provinces in 2015. (cont.)

Acitivity	Employment
Education	266,545
Health and social work	159,920
Other community, social, and personal service activities	236,823
Private households with employed persons	36,252
Others: information and communication, professional, scientific and technical activities, administrative and support service activities, arts, entertainment and recreation and unknown	347,151
Total (23 coastal provinces)	**9,969,331**
National employment	38,016,170
Percentage of employment in coastal provinces	26.22

Source: NSO, 2017.

3.2 Ecosystem Services

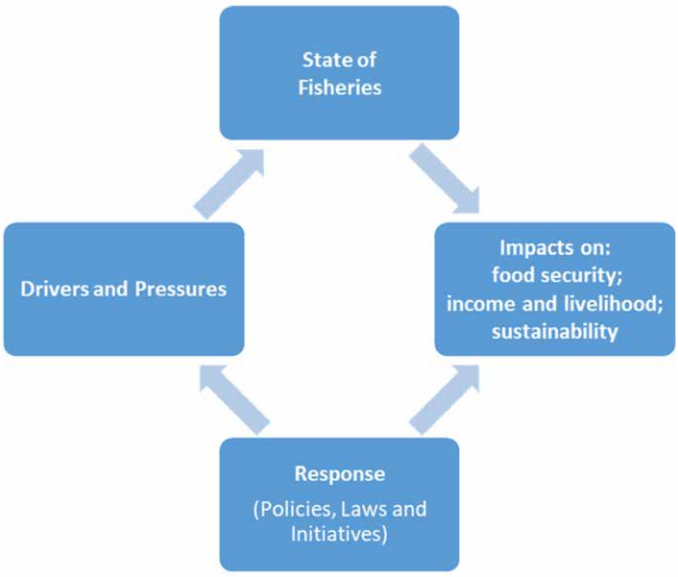
The GDP and GPP do not capture the full value of the contribution of coastal and marine resources to the economy and social welfare. There have been several attempts to evaluate the economic value of marine and coastal resources using the total economic value technique (TEV). However, those values were estimated using limited data. The data collection carried out by most of the government organizations were not designed for the calculation of TEV. There is a need for further research to acquire appropriate data and information to reflect actual TEV. The most recent evaluation could not cover all factors. The marine and coastal resources evaluated were coral, seagrass, mangrove, and endangered species. Some data used for the valuation were in 2014. The total value of the marine and coastal resources was USD36.00 billion (**Table 3.3**).

Photo from: TEI

Table 3.3: Economic Value of Marine and Coastal Resources.

	Value (USD million)	Source
1. Use Value		
1.1 Direct use value		
1.1.1 Fisheries value	4,438.59	Department of Fishery (2013)
1.1.2 Tourism value		
• Tourism	12,679.07	Ministry of Tourism and Sports (January – September 2013)
• Marine national park	5.69	Department of National Parks, Wildlife and Plant Conservation (2013)
1.2 Indirect use value		
1.2.1 Mangrove		
• Carbon sequestration	1,570.70	Social cost of carbon (2012)
• Coastal protection	4,040.93	Adapted from Edward Babier (2012)
• Fish nursery	563.82	Investment of restoration/ rehabilitation at Koh Mai Thon, Phuket (DMCR, 2013)
1.2.2 Coral reefs		
• Replacement cost	63.47	Investment of restoration/ rehabilitation at Koh Mai Thon, Phuket (DMCR, 2013)
• Coastal protection	946.71	Investment of coastal protection (DMCR, 2013)
1.2.3 Seagrass		
• Carbon sequestration	1,981.84	Social cost of carbon (2012)
2. Non-use value		
2.1 Mangrove	-	There is no report in Thailand
2.2 Coral reefs	51.52	Adapted from Na Bangchang, 2013 (Evaluation of coral reef from climate change phenomenon in 2013)
2.3 Seagrass	162.22	Calculated by benefit transfer method from Na Bangchang, 2012 (Studies and analysis of economics of seagrass for sustainable development)
2.4 Endangered species		
2.4.1 Sea turtle	152.58	Calculated by benefit transfer method ["Willingness to Pay for The Conservation of Endangered Species in Four Asian Countries" (Mobilizing Resources for Marine Turtle Conservation in Asia : A Cross-Country Perspective) Economy and Environment Programmeme for Southeast Asia, 2008]
2.4.2 Irrawaddy dolphin	37.05	Calculated by benefit transfer method ("Valuation Assessment of Icon Species in Lanta Marine National Park: Willingness to Pay for Conservation"; WWF Thailand Office, 2011)
2.4.3 Manta ray	13.56	
2.4.4 Whale shark	11.43	
Total	**36,007.42**	

4 Fisheries and Aquaculture



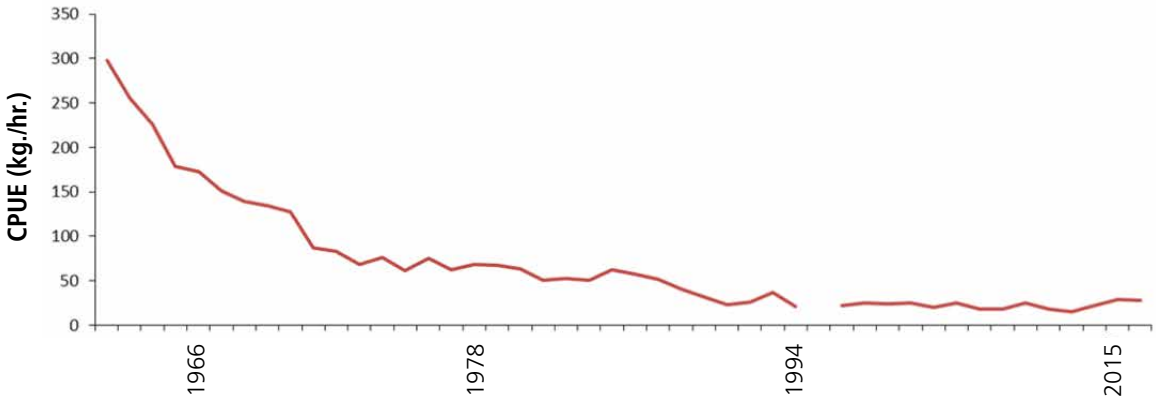
Thai fishing boat in mangroves.
(Photo by TEI)

4.1 Fishery Resources, and Stock Assessment

The fisheries resources, especially in coastal waters, are severely degraded as shown by the declining abundance, indicated by the catch per unit of effort (CPUE) derived from trawl surveys (kg/hour), and the current level of harvest being equal to or greater than estimated potential yields or maximum sustainable yield, MSY (Department of Fisheries, 2015a).

Declining CPUE of trawl surveys: Thailand has undertaken regular surveys with dedicated research vessels since the early 1960s. In the Gulf of Thailand, the CPUE declined steadily from 1961 to 1990 indicating an early decline in the abundance of demersal fish in the area during a time of heavy fishing pressure that coincided with introduction of trawling and then purse seining in Thailand. The CPUE then leveled off at a level that is now only 9% of the original CPUE (**Figure 4.1**).

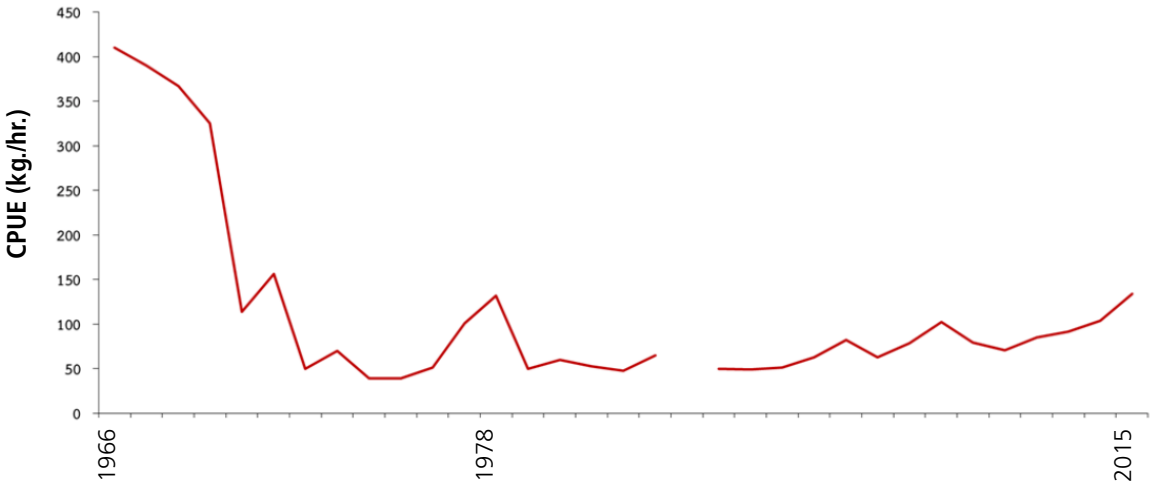
Figure 4.1: CPUE in the Gulf of Thailand Trawl Surveys from 1961 - 2015.



Source: Department of Fisheries, 2016.

In the Andaman Sea, the catch rate from trawl surveys declined sharply in the late 1960s and early 1970s, and has remained far below the early levels. The catch rate in 2015 was only about 38% of the 1966 value (**Figure 4.2**).

Figure 4.2: CPUE of Research Vessel Trawl Surveys in the Andaman Sea from 1966 - 2015.



Source: Department of Fisheries, 2016.

Catches equal to or greater than maximum sustainable yields (MSY): Based on recent stock assessments, the estimated fishing effort for demersal fish currently exceeds the MSY effort by 32.8% in the Gulf of Thailand, and by 5.3% in the Andaman Sea. For pelagic fish (except anchovies), the current fishing effort exceeds the MSY by 27.0% in the Gulf of Thailand, and by 16.5% in the Andaman Sea. On a more positive note, fishing effort for anchovies appears to be balanced with the MSY as shown in **Table 4.1** (Department of Fisheries, 2015).

Based on single-species MSY calculations (Department of Fisheries, 2015a and Nootmorn et al., 2014), most of commercial fishing stocks are overexploited. Except for sardine (*Sardinella gibbosa*), all pelagic fish species are overexploited both in the GoT and the Andaman Sea. Anchovies are also overexploited in the Andaman Sea. Most demersal species are overexploited in the GoT.

Table 4.1: Maximum Sustainable Yields (MSY), Optimal and Current Fishing Effort and Catches of Marine Fisheries Resources in Thai Waters.

Location	MSY (tonnes)	Optimal Fishing Effort	Current Catch (tonnes)	Current Fishing Effort	Status of Fisheries	
					Exceeded / Balanced / Lower	Percentage
(1) Demersal Fish*					**Exceeded (million hours)**	
Gulf of Thailand	2,942,739	24.33 mh**	503,276	36.20 mh	11.87	+32.8%
Andaman Sea	686,411	4.81 mh	177,684	5.09 mh	0.28	+5.3%
(2) Anchovies					**Balanced (days)**	
Gulf of Thailand	191,785	114,588 days	183,216	115,600 days	1,012	+0.9%
Andaman Sea	32,944	52,014 days	33,903	51,520 days	494	-1.0%
(3) Other pelagic fish					**Exceeded (days)**	
Gulf of Thailand	248,176	130,493 days	245,986	179,709 days	48,216	+27.0%
Andaman Sea	118,477	54,238 days	99,039	64,925 days	10,687	+16.5%

Source: Department of Fisheries, 2015a.
** Demersal fish refers to all bottom dwelling fish including crustaceans and molluscs.*
*** mh = million hours*

After implementing some fishing regulations according to the Royal Fisheries Ordinance of 2015 (see explanation in section 4.10), the current fisheries harvest and efforts are well within the maximum allowable harvest and optimal fishing effort based on the 2016 MSY (**Table 4.2**). In addition, MSY estimates for two consecutive years (2016 and 2017) for each target group, suggested a somewhat robust estimate of the maximum allowable harvests and optimal fishing effort.

Table 4.2: MSY, Maximum Allowable Harvest, Actual Harvest, and Current Fishing Effort.

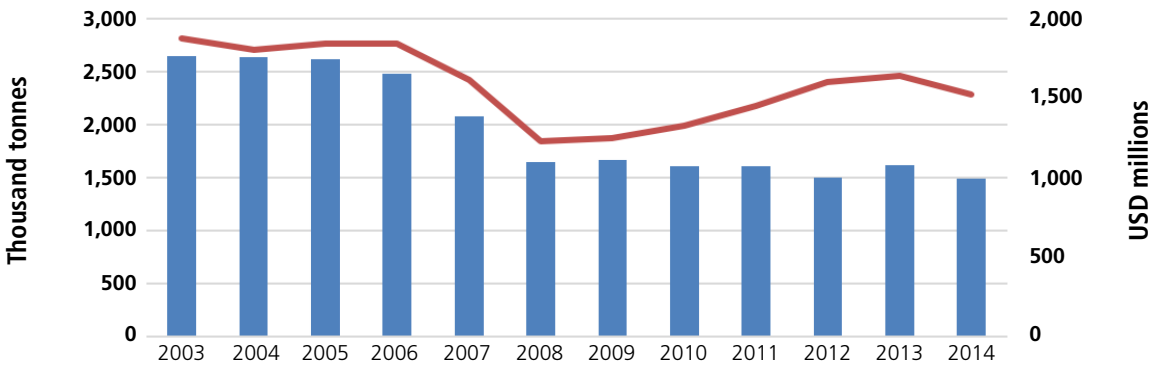
Location	MSY (tonnes)	Maximum allowable harvest (T)		Actual harvest (April 2016 – March 2017	Current fishing effort (April 2016 – March 2017)
		2016	2017		
	Demersal fish				
GoT	777,855	715,294	700,070	538,361	20.83 mh
Andanan Sea	240,051	216,467	216,046	154,947	3.71 mh
	Anchovies				
Gulf of Thailand	196,990	177,291	172,607	148,843	79,477 days
Andanan Sea	32,381	29,650	29,143	10,157	14,382
	Pelagic fish				
GoT	248,055	230,803	230,691	226,853	142,374 days
Andanan Sea	119,595	111,184	110,223	226,853	53,166 days

Source: Department of Fisheries, unpublished data.

4.2 Fisheries

Production of marine fisheries has leveled off since 2008 (approximately 1.5 million tonnes per year) following a sharp decline from approximately 2.5 million tonnes, 2001- 2006. In 2014, the total production from capture fisheries was 1,488,300 tonnes with a value of USD1.5 billion (**Figure 4.3**). The marine capture fisheries contributed to approximately 58% of total fisheries production (2,567,800 tonnes).

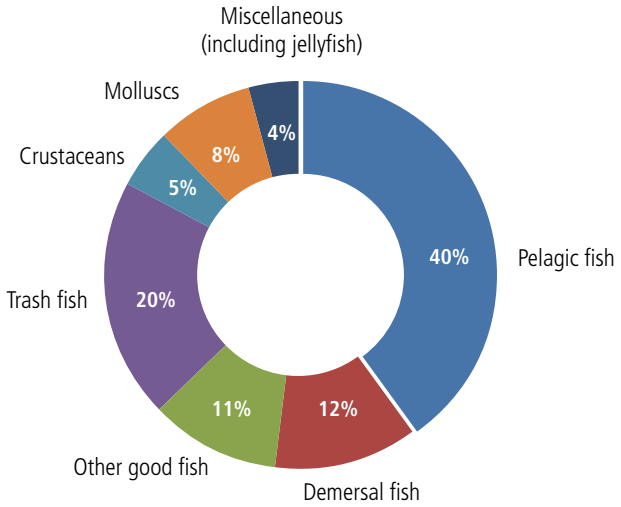
Figure 4.3: Fisheries Production and Value from Marine Capture 2003-2014.



Source: Department of fisheries, 2017.

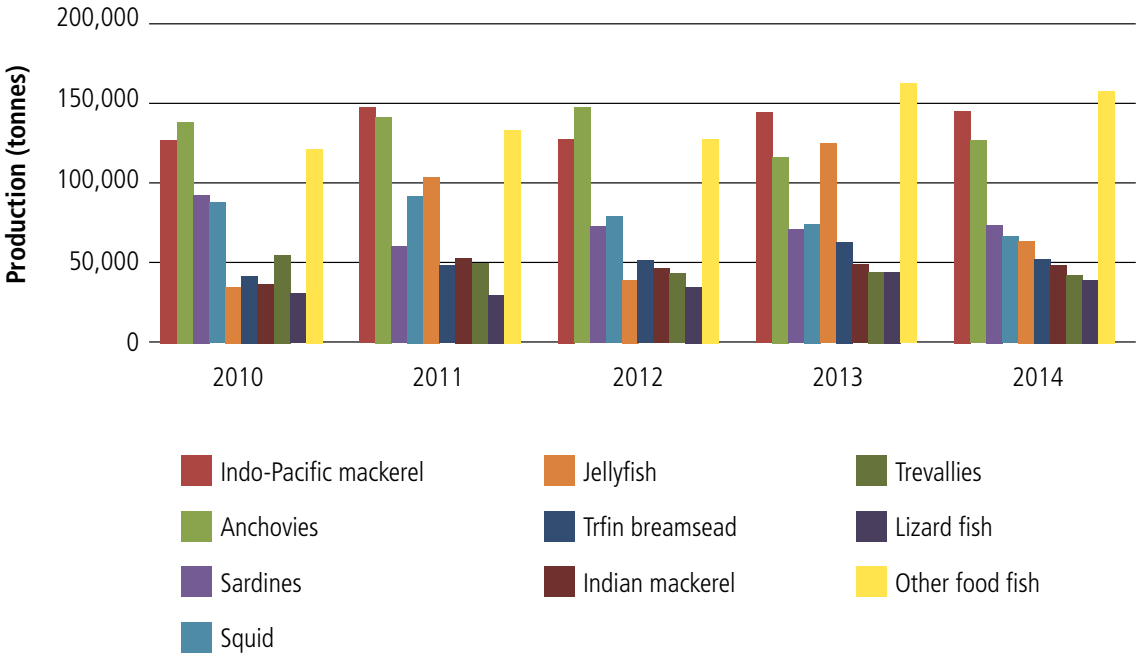
Species groups in the marine capture fisheries consisted of pelagic fish, demersal fish, trash fish, other food fish, molluscs, crustaceans, and others (**Figure 4.4**). By weight, pelagic fish contributed to the largest proportion (40% of total production, 589,722 tonnes), followed by trash fish (20%), demersal (12%) and miscellaneous food fish (11%). Molluscs (mainly squids and clams), crustaceans and other species groups comprised 4%-8% of total production.

Figure 4.4: Contribution by Weight (tonnes) of Species Groups to 2014 Marine Capture Fisheries Production.



The top ten species/groups being harvested in 2014 include pelagic fish (mackerels, sardines and anchovies), demersal species (beams, croaker, big-eyes, and lizard fish), trash fish, squids, jellyfish, and crustaceans (**Figure 4.5**). Squids and jellyfish (8% and 4% of total production, respectively) have been in the top five species/groups in marine capture fisheries for the past 5 years, with the production of more than 50,000 tonnes. Crustaceans contributed 5% of the total production.

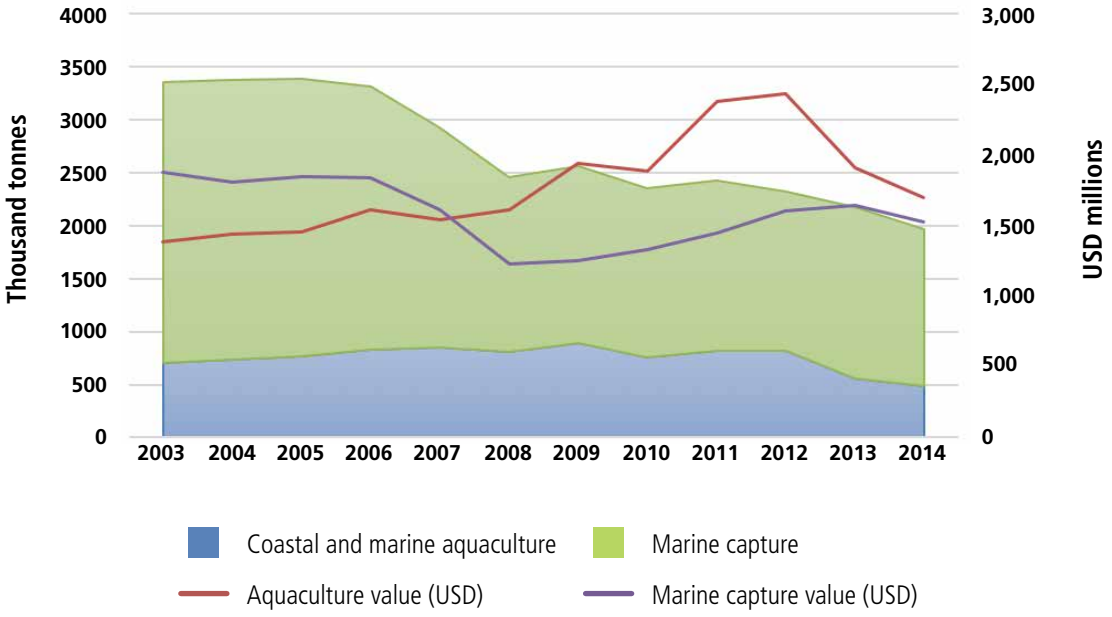
Figure 4.5: Top 10 Marine Species/Groups, Excluding Trash Fish, from Capture Fisheries, 2010 to 2014.



4.3 Aquaculture and Mariculture

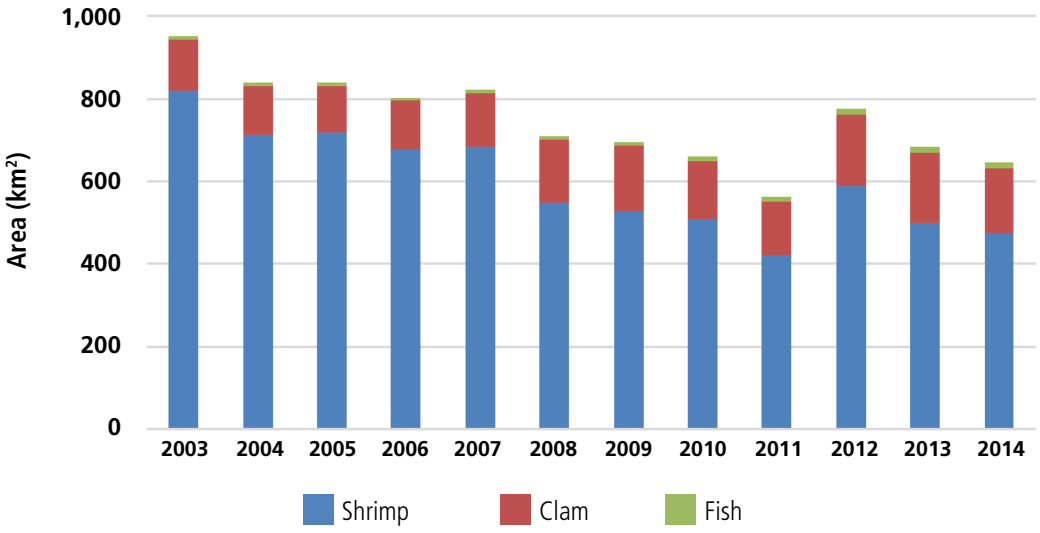
Coastal/marine aquaculture has been significantly contributing to Thailand's economy and to global food production. It accounted for approximately 20% of the total fisheries production (**Figure 4.6**). However, the economic value of aquaculture has exceeded marine capture fisheries since 2007. Production from the marine/coastal aquaculture has steadily increased since the 2000s with a peak in 2009 (894,000 tonnes). The fluctuation of the production was mainly due to the disease outbreaks in major cultured species, like Pacific whiteleg shrimp (*Penaeus vannamei*). In 2014, Thailand ranked 13 among the top aquaculture producers in the world (FAO 2016). The production of marine/coastal aquaculture in Thailand in 2014 was 482,600 tonnes, with a value of USD1,700 million (Department of Fisheries 2015b). The major cultured species include Pacific whiteleg shrimp (*P. vannamei*), giant tiger prawn (*P. monodon*), Asian seabass (*Lates calcarifer*), groupers (*Epinephelus spp.*), green mussel (*Perna viridis*), blood cockle (*Anadra granosa*), and oysters (*Saccostrea spp.*). About three species of oysters are cultured in various regions of Thailand: *Saccostrea spp.* commercial is mainly cultured in eastern Thailand; *Crassostrea belcheri* and *C.lugubris* are mainly cultured in southern Thailand.

Figure 4.6: Total Marine Fisheries Production, including Coastal and Marine Aquaculture and Marine Capture Production, 2003 - 2014.



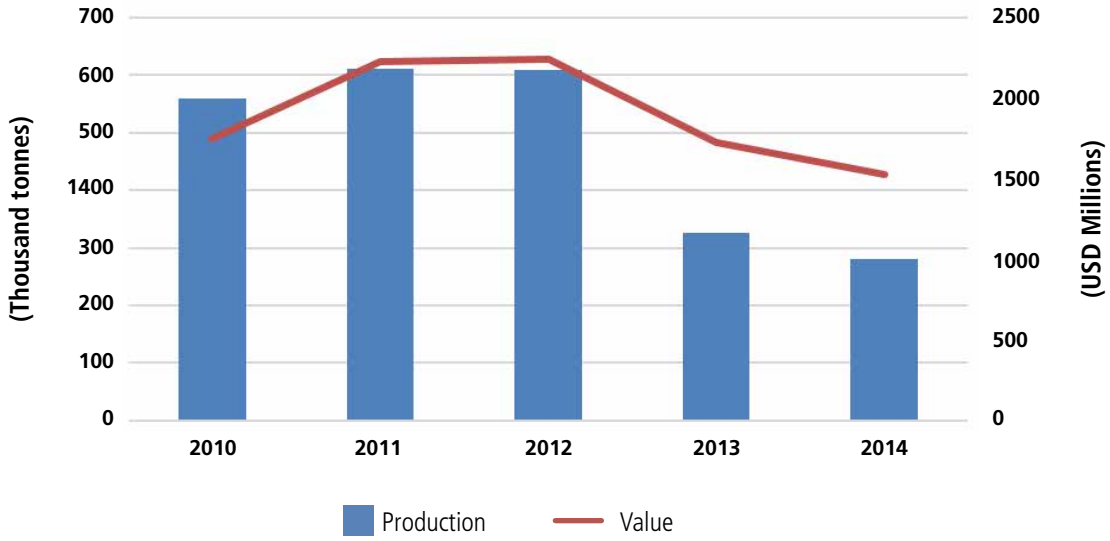
The shrimp aquaculture constituted the majority of the coastal aquaculture areas (>70%, **Figure 4.7**) as well as contributed to the significant production and economic value (**Figure 4.8, Figure 4.9, Figure 4.10**). In 2014, shrimp aquaculture occupied 472 km^2 out of 644 km^2 of coastal/marine aquaculture areas, with production of approximately 279,907 tonnes, with a value of USD1,527 million (Department of Fisheries, 2015b). The 2014 marine fish and clam production from aquaculture was 19,087 tonnes and 183,570 tonnes, respectively.

Figure 4.7: Total Coastal/Mariculture Area in Thailand, 2003 - 2014.



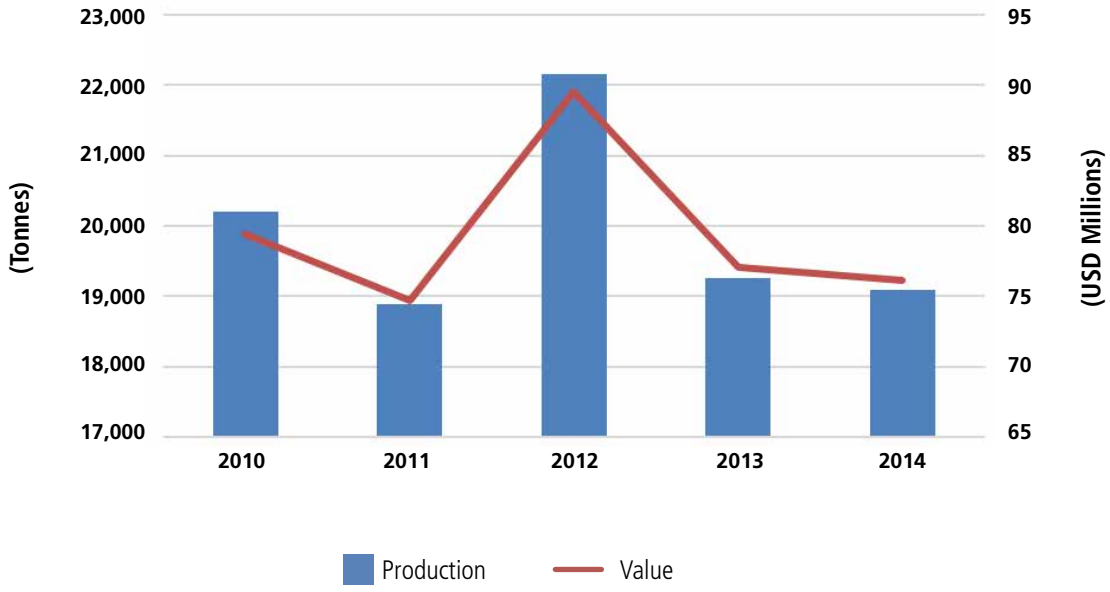
Source: Department of Fisheries, 2015b.

Figure 4.8: Marine Shrimp Aquaculture Production and Value in Thailand, 2010-2014 .



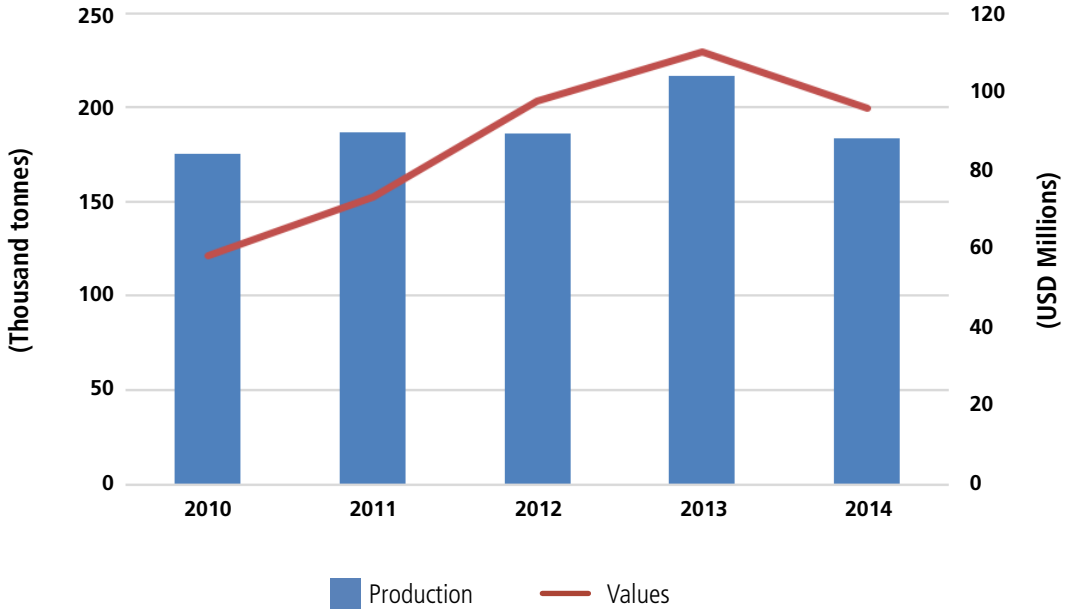
Source: Department of Fisheries, 2015b.

Figure 4.9: Marine and Coastal Fish Aquaculture Production and Value in Thailand, 2010 – 2014.



Source: Department of Fisheries, 2015.

Figure 4.10: Marine Coastal Shellfish Aquaculture Production and Value In Thailand, 2010 – 2014.



Source: Department of Fisheries, 2015.

Seaweeds have not contributed significantly to the fisheries production, hence, were not included in the national fisheries statistics (Department of Fisheries, 2015b). However, there are at least four species of seaweed being cultured: *Caulerpa lentillifera, Gracilaria fisheri, Ulva rigida, and Enteromorpha clathrate*.

4.4 Demand for Fish and Exports/Trade

The marine fisheries production is used for both domestic consumption and international trade. The majority of the marine capture fisheries production is consumed domestically (**Table 4.3**). A large proportion of the marine shrimp produced by aquaculture enters international trade. In 2013, the available domestic supply for seafood constituted approximately 70% of the total marine fisheries production (FAOSTAT, 2015).

Table 4.3: The Availability of Seafood in Thailand in 2013.

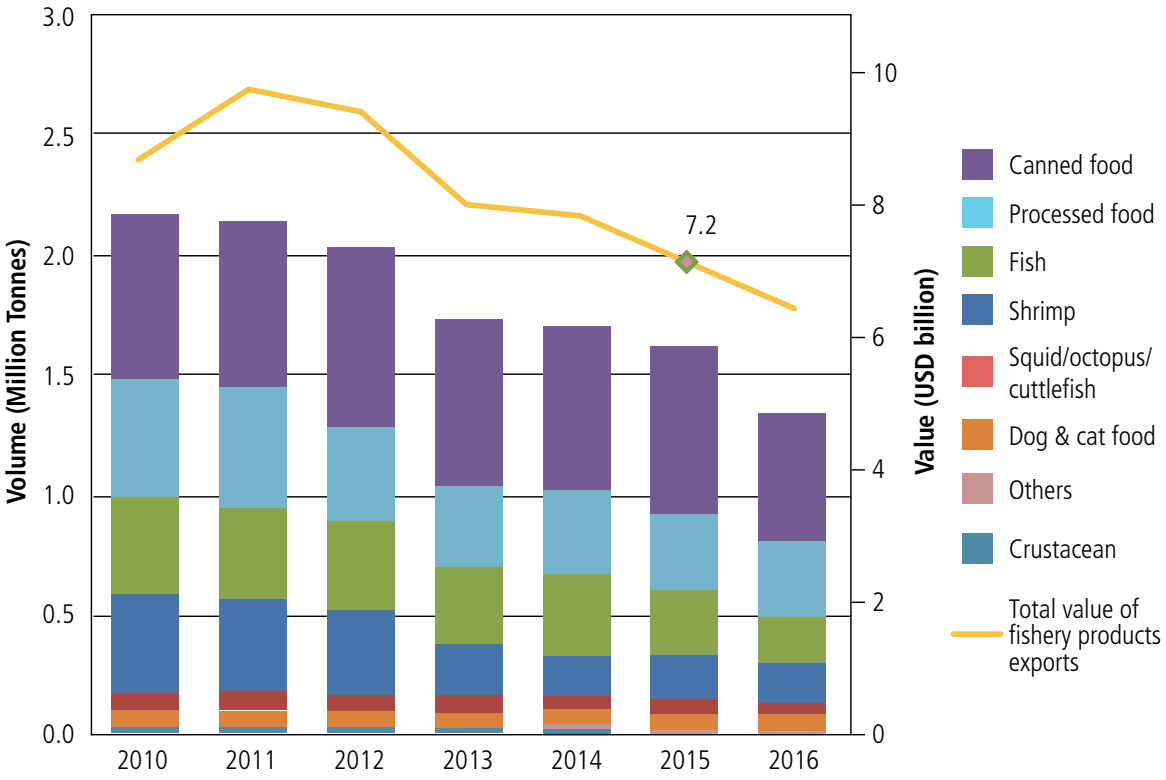
Region	Production (thousand tonnes)	Import Quantity (thousand tonnes)	Export Quantity (thousand tonnes)	Domestic supply quantity (thousand tonnes)
Freshwater fish	599	55	97	557
Demersal fish	183	41	157	67
Pelagic fish	595	1,460	1,390	665
Marine fish, Other	499	44	180	363
Crustaceans (shrimp and crabs)	718	55	678	96
Cephalopods (squid and cuttlefish)	128	86	72	142
Mollusc, Other	205	29	93	140
Aquatic plants	0	4	1	3
Total	2,927	1,774	2,668	2,033
Total (Marine species)	**2,328**	**1,719**	**2,571**	**1,476**

Source: FAOSTAT, 2015.

Photo from: TEI

Thailand also exports canned food, processed food, frozen fish, frozen shrimp, and related products (**Figure 4.11**). In 2015, Thailand exported 1.62 million tonnes, with a value of USD7,234 million and imported 1.62 million tonnes, with a value of USD2,636 million. Thailand mainly exported canned fish (701,508.58 tonnes), followed by processed food (318,003.20 tonnes), and frozen fish (278,177 tonnes). To have an adequate supply of seafood for processed food and domestic demand, there are major imported items, such as chilled and frozen fish, including tuna (1.3 million tonnes) (Department of Fisheries, 2017).

Figure 4.11: Volume and Value of Seafood Exported in Thailand during 2010 – 2016.



Source: Department of Fisheries, 2017; Ministry of Commerce, 2017, http://tradereport.moc.go.th/.

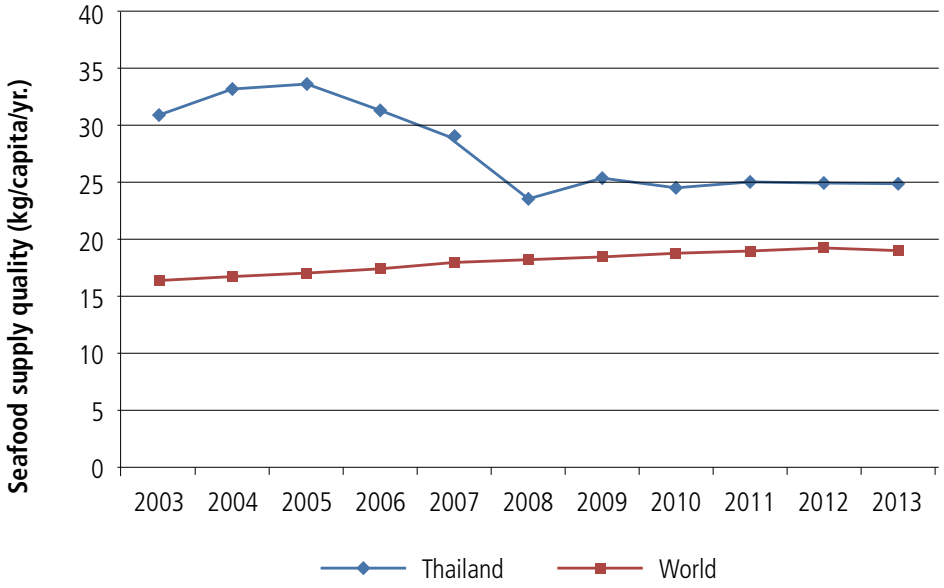
4.5 Contribution to Food Security

4.5.1 Availability

Compared to other Southeast Asian countries, consumption of seafood in Thailand (including freshwater fish) is in the upper range (the 2011 estimate from the household surveys = 31.4 kg/capita/year), with marine and freshwater species being eaten at a similar quantity (Needham and Funge-Smith, 2014). This amount represented 11.7% of total protein consumption. The regional seafood consumption estimates for 2011 ranged from 6.1 kg/capita/year (Timor-Leste) to 63.2 kg/capita/year (Cambodia). In Thailand, the highest levels of consumption are in the southern provinces (41.4 kg/capita/year, ~70% marine species), followed by the northeast provinces (32.7 kg/capita/year, ~60% freshwater species). Rural areas consumed more seafood (35.7 kg/capita/year) than urban counterparts (26.5 kg/capita/year). The estimates based on the household surveys (Needham and Funge-Smith, 2014) were slightly higher than the FAOSTAT estimate based on the food balance sheets method (24.99 kg/capita/year for 2011, **Figure 4.12**).

Due to the lack of more precise estimates for other years, the FAOSTAT estimates were used in this report to evaluate long-term availability of seafood supply during 2003-2013. In 2013, the seafood supply quantity (including freshwater fish) in Thailand was 24.83 kg/capita/year (FAOSTAT, 2015), which was greater than the global estimates at 18.98 kg./capita/year (Figure 6.12). The 2009 to 2013 estimates were similar, but they were lower than the supply during 2003-2007. The decline coincided with the sharp decline in marine capture fisheries (**Figure 4.12**).

Figure 4.12: The Seafood Supply Quantity in Thailand during 2003 – 2013 based on the Food Balance Sheets Method.

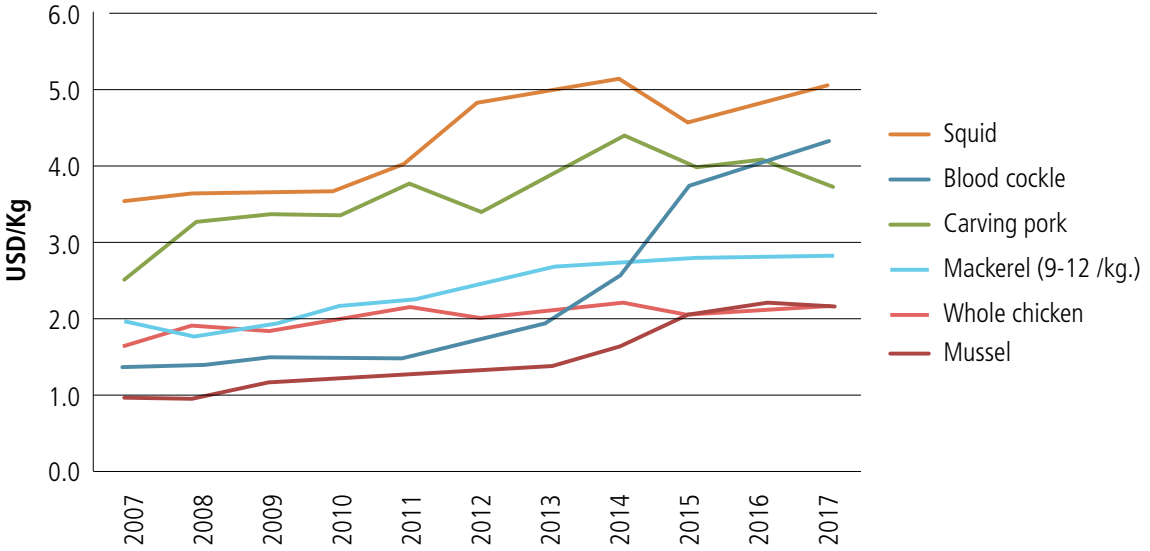


Source: Food and Agriculture Organisation, 2015.

4.5.2 Affordability

Seafood price varied upon the species, with freshwater species (e.g., tilapia) being cheaper than the marine species (e.g., fish, clams and squid). Compared to terrestrial protein sources, such as chicken, the price of marine species is typically higher (**Figure 4.13**). The seafood price has been steadily increasing in the past 10 years. In 2015, the highest price of seafood was squid (USD4.55/kg) (**Figure 4.13**). The accessibility of seafood to the population in different regions of the country is not uniform. Needham and Funge-Smith (2014) suggested that coastal communities (e.g., southern provinces) have easier access to seafood, more than the inland provinces (e.g., northern and northeastern provinces).

Figure 4.13: Wholesale Price of Seafood, 2007 – 2017.



Source: Department of Fisheries, 2017; Taladthai Central Market, Phathumthani, url.

4.5.3 Quality and Safety

Thailand has set a criteria for food safety standards for the contamination of some heavy metals, pesticides, chemicals, and pathogenic bacteria (Ministry of Public Health Notifications). The Ministry of Public Health has been routinely monitoring the contaminant levels in food and related products, including seafood. A consistently detected contaminant in seafood was formaldehyde, especially in raw and pickled squid. In 2016, the Department of Health detected formaldehyde in 35 out of 273 squid samples collected from 39 markets throughout the country (Department of Health, 2016).

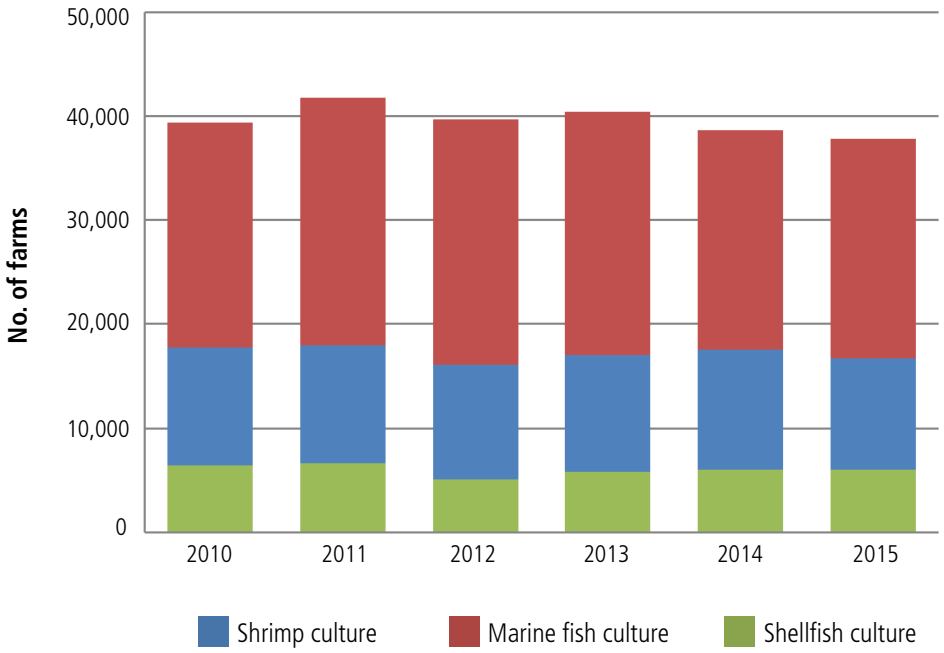
4.6 Contribution to Income and Livelihood

The fisheries and aquaculture sectors have generated jobs and income for coastal communities and for fish/shrimp farmers. Employment in the agriculture sector (including fisheries sector) was estimated to be 28% of total employment in 23 coastal provinces (National Statistical Office of Thailand, 2017). In 2015, there were 2,767,744 people employed/engaged in agriculture in 23 coastal provinces (Ministry of Labor, 2016). Unfortunately, the statistics did not allow for a separate estimate of employment in the fisheries sector alone.

Employment in aquaculture can be reflected in the number of active farms. In 2015, the total number of aquaculture farms in Thailand was 37,793 with shrimp farms accounting for 56% of total number of farms (**Figure 4.14**) (Department of Fisheries, 2017).

Although the fisheries resources contribute to the livelihoods of coastal communities, there are limited information on household income, which may vary among regions and between fisherfolks and aquaculture farm operators.

Figure 4.14: The Number of Culture Farms, 2010 – 2015.



Source: Department of fisheries, 2017.

4.7 Sustainability of Fisheries

Fishing Fleet

Fishing vessels in Thailand are categorized into two artisanal categories (less than 5 GT and between 5 and 10 GT), three commercial categories based on size, as well as a category of transshipment vessels. Based on a 2017 survey, there are a total of 38,432 registered vessels operating in Thai waters and 16 vessels operating outside of Thai waters (**Table 4.4**). Of the 38,432 vessels, 27,862 were artisanal vessels and 10,570 were commercial vessels.

Table 4.4: Total Number of Registered Vessels in Thai Waters (as of October 2017).

Category	Number of registered fishing vessels in Thai waters	Number of vessels operating outside of Thai waters
Artisanal	27,862	-
Commercial	10,570	16
Total	**38,432**	**16**

Fishing Gears

Thailand allows the use of a variety of fishing gears, such as trawls, gill nets, traps, falling nets, lift nets, and surrounding nets, depending on the target species (**Table 4.5**). Trawls and falling nets are major fishing gears in commercial vessels.

Table 4.5: Number of Fishing Gears Equipped in Registered Commercial Vessels.

	Number of vessels		
	Gulf of Thailand	Andaman Sea	Total
Trawl	3,011	667	**3,678**
Gill nets	767	5	**772**
Traps	728	96	**824**
Hook and lines	72	17	**89**
Falling nets	1,666	210	**1,876**
Lift nets	36	25	**61**
Dredges	89	-	**89**
Surrounding nets	838	302	**1,140**
Generator vessels	1,293	622	**1,915**
Push nets (krill)	126	-	**126**
Total	**8,626**	**1,944**	**10,570**

Source: Department of Fisheries, unpublished data, updated 2017

Fishing Effort

A recent implementation of vessel regulation resulted in the reduction in fishing effort for target groups both in the GoT and the Andaman Sea (**Table 4.6**). Moreover, the 2016 fishing effort for most groups was lower than the optimal fishing effort derived from the 2015 MSY (1.97% lower for pelagic fish to 72.35% lower for anchovies).

Table 4.6: The Differences in 2016 Fishing Efforts in Thai Waters (estimated for April 2016 to March 2017) Compared to Optimal Fishing Efforts Estimated in 2015.

Resource type	Gulf of Thailand			Andaman Sea		
	Optimal fishing effort based on 2015 MSY estimates	2016 fishing effort	% difference	Optimal fishing effort based on 2015 MSY estimates	2016 fishing effort	% difference
Demersal fish	24.33 mhr	20.83 mhr.	-14.41	4.81 mhr.	3.71 mhr	-22.99
Anchovies	114,588 days	79,477 days	-30.64	52,014 days	14,382 days	-72.35
Pelagic fish	130,493 days	142,374 days	+9.1	54,238 days	53,166 days	-1.97

4.8 Pressures and threats

Fisheries and aquaculture activities can pose a variety of threats to the coastal environment and natural resources. Threats from fisheries activities range from their direct interactions with fisheries resources to indirect interactions with benthic habitats and marine endangered species. Increasing marine debris, especially plastic waste and fishing nets have recently become a threat to marine endangered species. Degraded plastic particles can be accumulated in the environment and pass through natural food chains. Threats from aquaculture involves the release of nutrient-rich effluent, conversion of mangrove forests into aquaculture farms, and the release of non-native species.

Overfishing and IUU fishing can directly affect the abundance of targeted and by-catch species. These types of fishing, however, have been strictly regulated through the Royal Ordinance on Fisheries of 2015. These regulations should relieve extreme fishing pressure on Thailand's fisheries stocks. In addition, some mechanised fishing gears, such as bottom trawlers and push nets, are destructive to sea floor, which is an important benthic habitat for marine living resources. These habitats include coral reefs and seagrass areas.

Fishing grounds can also be an important roaming range for populations of marine mammals and sea turtles. Fishing gear entanglement can be lethal to some species, especially sea turtles and dugong. The majority of stranded sea turtles and dugong reported in 2016 were due to gill net entanglement (69%-75% of total stranded sea turtle and dugong individuals; DMCR, 2017). Stationary nets for the fisheries of Mekong giant catfish in Songkhla Lake were also responsible for some Irrawaddy dolphin injuries in the area.

The need to reduce marine debris, especially plastic, has recently become a national priority as the 2010 estimated quantity of marine plastic debris (from both inland and marine sources) has ranked Thailand as among the top ten producer countries (0.15-0.41 million MT; Jambeck et al., 2015). Plastic and microplastic particles (< 5 mm) from fishing nets can be settled in important habitats, such as beaches (Thushari et al., 2017a), coral reefs (DMCR, 2016), and seagrass (DMCR, 2016). In addition, plastic debris could directly impact the marine endangered species, such as sea turtles, that accidentally consumed these items (2%-3% of stranded individuals; DMCR, 2017). Microplastic can also be passed through the food web. Thushari et al. (2017b) found particles of micro plastic in tissue of sessile invertebrates in areas in Chon Buri Province.

Threats derived from aquaculture activities include the release of nutrient/sediment-rich/saline effluent from aquaculture operations, the conversion of mangrove forests or wetlands into farms, and the introduction of alien species.

Effluent from aquaculture, especially shrimp aquaculture, is rich in nutrients, especially total nitrogen and phosphorous, and contained high suspended solids (Briggs and Funge-Smith, 2004).

For inland marine shrimp farming, saline contamination to soil and inland water bodies is also a concern. This issue is regulated by the Enhancement and Conservation of National Environmental Quality Act of 1992 and its recent amendments. Also, the Department of Fisheries required the farm registration and actively encouraged good aquaculture practice certification for all registered farms. Due to unpredictable water quality from rivers and canals, recirculating aquaculture systems have received much attention (Suantika et al., 2018). In the long run, these technologies will help reduce this type of threat.

Marine shrimp farming is among the activities that convert mangrove forests into farm areas, especially during the 1980s to early 2000s (Hutric et al., 2002). During 2000-2014, Thailand has lost approximately 2.28% of mangrove forests (~6,700 hectares) for the areas reported in 2000 (236,821 hectares; DMCR, 2017). Based on the area estimates by satellite images, aquaculture (particularly shrimp farming), has lost approximately 11% (Richards and Friess, 2016). However, an increasing trend have been observed since 2009; this observation may be due to the efforts by the government and private sectors to restore mangrove forests in already existing degraded forests, reclaimed forests, aquaculture farms and urban areas.

The series of disease outbreaks in an important aquaculture species, the giant tiger prawn (*P. monodon*), since mid-1990s, have led to the introduction of domesticated strains of Pacific whiteleg shrimp, *P. vannamei*, a native species from the Americas for aquaculture. Aquaculture of Pacific whiteleg shrimp has rapidly expanded since 2000. Currently, the production of Pacific whiteleg shrimp has contributed to more than 95% of total marine shrimp production. Extensive aquaculture areas allowed for the release of large numbers of this introduced species into Thai natural waters. Senanan et al. (2007) first reported the presence of sub-adult Pacific whiteleg shrimp in the Bangpakong river mouth in eastern Thailand. Subsequent studies suggested geographic expansion of wild-caught individuals along the east coast of Thailand in both coastal and offshore areas (Panutrakul et al., 2010; Panutrakul et al., unpublished data) and suggested reproductive potential of some adults (Senanan et al., unpublished data). Threats posed by the establishment of a self-sustaining population of this species include the spread of a non-native pathogen, Taura Virus Syndrome (TSV) (Barnette et al., 2008 and Senanan et al., 2009), potential reservoir for local viruses (Barnette et al., 2008), and competition with local shrimp species (Chavanich et al., 2016). Barnette et al. (2008) detected TSV in 1.90% – 24.24% of the total number of individuals sampled in each of the local marine shrimp species examined (*Peneaus spp., Metapenaeus spp.* and *Parapenopis hungerfordi*). Chavanich et al. (2016) observed some competitive advantage of Pacific whiteleg shrimp over the local shrimp species, where Pacific whiteleg shrimp had the fastest feeding rates compared to those of *P. monodon, P. merguiensis, M. ensis, M. tenuipes,* and *M. affinis*.

4.9 Examples of Good Practices

Conservation and management practices have been implemented at the local and governmental levels. For fisheries management, local practices included community initiatives, such as seed banks for aquatic organisms. At the national level, the Department of Fisheries have regulated commercial fisheries by imposing seasonal regulation and to implement measures against IUU fishing. In addition, the Department of Fisheries has an on-going effort to implement sustainable fisheries approaches like ecosystem-based management in some areas. For aquaculture, some farmers have embraced environmentally friendly farm practices.

Crab seed bank initiatives are widely practiced in coastal communities as blue swimming crab and mud crab are important commodities (Coastal Fisheries Research and Development, Department of Fisheries, 2015). The goal of the initiatives is to allow gravid females to reproduce by releasing gravid females from fishermen's crab traps (either by cooperation or trading) in protected areas. A gravid female typically hold millions of eggs. A successful example is the 'crab condominium' initiative in Sri Racha District, Chon Buri Province, which commenced in 2006 (PEMSEA, 2016). It is a collaboration between Sri Racha Municipality, Chon Buri Fisheries Association and local fishing villagers, with appropriate financial and technical supports from various organisations. The initiative entailed the construction of 'crab condominium', a collection of individualized plastic cages tied together to prevent cannibalism among females. The initiative started with one pilot area and eventually expanded to neighbouring villages and communities. Eventually, the 'condo' complex can house up to 1,600 individuals, resulting in billions of released eggs. Although scientific reports on the positive impacts were informal and anecdotal, the fishermen noticed the increase of crab harvests. The success of this project has inspired other similar initiatives in local fishing communities in Chon Buri Province.

Regulations to address IUU fishing. In addition to the conservation efforts at the local level, the Department of Fisheries has reinforced season regulations for commercial fisheries since 1983, and recently implemented additional restrictions on fishing vessels in response to the continually declining pelagic fish catches, and to IUU fishing. In 2015, the more recent measures against IUU fishing (see section 5.10) have lowered the total number of commercial fishing vessels in Thai waters. These measures include limiting new fishing license, removing illegal fishing vessels, and prohibiting the use of push nets.

Integrated fisheries and habitat conservation plan. The Department of Fisheries recognised the need for an integrated fisheries plan to include the protection of important habitats for fisheries resources.

Seasonal closure of fisheries. For seasonal fishing regulation, the Department of Fisheries has imposed a three-month fisheries closure period during the spawning period (February to May for

the GoT; April to June for the Andaman Sea). The regulation focuses on commercial fisheries. The recovery of pelagic fish stocks has been more apparent in the Andaman Sea, however. The Andaman Sea closure programme has resulted in increased fisheries productivity, especially mackerels and shrimp (Department of Fisheries, 2015a). In 2014, the Department of Fisheries research vessel survey (trawl) reported that the CPUE before and during the closure was 150.59 kg/hour and 826.61 kg/hour, respectively.

Aquaculture auditing system. Due to a relatively long history of aquaculture in Thailand, Thai fish and shrimp farmers are typically skillful and entrepreneurial. Since 2003, the Department of Fisheries instituted a governmental auditing system, which has encouraged good aquaculture practices for important commodities, such as shrimp and fishes. The criteria include practices that are socially and environmentally responsible. Due to technical and financial limitations at a farm level, most aquaculture farms can meet only a basic set of standards (i.e., Good Aquaculture Practice, GAP). In 2015, there are more than 10,000 shrimp farms that has been certified for GAP. However, some farmers have taken further steps to meet international standards.

4.10 Supporting Policies and Plans for Sustainable Fisheries

Royal Ordinance for Fisheries of 2015. Thailand has established a number of policies and plans to support sustainable fisheries and aquaculture. For marine fisheries, since 2014, there have been several changes regarding the national fisheries policies, regulations, and management (Department of Fisheries, 2015a and Asian Research Centre for Migration, 2015). These changes were responses to the continuing decline of fisheries resources and to the EU's decisions to issue a 'yellow card' to Thailand for not taking sufficient measures in fighting IUU fishing. One of the most significant changes was the amendment to the national fisheries law, the Fisheries Act of 1947, resulting in the new Fisheries Act of 2015 and the subsequent Royal Ordinance for Fisheries of 2015. The Royal Ordinance for Fisheries of 2015 has greatly strengthened the government's ability to regulate illegal fishing activities as well as to facilitate sustainable fisheries practices.

Fisheries Management Plan. The Department of Fisheries has developed a 2015-2019 fisheries management plan recognizing the need to reduce the fishing capacity and fishing effort to limit the catch at or near the MSY, rebuild fisheries resources, eliminate IUU fishing, as well as prevent illegally fished commodity to enter Thailand seafood supply chain (Department of Fisheries, 2015). For example, for demersal fish, the specific capacity reduction targets for the GoT and the Andaman Sea are 40% and 10%, respectively. For pelagic fish, the proposed reductions were 30% in the GoT and 20% in the Andaman Sea. Proposed main measures include the removal of currently illegal commercial fishing vessels, imposing a series of temporal closures to fishing areas to relieve some fishing pressure, implementing the vessel monitoring system (VMS), and embracing a more holistic approach to fisheries management. The plan also recognizes the social/

economic impacts of strong regulations. It proposed some compensation strategies for affected fisheries sectors.

Ecosystem-based fisheries management (EAFM). Major initiatives to achieve sustainable fisheries under the 2015-2019 fisheries management plan include the ecosystem based fisheries management (EAFM) as well as exploring science-based management options [e.g., determining total allowable catch (TAC) and individual transferable quotas]. To implement EAFM, the Department of Fisheries recognized the need to work across sectors to restore ecosystem health to support the recovery of fisheries resources. For example, the Department of Fisheries, in collaboration with the Southeast Asian Fisheries Development Center (SEAFDEC), identified Trat and Surat Thani provinces to be fisheries refugia under the GEF- funded South China Sea Fisheries Refugia Initiative. In the management plan, the Department of Fisheries also proposed to increase the healthy habitat for spawning and nursing grounds. Specific activities include expanding the seed bank programmemes, community-based fisheries programme, and artificial reefs.

International agreements. Thailand has ratified a number of international agreements, including the Law of the Sea Convention (UNCLOS), Convention of Biological Diversity, Convention on International Trade in Endangered Species (CITES), and the Ramsar Convention on Wetlands of International Importance (Ramsar). The Department of Fisheries is currently considering the ratification of the UN Fish Stock Agreement and the accession to the FAO Port State measures (Department of Fisheries, 2015a).

Thailand is a member of the ASEAN community and is guided by the ASEAN Roadmap for an ASEAN Community (2009-2015) and its supporting Blueprints. Thailand has also endorsed the ASEAN-SEAFDEC Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2020 (Res/POA). Thailand is part of the Regional Plan of Action Against IUU fishing (RPOA-IUU), which is a ministerial initiative of 11 countries: Australia, Brunei Darussalam, Cambodia, East Timor, Indonesia, Malaysia, Papua New Guinea, the Philippines, Singapore, Thailand, and Viet Nam to promote responsible fishing practices and combat IUU fishing in the SE Asian region. Thailand is a member of the Indian Ocean Tuna Commission (IOTC), cooperating non-member of the Western and Central Pacific Fisheries Commission (WCPFC), and a non-contracting party of the International Commission for the Conservation of Atlantic Tunas (ICCAT) and the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR).

5 Coastal and Marine Tourism

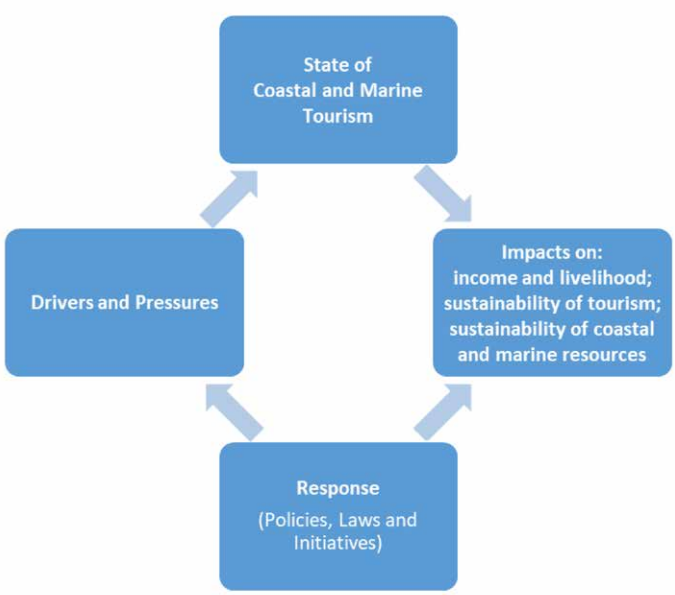


Photo by: J.Calayo

Thailand is located in the Indo-Pacific region with the GoT in the Pacific Ocean on the east side, and the Andaman Sea in the Indian Ocean on the west side. The seas of Thailand covered the area of more than 320,000 km2 of beautiful tropical biomes. Due to the appropriate geographical position, the marine and coastal areas of Thailand have high diversity of organisms and ecosystems, such as coral reefs, mangrove forests, seagrass beds, and various beach ecosystems. High biodiversity, combining with clear warm water, make the seas of Thailand among the world's best tourist destinations.

Thailand is under the influence of monsoons throughout the year. However, due to the different geo-morphological characteristics of the coastline, marine tourist activities are available all year round. Tourist activities can be conducted in sheltered coastlines while other coastlines, which are affected by the monsoon, cannot be visited.

Diverse ecosystems provide various tourist activities, at the same time, tourist activities can directly cause changes in natural resource conditions. This chapter encompasses the information on various types of marine and coastal tourist destinations, important tourism indicators, impacts of tourism, good management practices, and supporting policies needed for sustainable tourism. Although, there are various organisations responsible for tourism in Thailand, specific data and information on marine and coastal tourism are still lacking.

Photo from: TEI

5.1 Major marine and coastal tourist sites

Thailand has many unique tourist destinations. The most popular marine tourist site are: Phuket, Chon Buri, and Krabi provinces (Department of tourism, 2016). The following table shows short descriptions of the major marine tourist sites (**Table 5.1**).

Table 5.1: Major Marine Tourist Sites.

Location	Tourist site	Short description
Phuket	Rawai Beach	It was formerly a fishing village. Now, it offers beautiful scenery and is famous for seafood.
	Laem Phromthep	It is located in the southernmost tip of Phuket Island. A popular viewpoint for sunset watching.
	Patong Beach	The most famous beach in Phuket with white-powdery sand and nightlife.
Chon Buri	Pattaya beach	The best place for eating and partying. Tourists can experience and enjoy a lot of activities.
	Si Chang island	The tiny island is a perfect getaway for travelers who want to learn history and have fun.
	Khao sam muk	It is a good spot to see the panoramic view of Chon Buri sea.
Location	**Tourist site**	**Short description**
Krabi	Railay Beach	A beautiful beach with quiet and relaxing atmosphere. There are high limestone cliffs that attract rock climbers from all over the world
	Ao Nang Beach	The popular tourist site on the mainland Krabi, which offers the most developed services and hotels.

5.2 Marine Protected Area

Thai seas offer many opportunities for recreation and tourism development. In the past, most of marine and coastal environments were protected from tourist use by its inaccessibility, safety concerns, and the relatively high cost of recreation in the area. Through recent decades, substantial advances in technology, and an increase in international travel have made the marine areas more accessible. Marine and coastal tourism has become a major component of the growing tourism industry.

Most of marine tourist destinations in Thailand are located in the marine national parks, while other destinations are scattered across 23 coastal provinces in Thailand. At present, there are 22 marine national parks.

Marine National Parks

Thailand's 22 marine national parks are in both the Andaman Sea and the GoT (http://portal.dnp.go.th/p/marine). All of these parks are restricted areas, which prohibit visitors from destructive uses of marine resources, and encourage sustainable tourism. (**Table 5.2**)

Table 5.2: Marine National Parks in Thailand.

Name	Location	Brief Information
1. Lam Nam Kraburi National Park	Ranong	The national park's uniqueness is a versatile mangrove forest along the Kraburi River banks and the distinctive geographical estuary along the fault region of Kraburi River.
2. Mu Ko Ranong National Park	Ranong	The main attractiveness of the park is its offshore island coral reefs, black sand, boulder and shell sand beaches providing spectacular scenery. There are some sea gypsies known as Moken, who live traditional life on the islands within the park.
3. Laem Son National Park	Ranong	The park islands are shelter for fishing boats during monsoon. The coral reefs, seagrass beds and mudflats around Laem Son are biologically rich providing nursery grounds for some economically important species.
4. Khao Lak – Lam Ru National Park	Phangnga	The park is covered with vast areas of mountain and small patch of forests along the Andaman Sea.
5. Khao Lampi – Hat Tai Mueang National Park	Phangnga	It is located on a tombolo, with a low sandy ridge connecting the high rocky headland. The western side is famous for its unique sand dune.
6. Mu Ko Surin National Park	Phangnga	They are renowned for one of the best shallow water coral reefs in Thailand. Marine macrofauna, including giant manta rays, whalesharks, several types of whales and dolphins are frequently found around the park. Moken (sea gypsies) villages are also found in the park.

Table 5.2: Marine National Parks in Thailand. (cont.)

Name	Location	Brief Information
7. Mu Ko Similan National Park	Phangnga	The park is also famous for marine macrofauna, especially whalesharks, dolphins, turtles and manta rays. The distinctive granite boulder formations on the surface continue underwater on the western coast of the islands, creating vividly underwater seascapes.
8. Ao Phangnga National Park	Phangnga	The area around Phangnga Bay has a long human inhabitant history and the rock art in this area has always been an important attraction. Caves with rock art and tools point to a rich human culture in the region over 10,000 years ago.
9. Sirinat National Park	Phuket	Beach forest and mangrove forest surround a long beach together with 700 m offshore coral reefs. The beach is an important sea turtle nesting area.
10. Than Bok Khorani National Park	Krabi	The park encapsulated freshwater streams which flow through the area into the limestone cavern before flowing down to the sea. The many caves in the park provide remarkable natural attractiveness and harbour prehistoric rock art made by the ancient inhabitants of the valley.
11. Hat Noppharat Thara - Mu Ko Phi Phi National Park	Krabi	The terrestrial part of Hat Nopparat Thara is renowned for its geological formation consisting of gastropod fossils called "Shells Cemetory" or "Susaan Hoi". The Phi Phi Islands are famous for its beautiful limestone pinnacles surrounded by stunning coral reefs.
12. Mu Ko Lanta National Park	Trang	The seas around the islands in Mu Ko Lanta are rich with marine life; seagrass beds and coral reefs provide shelter for juvenile fishes and dugongs, dolphins, and manta rays. Urak Lawoi (Sea Gypsies) have inhabited Ko Lanta Yai for about 500 years.
13. Hat Chao Mai National Park	Trang	The park is renowned as the sanctuary of the largest remaining population of dugongs in Thailand. Extensive seagrass meadows provide feeding ground for dugongs as well as nursery ground for many species of coral reef fishes.
14. Mu Ko Phetra National Park	Trang	There are also many diverse habitats including coral fringed islands, sandy beaches, rainforest islands and rocky islands with steep cliffs, and mangrove, beach and tropical forests.
15. Tarutao National Park	Satun	It is the largest marine national park in Thailand. Its diversity is extremely high. Marine species include dugong, Irrawaddy dolphin, sperm whale, and minke whale. The island was used as penal colony for Thai political prisoners in the late 1930s.
16. Thale Ban National Park	Satun	The foothills of the mountain range are marked by coastal swamps featuring large populations of birds and amphibians.
17. Hat Wanakon National Park	Prachuab kiri khan	The park consists of the tranquil beach with rock headland and gradually slopes into the sea. The park also includes two small islands namely Ko Chan and Ko Thaisi.
18. Khao Sam Roi Yot National Park	Prachuab kiri khan	Situated in the Gulf of Thailand, the national park consists of limestone hills and 37% of the national park are covered with freshwater swamp making it the largest wetland area in Thailand.

Table 5.2: Marine National Parks in Thailand. (cont.)

Name	Location	Brief Information
19. Mu Ko Chumphon National Park	Chumphon	The park has mixed types of landscape that include sandy beach, bays, mangrove forest, mountains as well as an archipelago of 41 islands. The park is home to numerous kinds of forests and a high diversity of terrestrial wildlife and marine life.
20. Mu Ko Ang Thong National Park	Surat Thani	The park harbours rugged and steep limestone mountains with sinkholes, caves, natural formations of stalagmites and stalactites, subterranean rivers, and scenic inland marine lakes.
21. Khao Laem Ya - Mu Ko Samet National Park	Rayong	The park consists of Khao Laem Ya, Hat Mae Ramphueng, and several surrounding coral reef islands, including Ko Samet, Ko Kudi, and Ko Thalu.
22. Mu Ko Chang National Park	Trat	The main island, Ko Chang is the second largest in Thailand with high mountain range and many beautiful waterfalls. Colorful coral reefs are found around Mu Ko Rang, the small archipelago south of Ko Chang.

Important Tourism Sites

While many major tourism sites are in the marine national parks, there are some sites around the national parks, which are popular among local visitors and tourists. Though tourist attractions exhibited natural, cultural value or historical significance, most of the marine tourist sites are popular for their natural beauty, recreation and for socialization. Major tourism sites are listed in **Table 5.3**.

Table 5.3: Important Marine Tourism Sites.

Name	Location	Brief Information
1. Khung Kraben Bay Royal Development Study Centre	Chanthaburi	Initiated by King Rama IX, the center was established to conserve mangrove forest and provide a demonstration site for sustainable development of fisheries and shrimp farming. It also has been introduced as an eco-tourist site.
2. Hat Thung Wua Laen	Chumphon	The beach is covered with white, fine sand, with small slope, which is suitable for swimming and listed as one of the most famous snorkeling sites.
3. Ao Khanom	Nakhon Si Thammarat	The largest bay in Surat with many tourist beaches such as Hat Nai Phlao and Hat Na Dan which are the most popular tourist attraction in the area.
4. Ko Samui and Ko Pha-ngan	Surat Thani	Ko Samui or the Coconut Island is one of the most famous and popular attractions of Thailand. Ko Pha-ngan is less crowded and very famous for the biggest beach party in the world, "The full moon party on Hat Rin".
5. Ko Tao and Ko Nang Yuan	Surat Thani	Ko Tao is known as the best diving site in the gulf of Thailand, Ko Nang Yuan, located to the north of Ko Tao, which offers a stunning and breathtaking view.

Table 5.3: Important Marine Tourism Sites. (cont.)

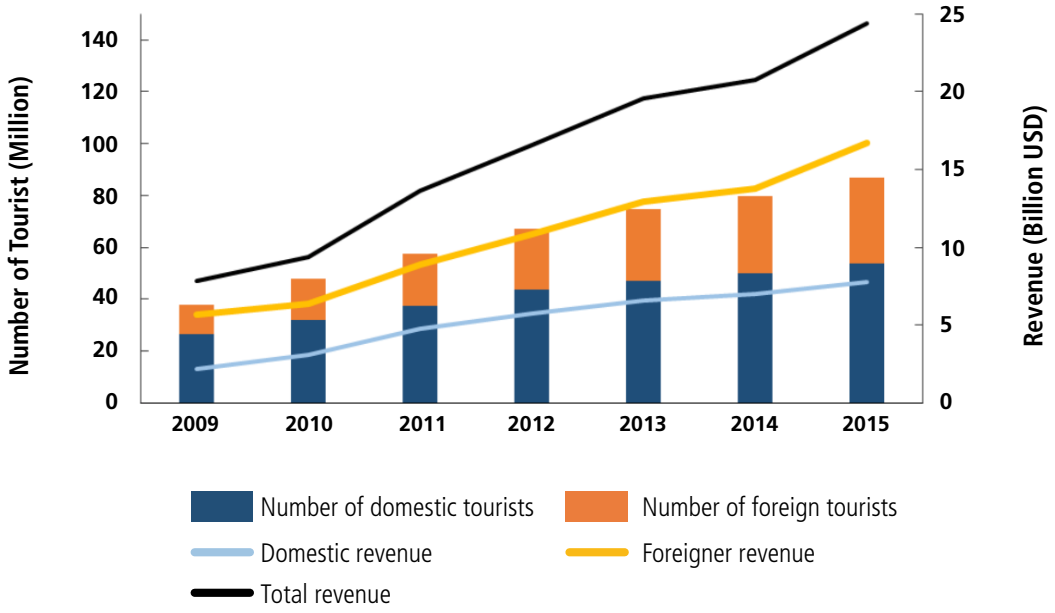
Name	Location	Brief Information
6. Ko Kho Khao	Phangnga	Most of the island's topographic features are plains with shady pine and coconut trees, and a white sandy beach stretching for several kilometres. The beach is suitable for swimming.
7. Ko Yao	Phangnga	Ko Yao is one of the main eco-tourism and cultural tourism sites in the Andaman Sea of Thailand. The island is popular for the home-stay type of accommodation with most of its dwellers are Thai Muslim.
8. Hat Kata	Phuket	Kata Noi and Kata Yai beaches are both renowned for snorkeling with diverse corals, tropical fishes, and complex marine ecosystem.
9. Hat Patong	Phuket	The most famous beach in Phuket provides both beautiful scenery together with its wide variety of activities and nightlife.
10. Hat Karon	Phuket	The crescent bay is the beach's signature that draws travelers attention. Its topographical characteristic provides suitable condition for surfing.
11. Ko Racha	Phuket	The island consists of Racha Yai and Racha Noi islands. Racha Yai is famous for its white powdery beach and clear water. Racha Noi originated from the accumulation of coral stones and is suitable for fishing.
12.Ko He	Southwest of Phuket	The island is famous for its white powdery beach and rich coral reefs, ideal for swimming, snorkeling, SCUBA diving, fishing, and other activities.
13.Ko Dam Khwan	Ao Phangnga, Krabi	It is remarkable for its famous scenic site called Thale Waek (meaning separated sea). The white sand tombolo and limestone beach will appear to amazingly connect the two islands during low tide.
14. Mu Ko Poda	South of Ao Nang, Krabi	Mu Ko Poda is fringed by clear water and pristine coral reefs together with white sandy beaches. The island provides a year-round attraction and renowned as an excellent place for fishing because of its monsoon-sheltered characteristic.

Photo by: J.Calayo

5.3 Contribution to Income and Jobs

Tourism is one of Thailand's economy boosted activities as this is currently one of the fastest growing sectors. Particularly in the ecotourism, marine, and coastal tourism, the number of tourists coming to visit these sites are growing (**Figure 5.1**).

Figure 5.1: The Number of Tourist Arrival and Revenues in 23 Coastal Provinces.



Marine and coastal tourist activities include scuba diving, snorkeling, wind surfing, fishing, marine mammals and bird watching, cruising or ferry riding, sea kayaking, sailing, and motor yachting.

The growth in marine and coastal tourism has helped develop and improve the coastal economy. Thailand's natural scenery of sea and sand continues to attract tourists from around the world. Thus, the revenue created from tourism related sectors is increasing every year. Apart from the revenue, the number of employment is also escalating, providing more job opportunities for local people. According to **Table 5.4**, employment in tourism and related sectors (inland and marine) is equal to 10.96% of total employment. Employment in the food and beverage services was the main contributor to the overall employment in the tourism sector.

In 2015, total gross value added (GVA) of tourist industries in Thailand is USD 28.90 billion. The number represents total GVA both from inland and marine tourism sectors, because there is no specific data for marine and coastal tourism. While the percentage of revenue from coastal provinces was 45.04% (which is calculated from total tourist revenue and revenue from both inland and coastal provinces), total GVA of marine tourism sector was estimated at USD 13.01 billion (Ministry of Tourism and Sports, 2017).

Table 5.4: Employment in Tourism Industries during 2010-2015.

Tourism industries	Employment (person)					
	2010	2011	2012	2013	2014	2015
1. Accommodation for visitors	348,492	404,849	470,371	494,636	503,854	516,100
2. Food and beverage	2,314,475	2,142,755	2,119,879	2,083,304	2,100,865	2,129,419
3. Railway passenger transport	15,041	16,405	16,585	16,801	17,053	17,104
4. Road passenger transport	553,872	526,577	589,902	588,819	584,990	592,857
5. Water passenger transport	29,608	31,829	34,630	37,574	40,661	44,127
6. Air passenger transport	30,493	35,128	39,618	44,071	47,081	51,094
7. Transport equipment rental	5,851	6,468	9,856	8,488	10,580	11,482
8. Travel agencies and other reservation services	40,016	47,721	57,412	68,223	64,504	70,003
9. Cultural industry	69,155	62,938	59,899	52,685	52,645	54,595
10. Sports and recreational industry	127,300	164,682	246,650	252,793	258,431	265,367
11. Retail trade of country-specific tourism goods	287,783	291812	294,362	259,396	240,648	241,851
12. Country-specific tourism industries	109,513	122,983	143,275	162,588	168,070	174,084
Total employment in tourism industries	**3,931,599**	**3,854,147**	**4,082,439**	**4,069,378**	**4,089,382**	**4,168,083**
Total employed	**38,037,342**	**38,464,667**	**38,939,130**	**38,906,889**	**38,077,429**	**38,016,169**
Total employed in tourism industries /Total employed	**10.34**	**10.02**	**10.48**	**10.46**	**10.74**	**10.96**

5.4 Major Issues Related to Tourism

Marine and coastal tourism has a high potential for increasing country revenue and is growing at an accelerated pace. Increase in this sector can lead to a lot of problems that significantly harm the marine environment and resources. For example, poorly informed and careless divers could harm corals by touching or trampling, anchoring on coral can destroy it, and coastal construction can cause chronic sedimentation, sewage, industrial discharge and water flow. However, tourism industries were also regarded as unstable industries due to their volatility from the quality of natural resource and other supplementary factors such as political, health, and economic undulations. This section highlights some negative impacts and major issues affecting tourist activities.

5.4.1 Natural Resource Degradation

An increase in uncontrolled marine tourism has resulted in the degradation of marine and coastal resources and pollution. Coral reef degradation is caused by touching and trampling, and boat anchoring. Tourism also causes various forms of pollution: air emission from transportation, solid waste, and sewage disposal. Without proper management, tourism is exceeding the carrying capacity of the marine environment.

Nature tourism involves visiting natural areas whereby it is dependent on the health of natural resources. If the natural condition is degraded, it is likely that nature based tourism will be affected. As described in this report, the condition of key natural habitats, such as coral reef and seagrass in 2015, was in a decline both in quality and quantity.

5.4.2 Safety and Security Concerns

Safety is a major challenge facing the tourism industry. The current population trend indicates that the world is becoming an aging society. Average age of tourists is getting higher each year. Although most elderly people tend to enjoy slow paced activities (e.g., sunbathing, beach walking), many still enjoy all sorts of physical activities, from windsurfing to skiing. While injury prevention from tourist activities is in place, accidents tend to happen. To ensure tourism safety, tourism officials needs to be prepared to implement safety measures, including knowledge on marine related injury and illness. Local hospitals near tourist destinations should be equipped with necessary medical equipment and supplies, as well as mobile units to respond to accidents caused by tourist activities.

Occurrence of pandemics can cause some major disruptions to the industry. Security is another challenge facing the tourism and travel industry. Recently, Thailand marine and coastal tourism was tainted by news about the crime against foreign tourists. Unless tourism safety and security become a primary concern, many tourist destinations may face great economic losses in the future.

Political conditions and southern unrest will continue to be a challenge for the tourism industry. Though, there is no political unrest in most of coastal province, political demonstrations in Bangkok may not only create negative publicity, but also make travel more difficult and less appealing.

5.4.3 Economic Factors

Global economic slowdown affects the travel and tourism industry in various scales. Currency exchange rate instability can obstruct the urge of overseas visitors. Tourism and travel are highly dependent on the cost of fuel. The recent fluctuation in the price of fuel such as gasoline has a major impact on the entire industry. Tourist expenses are difficult to precisely calculate, which is reflected in too expensive or too cheap costs.

5.4.4 Conflict of Uses

Conflicts that arise, between fisheries and tourism, in resource exploitation are another major environmental issue of this sector, especially the illegal fisheries in the national parks. Although this was not so distinct in the past, with the development and expansion of reef fish extraction for aquaria such as coral and ornamental tropical fish, this problem has been exacerbated.

5.5 Examples of Good Practices

This section reviews some good practices implemented in Thailand, including their concepts, limitations, and lessons learned.

5.5.1 Green Fins

Green Fins was initiated in 2004 and coordinated by the Secretariat of the Coordinating Body on the Seas of East Asia (COBSEA), United Nations Environmental Programmememe (UNEP) as part of the effort to increase public awareness on diving and snorkeling practices that will contribute to the conservation of coral reefs and reduce current unsustainable tourism practices. Its mission is "to protect and conserve coral reefs by establishing and implementing environmentally friendly guidelines to promote a sustainable diving tourism industry."

Thailand started the Green Fins Programme in 2004 by the Phuket Marine Biological Centre (PMBC), and the Department of Marine and Coastal Resources (DMCR). The main objective of the programme is to assist dive operators to ensure that they minimize environmental impacts of diving and snorkeling. Dive operators have to undergo training and follow a code of conduct. Green Fins members will become a network for protection, conservation, and sustainable use of coral reefs. Moreover, the dive operator may help with monitoring coral reefs when they take customers on dive trips. The programme is also supported by local volunteers in Phuket and

many Green Fins members, who are owners of dive centres and snorkel tour operators across the country. The project has been implemented in the islands of Phi Phi, Ko Lanta in Phuket, Ko Tao, Ko Samui in Surat Thani and Ko Phra Thong, Takua Pa, Ko Lak, Ko Lipe, Khao Lak, and Pattaya, while the network continues to grow. The Phuket Marine Biological Centre, led by Green Fins Thailand Network Leader, Niphon Phongsuwan, has been training SCUBA diving and snorkeling operators for many years. In addition to implementing the Green Fins Code of Conduct, other activities such as beach and coastal clean-ups and coral reef monitoring, are also encouraged.

5.5.2 Khung Kraben Bay Royal Development Study Centre

Located in Kraben Khung Bay, Chantaburi Province, the Kraben Khung Bay Royal Development Study Centre is one of the royal initiative projects of H.E. King Rama IX, which aimed to promote the wellbeing of the local people while conserving the marine environment, particularly mangrove forests. The centre has focused on the sustainable development of sustainable shrimp farming by mitigating and preventing pollution from shrimp farms. The centre also provides local people with a training programme on coastal resources management, forest management, as well as soil and water conservation. The centre have provided visitors with a variety of activities to learn about sustainable development of fisheries, aquaculture and agriculture, as well as culture and the way of life of the local people and the conservation of natural resources. This provides visitors with the integrative knowledge of agriculture, fishery, livestock, and conservation of the natural resources, while at the same time promoting recreation. At present, the centre is a renowned site for eco- and agro-tourism. There are more than 200,000 tourists visiting the centre each year.

5.5.3 Bor Hin Farmstay, Amphor Sikao, Trang province

Recipient of the Award of Excellence in the category of Tourism Support and Promotion Organisation at the 2013 Thailand Tourism Award, Bor Hin Farmstay provides a unique ecotourism experience to visitors amidst peaceful natural surroundings of Trang Province. One of the main objectives is to conserve endangered species, particularly dugong, through seagrass preservation. Apart from exploring the local fisherman's cage culture practices and joining the mangrove reforestation activity, visitors can also spend time learning about seagrass and the importance of their conservation. Seagrasses play multiple ecological roles in the coastal system, and Bor Hin Farmstay established a "Seagrass Seeding Bank" to help preserve the biodiversity in Thailand.

5.5.4 Low carbon destination project in Koh Mak, Trat Province

The Koh Mak Project in Trat Province, Thailand's first "Low Carbon" destination, was launched in 2014 by DASTA, in cooperation with the ISMED. As a special area for sustainable tourism development, the objectives of the project are to reduce carbon footprint and pollution and maintain and improve the environment. The project encourages all tourism stakeholders, such as hotels, transport operators and tour agents, and local residents to lower carbon dioxide emission

and pollutants on the island by using alternatives to petroleum-based fuels, implementing water and waste management, and preserving the traditional way of life of the local people. An example of alternative energy is the installation of solar cells to reduce carbon dioxide emission. The project also emphasizes the use of raw materials such as locally produced vegetables, and fresh seafood caught by local fishermen. By reducing transport of raw materials from the mainland, the project would contribute to mitigating global warming.

For tourists, the island offers environment-friendly activities, such as cycling, kayaking, and sailing. Moreover, business operators are now using fresh groceries, avoiding all polluting products.

5.6 Supporting Policies

Over the past 70 years, the tourism industry has experienced continuous growth and is now one of the major economic sectors in the world. Thailand is at the forefront of this development in Asia. At present, Thailand offers many forms of tourism such as agro-, eco-, medical, and spiritual tourism to meet the increasingly diverse demands of tourists. In the last two decades, ecotourism has become an emerging trend among tourists who travel to Thailand.

Photo by: J.Calayo

Recently, Thailand has applied the responsible tourism concept to promote environmental friendly tourism. Many of the policies and plans at the national and ministerial levels raise more concern on environmental issues. Thailand's 4.0 policy also emphasizes the use of information technology, social media, and renowned Thai hospitality to promote the expansion of tourism (2015 discover Thainess campaign) to stimulate the growth of the tourism industry.

This section summarizes both the national plan and the ministerial policies in Thailand including the 12th National Economic and Social Development Plan (NESDP), the 4th Tourism and Sport Development Plan and Policy (2017-2021) and the 2nd National Tourism Development Plan (2017-2021) formulated by the Ministry of Tourism and Sports. These national plans will provide guidance for tourism development in the regional, provincial, and local plans.

In Thailand, there are numerous policies and plans which are interrelated and sometimes overlapping. This section highlights major key policy aspects aimed to address negative impacts and major issues affecting tourism described earlier.

5.6.1 Key Aspects of Thailand Tourism Development Polices

- Develop, restore, and recuperate existing natural, historical, and cultural tourist destinations.
- Promote the development of new destinations in areas with potential for linking nature, culture, and local lifestyles; to reduce the pressure from crowded tourist areas, and provide the recovery time for the impacted areas.
- Promote the development of elderly and disabled friendly infrastructure to support tourism, and expedite improvement in the standard of facilities, safety and hygiene.
- Raise and maintain the standard for tourism services to meet international standards; improve the standards of personnel in the tourism sector; and, improve public services in order to attract and be able to efficiently service the market for quality tourists.
- Promote the market for quality tourists, both inbound and domestic, through proactive marketing strategies targeting various groups in Thailand and abroad; making Thailand a world-class tourist destination, a center for international meetings and exhibitions.
- Using multimedia and recent technology to advertise, assist and manage the use of tourist destination.
- Promote inter-agency cooperation to provide quality service to tourists; improve the quality of tourism personnel to meet the demands; revise laws and regulations and improve the effectiveness of law enforcement to facilitate tourism; ensure safety; prevent the exploitation of tourists; resolve environmental problems; and, develop a sustainable tourism industry.

5.6.2 Thailand Tourism Clusters

During the past decades, Thailand tourism development plan has been focused on the thematic clustering of tourist destinations. In 2009, 14 tourism clusters were set up to group the provinces with similar type of tourism together. The clusters have been restructured to eight clusters in 2011, three of which are closely related to marine and coastal tourism, namely, the Royal Coast, the Active Beach, and the Andaman Cluster.

The idea of clustering tourism provinces is to boost the value of surrounding provinces instead of the renowned tourist destinations. Hence, each province in the cluster plays a different role, while integration of all sectors and all provinces is promoted to move tourism forward.

The Royal Coast cluster comprises four provinces (Phetchaburi, Prachuap Khiri Khan, Chumphon, and Ranong provinces) aimed at developing a leisurely relaxing tourism destination at the same standard as the Riviera/Mediterranean destinations. Phetchaburi is a city of beaches, culture, ecotourism, and food. Renowned for its many sandy beaches including the popular Hua Hin Beach, Prachuap Khiri Khan is positioned as a leisure destination and health city. Chumphon is renowned for its beaches, islands, people, way of life, and local wisdom. Ranong also share characteristics as a city of local wisdom, mineral spring, and leisure travel.

The Active Beach includes four provinces (Chon Buri, Rayong, Chantaburi and Trat Provinces) aimed at an activity-based tourism destination. Chon Buri is positioned as a hub of beach destinations, entertainment, and ports for yacht and cruise. Rayong is characterized by fruit, fishing industries, and a foreign investment base. Chantaburi is a city with folk wisdom destination, community based tourism, and fruit and gems. Trat is a city with fisheries and local community tourism and is a bordering city of Cambodia.

The Andaman Cluster contains five provinces (Phuket, Phangnga, Krabi, Trang and Satun Provinces) aimed at being a high class and quality tourist destination. Phuket is positioned as a gateway hub of tourism activity. Phangnga is a city of marine national park and diving. Krabi functions as a marine ecotourism city, which provides unique island experiences. Trang is a city with high diversity of tourism resources. Satun, which is a Thailand-Malaysia border city, also has high diversity of marine tourism resource.

Photo by: D.Bautista

6 Shipping and Ports

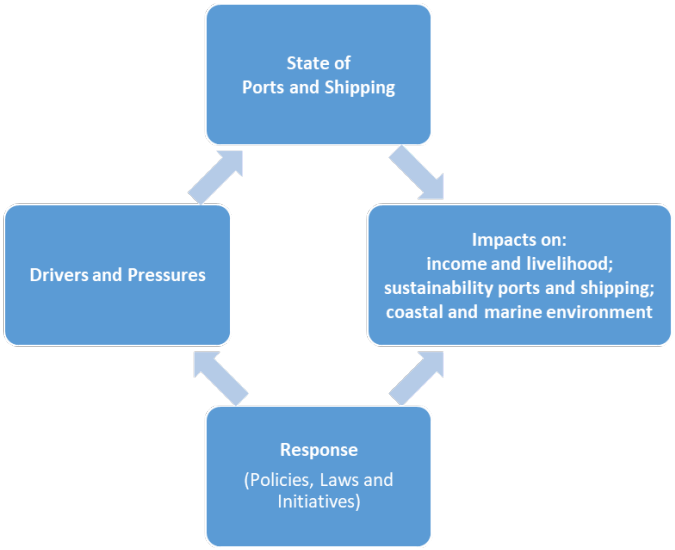


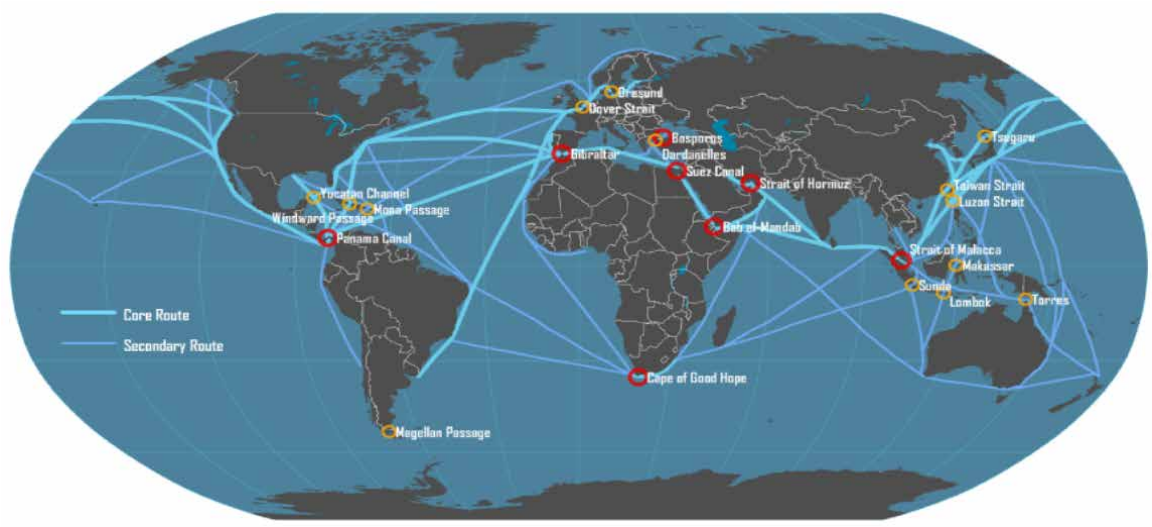
Photo by: J.Calayo

Shipping has been an important human activity throughout history, particularly where prosperity depended primarily on international and interregional trade. In fact, transportation has been one of the four cornerstones of globalization, along with communications, international standardization, and trade liberalization (Kumar and Hoffmann, 2002). Shipping is truly the lynchpin of the global economy: without shipping, intercontinental trade, the bulk transport of raw materials, and the import/export of affordable food and manufactured goods, would simply not be possible. Thailand has the open economy which international shipping is a mechanism to drive the development and growth of the country.

6.1 Important Navigational Lanes

The important world navigation routes are: 1) Trans-Pacific Route – East Asia cross Pacific Ocean to West Coast of America; 2) Trans-Atlantic Route – Europe cross Atlantic Ocean to East Coast; 3) Europe/Asia Route – Europe to Asia; and 4) Intra-Asia Route – Between Asia Countries (**Figure 6.1**).

Figure 6.1: World Navigation Route.



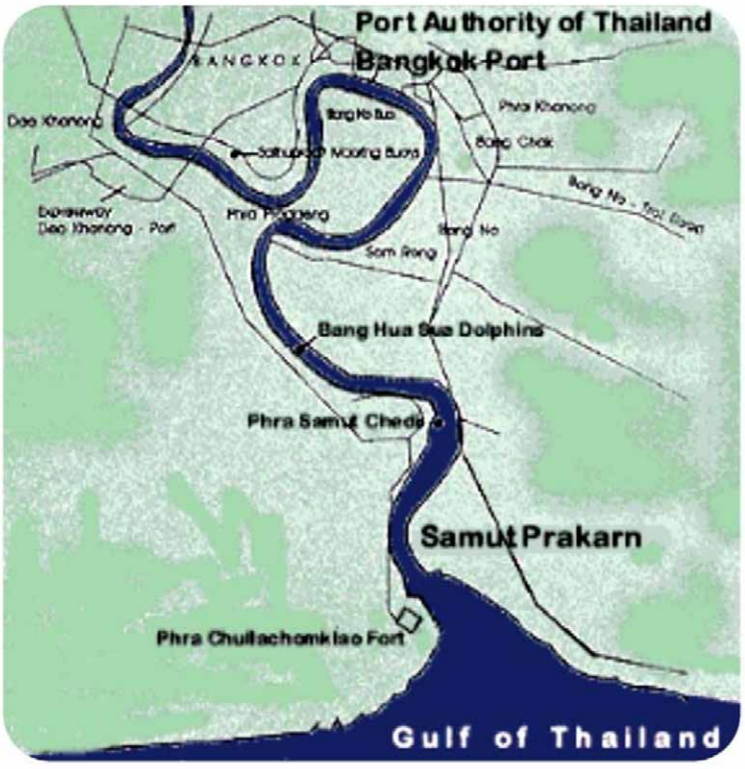
Source: Hofstra University, 2016.

6.2 Ports

Major Ports

Major ports in Thailand are Bangkok Port, Laem Chabang Port, and Map Ta Phut Industrial Port. Bangkok Port and Laem Chabang Port are operated by The Port Authority of Thailand (PAT), which is a state enterprise under the jurisdiction of the Ministry of Transport. Map Ta Phut Industrial Port is under the responsibility of the Industrial Estate Authority of Thailand, under the Ministry of Industry.

Figure 6.2: Location of Bangkok Port.



Source: www.pemsea.org.

6.2.1 Bangkok Port

Bangkok Port, which is the first port in Thailand, has been operating since 1947. It is located on the east side of the

Chao Phraya River in Khlong Toei District, Bangkok (**Figure 6.2**). The port is well connected with roads and rail systems, which facilitates transport of cargoes between the port and its hinterland. Its inland location limits access to ships of 12,000 deadweight tonnes or less. The port primarily handles cargo about 22% of the total cargo handled by international ports in the country.

Bangkok Port is Thailand's second largest port with a throughput of 1.449 million TEU in 2011. It has a total land area (within the customs fence) of about 1.45 km2. Bangkok Port offers cargo services, which include container storage and inbound cargo services, outbound container freight station services, open stuffing areas, empty container yard services, reefer container services, and coastal and barge terminals (**Table 6.1**).

Table 6.1: Facilities of Bangkok Port.

Quay/Dolphin/Buoy	Length (m)	Number	Size of Vessel Length/Draught (m)	Capacity
East Quay	1,528	8	172.26/8.23 91.46/4.57	7 1
West Quay	1,660	10	172.26/8.23	10
Klongtoey Dolphin	1,400	36	172.26/8.23	7
Bang Hua Sua Dolphin	1,520	25	172.26/8.23	8
Mooring Buoy at Sathupradit	1,580	5	137.19/7.62 91.46/7.00	4 1

Source: Hofstra University, 2016.

The port has CFS transit sheds and warehouses of 88,850 m^2; open storage areas and container yards of 431,472 m^2: and electrical power/reefer points for refrigerated cargo of 660 m^2. With regards to waste reception facilities for ballast, sludge, chemical waste, and garbage disposal, there are two garbage boats (160 HP, 200 HP). PAT also conducts dredging operation and maintenance of the bar channel and wharf area. They also conduct hydrographic surveys within the responsible area as well as in private and other government agencies wharves.The port hospital provides emergency treatment and emergency vehicles.

To ensure safety of lives, properties, and goods kept in the port area, Bangkok Port's security staff, in cooperation with the port police, is on duty on an around-the-clock basis. The port fire-fighting brigade consists of well trained staff and sophisticated facilities, and foam and water fire-fighting trucks. Precaution and measures to tackle incidents are strictly exercised.

The port has installed a CCTV system for container terminals' surveillance so that prompt action can be taken to deal with incidents such as smuggling and accidents.

6.2.2 Laem Chabang Port


Photo from: TEI

Laem Chabang Port is the main deep sea port of Thailand, providing services to ships from around the world. It is located in Chon Buri Province on the eastern seaboard of Thailand. The Government promoted Laem Chabang Port to be the country's main port, replacing the Bangkok Port in 1996.

With an area of 10.409 km², the port consists of minor ports and container terminals, multipurpose terminals, general cargo terminals, and shipyard terminals. Laem Chabang Port has state-of-the-art infrastructure and hi-technology facilities to support all services. It is capable of handling large vessels (Post Panamax). It has sufficient supporting areas for docking operations and related activities. Moreover, the port is served by a network of highways, railways, and waterways; connecting regions within the country and bordering countries (Myanmar, Laos, Cambodia, Malaysia, and neighboring countries, China and Viet Nam). This makes the port a gateway to South East Asia.

PAT is responsible for operating the port. It is called the "Landlord Port" due to the fact that PAT contracts the private sector to operate the minor ports and terminals. Laem Chabang Port has one of the highest (trading) growth rates in the world. (Laem Chabang Port, 2014). It is also rated World Top Container Port by the world's leading magazine such as Loylld List, etc. The rating had leapfrogged from the 23rd place in 1998 – 1999 to the 20th place in 2002 and 18th place in 2003.

To develop Laem Chabang Port as one of the World Class ports, requirements to meet the high standard service provision have to be implemented as follows:

1. Increase the service capacity to ensure all services as mentioned are achieved.
2. Utilize port area to also support other relevant activities.
3. Increase productivity.
4. Employ modern technology to function docking field and yard operation.
5. Initiate new projects and activities to fulfill and cover all services requirements such as Container Care Centre Project.

Furthermore, Laem Chabang Port has sufficient areas to support related business such as truck terminals and distribution centres. The port also provides other crucial facilities such as hazardous bulk warehouses and fire damage prevention centres.

6.3.2 Map Ta Phut Industrial Port

Map Ta Phut Industrial Port is located in the Map Ta Phut Industrial Estate on the east coast of the GoT, between Sattahip and Rayong, approximately 220 km from Bangkok. The construction was completed in 1992 and the port was officially opened in 1993. It is managed by the Map Ta Phut Industrial Estate, a state enterprise under the Ministry of Industry. The port was developed as part of Thailand's Eastern Seaboard Development Plan. The purpose of the plan is to build an industrial port for liquids, general cargo, agricultural and mineral bulk, and an industrial park for petrochemical and other related industries.

The port consists of two types of berths: 1) Publics Berths, which are opened to provide services to every customers, and 2) Specific Berths, which are only used by investor groups and their customers.

Table 6.2 shows the performance indicators such as ship calls, passenger traffic, cargo, and container throughput in two major ports, i.e., Bangkok and Laem Chabang in 2014-2016. In general, performance indicators of Laem Chabang were better than the number of ship calls at Bangkok Port. It increased from 3,193 in 2014 to 3,267 in 2015, and then dropped to 3,096 in 2016. Meanwhile, the ship calls at Laem Chabang Port dramatically increased from 6,598 to 10,271 in 2015 and then increased slightly to 10,385 in 2016 due to the government promotion policy since 1996. The number of passengers at Bangkok Port and Laem Chabang Port were similar to those of ship calls. The number of passengers between Laem Chabang Port and Bangkok Port had more than a twofold increase in 2016. Moreover, the volume of cargo and container throughput in 2016 at Laem Chabang Port reached 76,683 MT and 7.062 TEU, respectively, compared to the volume at Bangkok Port which were at 18,914 MT and 1,506 TEU.

Photo by: M.Ebarvia

Table 6.2: Port Performance Indicators.

	Bangkok Port			Laem Chabang Port		
	2014	2015	2016	2014	2015	2016
Ship call	3,193	3,267	3,096	6,598	10,271	10,385
Passenger traffic (person)	25,000	20,000	30,000	50,000	70,000	80,000
Cargo throughput (MT)	21,422	21,848	18,914	71,366	72,606	76,683
Import	11,292	12,088	9,981	26,906	27,471	29,029
Export	1,013	976	8,933	4,446	45,135	47,654
Container traffic (TEU)	1.532	1.559	1.506	6.458	6.780	7.062
Import	0.802	0.z65	0.86	1.759	1.878	1.989
Export	0.665	0.651	0.605	3.257	3.369	3.531
Empty container (in-out)	0.065	0.043	0.041	1.442	1.533	1.542

MT = metric tons
TEU = twenty-feet equivalent unit

Source: Port Authority of Thailand (2017).

6.3 Fishing Ports and Others

There are three types of port in Thailand: shipping, passenger, and fishing ports. **Table 6.3** shows the number of ports in 23 coastal provinces.The total number of fishing ports, which was the highest, is 1,043; while the number of shipping ports and the passenger ports is 144 and 77 ports, respectively. In practice, some ports are used for several purposes, such as passenger and fishing.

Table 6.3: Number of Ports by Type and Province.

Location	Number of Ports		
	Fish port**	Passenger port*	Shipping port*
1. Chachoengsao	4	0	9
2. Chanthaburi	40	1	8
3. Trat	37	5	10
4. Rayong	114	7	9
5. Chon Buri	23	8	7
6. Bangkok	3	0	11
7. Samut Prakarn	25	4	19
8. Samut Sakorn	173	4	11

Table 6.3: The Number of Port by Type and Province. (cont.)

Location	The number of port		
	Fish port**	Passenger port*	Shipping port*
9. Samut Songkhram	14	1	2
10. Phetchaburi	138	3	2
11. Prachuap Khiri Khan	32	1	1
12. Chumphon	91	5	2
13. Surat Thani	41	6	12
14. Nakhon Si Thammarat	99	2	4
15. Songkhla	12	3	4
16. Pattani	26	0	0
17. Narathiwat	4	0	0
18. Ranong	70	3	0
19. Phangnga	27	8	27
20. Phuket	12	6	3
21. Krabi	10	3	2
22. Trang	25	3	1
23. Satun	23	4	0
Total	**1,043**	**77**	**144**

Source: Marine Department, 2014, Department of Fisheries, 2018***

6.4 Marina and Recreational Ports

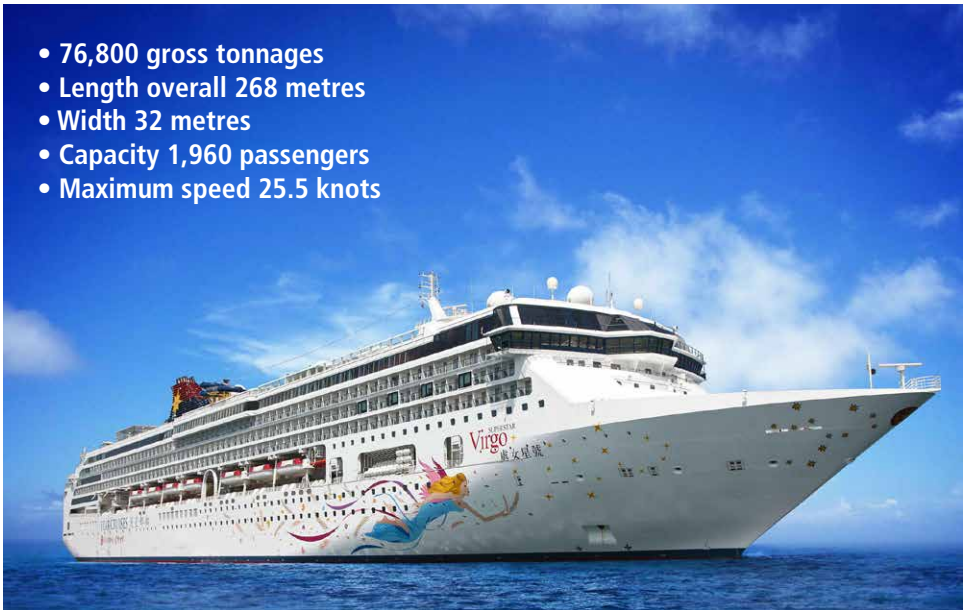
Thailand has provided port services to cruise ships for more than 30 years. In the past, small cruise ships often docked at Bangkok Port on the Chao Phraya River. Cruise shipping became more popular when Star Cruise Line, the third-largest cruise line, used Thai ports as destinations for their cruise ships, firstly Phuket port in 2000 and then Ko Samui and Laem Chabang ports.

During tourist season, from November to April, both regional and international cruise ships visit Phuket, Ko Samui, Laem Chabang, and Bangkok ports. Regional cruise lines operate all year round.

At present, the number of cruise ships visiting Thailand has increased because of the tourism promotion programmes of countries. There are many cruise line programmes operating in Southeast Asia starting from Singapore, such as SuperStar Virgo Cruises, Sapphire Princess, Mariner of the Seas, and Voyager of the Seas.

Route of SuperStar Virgo Cruises, is shown in **Figure 6.3**.

Figure 6.3: SuperStar Virgo and Its Navigation Route.



Source: www.starcruises.com, 2017.

There are several Thai Cruise lines, which operate domestic routes, such as the Royal Cruise, River King Cruise, Chao Phraya Prince, and the Ocean Princess Cruise.

Thai cruise ports are mainly ports of call, not home ports. Cruise ships operate a round trip and return to the original port, which can take a day or a several day trip. Inadequate infrastructure and public utility are obstacles to the development of home ports for cruise ships.

Major Issues

There are a number of problems facing Thai cruise ports. These include:

- Tourism areas, such as Ko Samui and Phuket, are rich with natural tourism sites but a few cultural and traditional sites.
- Lack of management mechanisms. The cruise port management is necessary to meet the standard of International Maritime Organisation (IMO) on International Ship and Port Facility Security Code (ISPS). Clean food and good sanitation are important to the image of cruise lines.
- Inadequate response and preparedness plan for natural disasters. There are no ports which are developed specifically for cruise ships. For example, the Phuket deep-sea port, which was originally designed for cargo shipment, is used for cruise ships. Ko Samui mainly have fishing ports which are not equipped with enough necessary facilities to accommodate cruise ships. Other barriers include the depth, weather, access to beaches, and lack of passenger terminals, toilets, and parking. Similarly Laem Chabang Port and Bangkok Port are not built as cruise ports and have to be further developed to meet the standard of cruise ports.

As the number of tourists that are visiting the Gulf of Thailand and Andaman Sea is increasing, there is a need to develop other ports for cruise ships in the Andaman Sea, Krabi, Trang, and Ranong ports to begin being used as ports of call for cruise ships. The Gulf of Thailand, Hua Hin, Nakhon Si Thammarat, and Songkhla have high potentials to be ports of call. The ports of Laem Chabang, Bangkok, and Koh Samui also need to be further improved to effectively accommodate cruise ships in the future.

6.5 Pressures and Challenges

One of the major problems in port areas is oil pollution from ships caused by accidents and ship operations. Although tanker accidents attract much publicity, they are not an important source of petroleum hydrocarbons polluting the sea except locally and incidentally. On the other hand, the overall amount of oil discharges resulting from routine oil tankers and ship operations is greater and more persistent in the longer term. It is estimated that while accidental spills result in 120,000 cubic metres of oil in the sea world-wide each year, routine operational oil spills amount to 520,000 cubic metres each year. Under current maritime legislation it is fair to estimate that nearly all of what we refer to as routine and operational is illegal. There are three main ways in which oil tankers and ships illegally discharge oily wastes into the sea:

- Oily mixture in ballast water (mainly oil tankers);
- Oily mixture in cargo tank washings (mainly oil tankers) resulting from cleaning directly into the sea; and
- Oily mixture in fuel oil sludge, in engine room effluent discharges and in bilge water (from all types of vessels).

Photo from: TEI

Oil Pollution in Thailand

Shipping and offshore oil and gas exploration and production are the primary sources of marine-based pollution in the Gulf of Thailand. Wattayakorn (1986, 1987, and 1991) has reported chronic petroleum hydrocarbon contamination in coastal waters. Accidental spills have also been reported along transport routes at points of loading and discharging of oil tankers.

From 1974 to 2009, there were over 200 reported oil spill incidents in Thai waters. Frequent spills occurred at the mouth of the Chao Phraya River, Ko Si Chang in Sriracha District, Laem Chabang Port, and Map Ta Phut Port.

An increasing trend in oil spill incidents from oil exploration and production activities has also been observed. In July 2013, an oil spill off the coast of Rayong Province raised major public concern in Thailand. More than 50 tonnes of crude oil spilled into the Gulf following a leak in an oil pipe at an offshore platform operated by PTT Global Chemical Public Company Limited, a subsidiary of Thailand's national petroleum company, PTT. This incident represents the largest oil spill in the GoT, resulting in an increasing threat to the coastal and marine resources and coastal communities in the area.

According to the Marine Department, there were 10 major oil spills (over 20,000 litres) that occurred in Thailand. Most of the oil spills found in port areas were caused by accidents and loading/discharge operations as shown in **Table 6.4**.

Table 6.4: Major Oil Spill in the Sea, Coastal Line and Ports.

	Date	Type oil	Location	Cause	Quantity (tonnes)
1	22 May 2001	Crude Oil	Oil pipeline in the sea of Alliance Refining Co., Ltd. In Map Ta Phut Industrial Port, Rayong	Breakaway Coupling 16 inch out of, discharge from "Tokachi" Ship.	30
2	15 Jan. 2002	Fuel Oil	Shark Fin Rock in Koh Jum Island Area, Out coast of Sattahip, Chon Buri	"Eastern Fortitude" Panama flag ship collision with Shark Fin Rock	234
3	17 Dec. 2002	Fuel Oil	Entrance of Laem Chabang Port, South of Sattahip, Chon Buri Koh Jum Island , Chon Buri	"Kota Wijaya" Ship collided with "Sky Ace" Ship	210
4	20 Nov. 2005	Crude Oil	Single Buoy Mooring (SBM) Thaioil Public Company Limited, Chon Buri	Connection joints fell in discharge oil as strong winds and waves	20
5	4 May 2006	Fuel Oil	Port area of Alliance Refining Co., Ltd. in Map Ta Phut Industrial Port, Rayong	Spilled from the leaks of the boat at Hold No. 2 of Oil Tanker "CP 34"	20
6	6 Oct. 2007	Saraline 185V	Trident-16 (Offshore Mobile Drilling Unit) Chevron, Thailand	Spill from Storage Tank	29.9
	Date	**Type oil**	**Location**	**Cause**	**Quantity**
7	9 Dec. 2007	Diesel & Fuel Oil	Out coast of Sathing Phra, Songkhla about 6 nautical miles	Gas Carrier founder of World Wide Transport Co., Ltd.	~20
8	15 Jun. 2008	Fuel Oil	Dockyard Area of Asian Marine Services pcl. (ASIMAR), Phra Samut Chedi, Samut Prakan.	Spilled from "Chol Han Vong Chong Nyon Ho" North Korea Flag Ship	> 40
9	4 Sept. 2011	Diesel Oil (B5)	East of "Koh Racha Yai" Island about 4 nautical miles, Phuket.	Oil Tanker "S.Choke Thavon 6" sunk as weather and windy	~40
10	27 July 2013	Crude Oil	Single Point Mooring: SPM Area of PTT GC: 20 km southeast of Rayong coast	The leak occurred from a 16-inch diameter leak on a transport pipe.	50

Source: Gathered from Marine Department. (Oil spill Statistics).

In Thailand, the Marine Department under the Ministry of Transport is the principal agency dealing with the prevention and response of marine-based pollution incidents in the country. Other agencies involved in oil pollution are the Royal Thai Navy, the Provincial Administration, and the Oil Industry Environmental Safety Group. The Committee on the Prevention and Combating of Oil Pollution, established in 1982, incorporates all interested bodies to review the current state of response readiness and provide suitable equipments during an oil spill incident. The Committee, chaired by the Minister of Transport, is responsible for the National Oil Spill Contingency Plan. The Marine Department has sufficient response resources for a 500-tonne oil spill. Equipment used for marine oil spills are stored and maintained at the Channel Development and Maintenance Centre in Songkhla Province and Merchant Marine Training Centre in Samut Prakan Province.

6.6 Examples of Good Practices

An example of good practices is the implementation of *Port, Safety, Health and Environmental Management System* (PSHEMS) at the Bangkok Port and Laem Chabang Port. The development and implementation of its PSHEMS resulted in concrete economic, social and environmental benefits. (Aunporn Poopetch, 2014).

The explosion in the dangerous cargoes warehouse of the Bangkok Port in 1991, which caused losses of life, cargo, property, and damage to the environment estimated at USD8 million, called for the implementation of the PSHEMS in Bangkok Port. The PAT recognized that PSHEMS is an integrated management system, designed to provide port authorities with a management framework for enhancing efficiency, cost-effectiveness, and profit for their operations. Taking into consideration the availability of resources, manpower, and time constraints, the initial phase of PSHEMS initiative covered only the DG handling since it is one of the core processes in port operations and has the highest threat level for safety, health, and environment. The scope of PSHEMS was later broadened to include all other services in the organisation. The safe handling and transport of DG in Bangkok Port was related to the International Maritime DG (IMDG) Code and Recommendations on the Safe Transport of Dangerous Cargoes and Related Activities in Port Areas. In developing the PSHEMS of Bangkok Port, the specific provisions of these international instruments were reviewed, and applicable provisions were identified. An action plan was developed to address the gaps in the implementation of relevant and applicable provisions of these instruments.

The PSHEMS initiative has resulted in continual improvement of Bangkok Port. The success of the PSHEMS initiative comes from securing top management support and provision of the overall direction in PSHEMS Development and Implementation by top management, as well as proper training, establishment of the PSHEMS Working Group comprising an administrative committee, working team and an internal audit team which was responsible for the monitoring, control, and improvement of the PSHEMS. The administrative arrangement for the PSHEMS in Bangkok Port has encouraged not only support from the bottom up, but also effective engagement of key personnel in the planning

stages of PSHEMS development. This approach ensured that the processes are driven by the real process owners and other key contributors in the process. With regard to capacity building, trainings were provided to the personnel of Bangkok Port to equip them with the right tools and materials in the development and implementation of the PSHEMS. The training given to port personnel covered the major international regulations on port operations. The training facilitated the identification of international and national regulations relevant to Bangkok Port's operations and increased the awareness of the project team on the relevant regulations, enhanced their auditing skills and enabled them to assess the strengths and weaknesses in port operations and identify areas for improvement.

PSHEMS programmes were implemented to address identified safety hazards and environmental aspects with significant risks: Port Traffic Management Plan (short, medium and long term measures), and the Bangkok Port Access Control Project (e-Gate System). The project is expected to yield a number of benefits. Firstly, it will support Bangkok Port's implementation of the International Ship and Port Facility Security Code (ISPS Code), which is a comprehensive set of measures to enhance the security of ships and port facilities. It will also reduce the traffic congestion and the activity level at the gate entrance. In terms of CSR programmes, Bangkok Port has actively participated in several that the PAT has spearheaded. These include energy conservation, greening of the port area, pollution reduction, health programmes for children, and other environmental programmes. As a result, PSHEMS Department was institutionalised within the Port Organisation, the most valuable benefit that is being considered by Bangkok Port in PSHEMS Department. As in the past, the big responsibility of looking into SHE concerns falls on one person and was deemed to be unsustainable. There is now a dedicated department that concentrates on purely SHE matters. This signifies a clear commitment by the port's top management that it is not taking SHE-related problems lightly. It gives a reassuring atmosphere to port personnel that they are in good hands with Bangkok Port management.

With assistance from the GIZ-supported Sustainable Port Development in the ASEAN Region project, at present, the SHE Department is in the process of setting up the work procedures and work instructions including daily work records and reports of accidents, accident investigation records, and reports on environmental aspects.

Second, with DG-related incidents and the development and implementation of PSHEMS, remarkable improvements were experienced in the handling of dangerous cargo. With the identification of potential environmental hazards, several measures were undertaken to prevent accidents in the DG area. This includes the strict regulation of access to the DG warehouse area for cargo trucks, which are now required to park in a designated area and can only enter the DG area when the dispatch process has already been completed. Moreover, a safety sign was posted at the entrance showing the number of accidents that have occurred in the DG warehouse. In terms of capacity building, the DG training course has been revised based on the prescribed DG training course developed by GIZ.

In particular, a dramatic reduction in the number of incidents/accidents related to DG handling has occurred.

Key lessons learned include:

- Securing top management support is key to the sustainability of the PSHEMS as top management provides not just the resources needed for PSHEMS, but also the overall direction and strategy that would guide the whole organization.
- To ensure that the development and implementation of PSHEMS is well planned, monitored, and supported, a working group and working teams composed of representatives from all concerned units must be established. This has ensured commitment and support from the grassroots level.
- The competency of personnel tasked to develop and implement the PSHEMS must be fully addressed through proper training.
- Continual improvement of the port management system through the internal audit and management review processes are essential components for a management system to remain effective.
- To remain relevant and competitive, ports implementing PSHEMS must continually adopt its policies and procedures to applicable national and international regulations and revise existing rules and regulations accordingly.
- The crafting of a good PSHEMS Policy will give clear directions toward the attainment of targets and objectives.
- It is important to build a culture of safety among port workers. Likewise, increasing the awareness of people concerned on the environmental impact of port operations and the problems that may arise from it lead to a better appreciation of the PSHEMS and how it can address these problems.
- Cooperation and coordination among different units concerned has proven to be an effective way of solving problems.
- Providing intensive training to key personnel capable enough to be trainers is an effective way to support other ports in setting up the system.
- Exchange of knowledge and experience to develop PSHEMS with other ports is a mutually beneficial way to improve port SHE governance.
- Intensive and numerous trainings of port personnel have helped raise the awareness on safety, health and environment and enhanced their competency to develop and implement a PSHEMS.
- Given limited resources, limiting the scope of work to a small manageable area but having the greatest risk, proved to be a good strategy.
- Technical assistance from a knowledgeable organisation, such as PEMSEA, provides a good head start for the development.

A series of trainings on PSHEMS were conducted by the PEMSEA Resource Facility (PRF) for relevant stakeholders, such as the port officers, Customs, Marine Department, private terminal operators, and dangerous good warehouse operator at Bangkok and Laem Chabang Ports.

Another example of good practice was the **Joint Statement on Partnership in Oil Spill Preparedness and Response in the Gulf of Thailand** (GOT Programme). The Joint Statement was initiated by PEMSEA, and signed on January 12, 2006 in Hanoi by Cambodia, Thailand, and Viet Nam. This coordination mechanism aims to enhance national and regional competences on oil pollution prevention, preparedness, and response by exchanging information, research, and conducting oil spill response (OSR) exercises for capacity building and Gulf-wide implementation. The Marine Department, Ministry of Transport is the National Contact Point in Thailand for the partnership. Moreover, the **Environmental Sensitivity Index (ESI) Mapping in the Gulf of Thailand Project**, supported by IMO, KOICA and PEMSEA, and involving sub-regional and national technical teams, produced the **ESI Atlas for the Gulf of Thailand**. The ESI Atlas provides guidance for planning and response to oil spill incidents covering coastal and marine resource along the Gulf. It is used as reference during OSR exercises.

6.7 Supporting Policies and Plans

Supporting policies and plans of Thailand were enacted to implement the international conventions relating to sea and marine pollution, especially the *United Nations Convention on the Law of the Sea* (UNCLOS), also called the Law of the Sea Convention or the Law of the Sea Treaty, and International Maritime Organisation (IMO) conventions concerning prevention of marine pollution and liability and compensation for pollution.

UNCLOS is the international agreement that resulted from the third United Nations Conference on the Law of the Sea (UNCLOS III), which took place between 1973 and 1982. The Law of the Sea Convention defines the rights and responsibilities of nations in their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources. The Convention concluded in 1982 and replaced four 1958 treaties (Geneva Conventions of 1958).

UNCLOS establishes general rights and obligations for protection of the marine environment, including rare and threatened species and fragile ecosystems. The pollution prevention includes all forms and sources of pollution, including marine debris and derelict fishing gear. The Convention provides for the powers, duties, and rights of all states (Flag State, Port State and Coastal State) in each maritime zone – internal waters, territorial sea, contiguous zone, exclusive economic zone, continental shelf, and high seas, including different regimes of passage of ships therein.

UNCLOS came into force in 1994, a year after Thailand became the 162nd nation to sign the treaty. As of May 2017, 168 countries, which includes 167 states (164 United Nations member states plus the UN observer state Palestine, as well as the Cook Islands and Niue) and the European Union, signed the treaty. The Convention entered into force for Thailand on 14 June 2011 in accordance with its article 308 (2). Henceforth, by adhering to this important instrument, Thailand

will be able to effectively preserve and protect its rights and interests in maritime sphere as well as strengthen Thailand's role and image in regional and multilateral arena.

UNCLOS provides a legal framework that is being filled in, rounded out and complemented by existing and subsequently enacted international agreements and customary international law about marine pollution, including Conventions of IMO. IMO Conventions concerning the prevention of marine pollution include International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto and by the Protocol of 1997 (MARPOL or MARPOL 73/78), and International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC), 1990.

The main IMO Conventions concerning liability and compensation, especially in relation to damage caused by pollution are the *International Convention on Civil Liability for Oil Pollution Damage (CLC), 1969* and the *1992 Protocol to the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (FUND, 1992)*.

At present Thailand has already ratified UNCLOS 1982, MARPOL (Annex I and II), OPRC, CLC, and FUND in order to protect the marine environment from pollution from ships. Thailand has also enacted and amended relevant laws and regulations in order to implement the obligations under these international commitments.

MARPOL 73/78 is one of the most important international marine environmental conventions. It was designed to minimize the pollution of the seas, including dumping, oil and exhaust pollution. Its stated objective is "to preserve the marine environment through the complete elimination of pollution by oil and other harmful substances and the minimization of accidental discharge of such substances."

As of 17 May 2018, 156 countries, representing 99.42% of the world's shipping tonnage, are parties to MARPOL 73/78 (Annex I/II). All ships flagged under countries that are signatories to MARPOL are subject to its requirements, regardless of where they sail, and member nations are responsible for vessels registered under their respective nationalities.

The MARPOL 73/78 provides a comprehensive approach to dealing with pollution from ships by creating international guidelines for pollution prevention from ships. There are six Annexes of MARPOL according to various categories of pollutants from ships:

- Annex I - Oil
- Annex II - Noxious Liquid Substances carried in Bulk
- Annex III - Harmful Substances carried in Packaged Form
- Annex IV - Sewage
- Annex V - Garbage
- Annex VI - Air Pollution

Thailand has ratified MARPOL Annex I and II on 2 November 2007 and these Annexes entered into force for Thailand on 2 February 2008. At present, Thailand is in the preparation process to becoming a party to Annex IV and V.

OPRC is the convention aimed to establish measures for dealing with pollution incidents, either nationally or in co-operation with other countries. Ships are required to carry a shipboard oil pollution emergency plan. Operators of offshore units under the jurisdiction of Parties are also required to have oil pollution emergency plans or similar arrangements which must be co-ordinated with national systems for responding promptly and effectively to oil pollution incidents. Also ships are required to report incidents of pollution and the actions that are then to be taken to coastal authorities and the convention. OPRC calls for the establishment of stockpiles of oil spill combating equipment, the holding of oil spill combating exercises, and the development of detailed plans for dealing with pollution incidents. Parties to OPRC are required to provide assistance to others in the event of a pollution emergency and provision is made for the reimbursement of any assistance provided as an important co-ordinating role. Thailand has ratified OPRC on 20 April 2000 and entry into force for Thailand is 20 July 2000.

On oil pollution response, Thailand has developed a *National Oil Spill Response Plan* (OSRP) according to the Regulation of the Office of Prime Minister , the Office on the Prevention and Mitigation of Oil Pollution, 2004, and the *Navigation in Thai Waters Act, 1913*, as amended by the *Navigation in Thai Waters Act (No. 14) 1992*.

Regarding the liability and compensation of oil pollution, CLC is the convention to ensure that adequate compensation is available to persons who suffer oil pollution damage resulting from maritime casualties involving oil-carrying ships. CLC places the liability for such damages on the owner of the ship, from which the polluting oil escaped or was discharged from. The compensation limits of the 1992 protocol of CLC were set as follows: (1) for a ship not exceeding 5,000 gross tonnage, liability is limited to SDR3 million; (2) for a ship 5,000 to 140,000 gross tonnage, liability is limited to SDR3 million, plus SDR420 for each additional unit of tonnage; and (3) for a ship over 140,000 gross tonnage, liability is limited to SDR59.7 million. Also, the 1992 protocol of CLC widened the scope of the Convention to cover pollution damage caused in the exclusive economic zone (EEZ) or equivalent area of a State Party.

Although the CLC Convention provided a useful mechanism for ensuring the payment of compensation for oil pollution damages, it did not deal satisfactorily with all the legal and financial issues. The Fund Convention is under an obligation to pay compensation to states and persons who suffer pollution damage, if such persons are unable to obtain compensation from the owner of the ship from which the oil escaped or if the compensation due from such owner is not sufficient to cover the damage suffered. The victims of oil pollution damage may be compensated beyond the level of the shipowner's liability. However, the Fund's obligations are limited. Where, however, there is no shipowner liable or the shipowner liable is unable to meet their liability, the Fund will

be required to pay the whole amount of compensation due. Under certain circumstances, the Fund's maximum liability may increase. The Fund's obligation to pay compensation is confined to pollution damage suffered in the territories including the territorial sea of contracting states. Also the Fund is obliged to pay compensation with respect to measures taken by a contracting state outside its territory. Thailand has ratified the CLC 1992 Protocol and the FUND 1992 Protocol on 7 July 2017 and was entered into force on 7 July 2018.

For the liability and compensation of oil pollution, Thailand has enacted the *Civil Liability for Oil Pollution Damage from Ship Act, 2017*.

In addition, Thailand continued the process of preparation for ratification of other IMO conventions concerning marine pollution, such as MARPOL Annex IV on sewage and Annex V on garbage, International Convention on the Control of Harmful Anti-fouling Systems on Ships (AFS) 2001, International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM) 2004, and Convention on the Marine Pollution by Dumping of Wastes and Other Matters (LC) 1972.

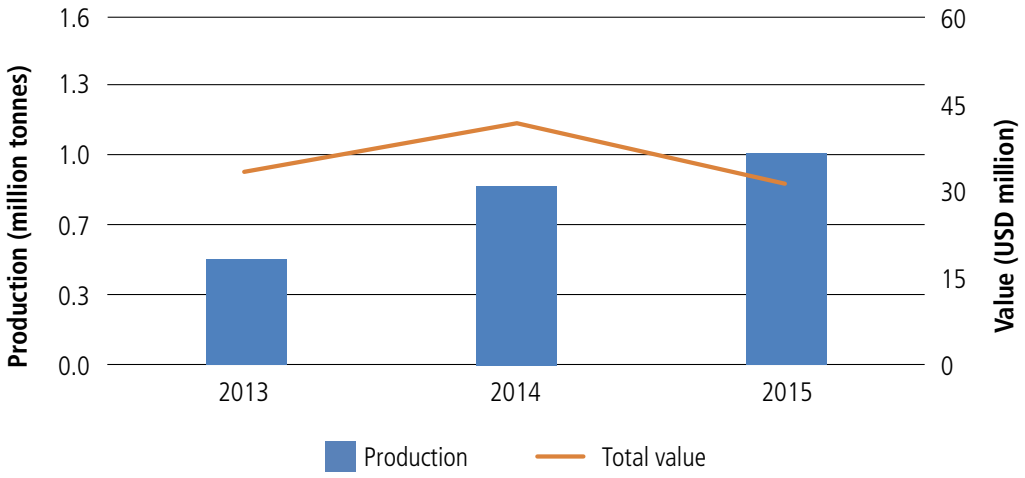
Photo by: J.Calayo

7 Other Ocean Economic Activities

7.1 Sea Salt Farm

In 2007, Sea salt farming covered an area of about 2,379 km2. More than half of the area was in Phetchaburi, Samut Sakorn, and Samut Songkhram. Although the production of salt had increased in 2013 – 2015, the value of production did not follow the production trend. Production increased from 1.14 million tonnes in 2014 to 1.29 million tonnes in 2015. The value, however, decreased from USD51.54 million in 2014 to USD39.77 million in 2015 (**Figure 7.1**).

Figure 7.1: Salt Production and Value, 2015.

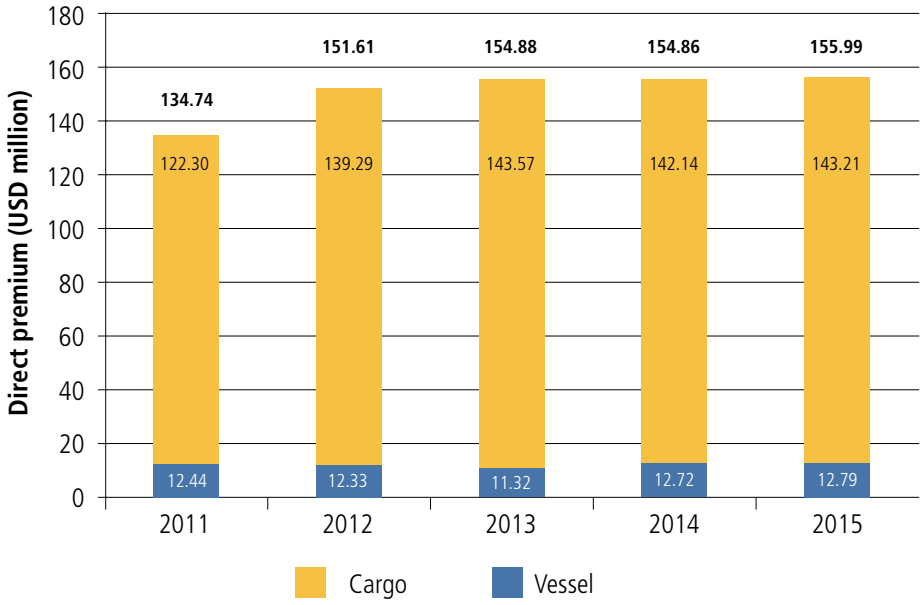


Source: Department of interior trade, 2017.

7.2 Marine Insurance

The Office of Insurance Commission reported the market share of direct premiums of non-life insurance business on marine transportation in vessels and cargo. During 2011-2012, the total direct premium increased to 12.52%. After that, both the direct premium slightly increased (except in 2014). The highest was in 2015, which was USD155.99 million (**Figure 7.2**). The majority of premium was in cargo, with average percentage of premium of vessel was only 8.2%.

Figure 7.2: Market Share of Direct Premiums of Non-life Insurance Business on Marine Transportation in Vessels and Cargo (2011 – 2015).



Source: Office of Insurance Commission, 2017.

7.3 Ship Building and Repairing

According to the Department of industrial works, ship building and repair operators have to be registered under the Factories Act of 1992. There were 227 factories in 2017 (Thai Shipbuilding and Repairing Association, 2017), but 189 enterprises are registered as legal entities under the Department of Business Development. However, only 92 enterprises are registered in the online accounting system of the Department of Business Development. The total revenue of 92 enterprises were USD0.43 billion in 2015 (**Table 7.1**).

Table 7.1: Number and Revenue of Ship-building and Repairing Enterprises.

	2014	2015	2016
Total Revenue (USD billion)	0.50	0.43	0.36
Number of active accounting	89	92	91

Source: Department of Business Development, 2017 (website).

7.4 Energy

7.4.1 Exploration and Production of Offshore Oil and Gas

The national production in 2015 was equivalent to 320.3 million barrels of crude oil, a 0.5% rise from 2014, but with a 20% drop in revenue because of oil price drop.

All petroleum concessions in maritime sources of Thailand were in GoT, with most of them in the EEZ (**Figure 7.3**). As of December 2015, there were 438 installations. Most of them were wellhead platform. (**Table 7.2**)

Figure 7.3: Thailand Petroleum Concession Map (2015).

Source: Department of Mineral Fuel, 2015.

Table 7.2: Petroleum Facilities in 2015 in Gulf of Thailand.

Types	Number
Wellhead Platform	367
Processing Platform	21
Living Quarter Platform	11
Compression Platform, Riser Platform, Flare Platform, Mobile Production Unit	25
Floating Production Storage and Offloading	2
Floating Storage and Offloading	12
Total	**438**

Source: Department of Mineral Fuel, 2015.

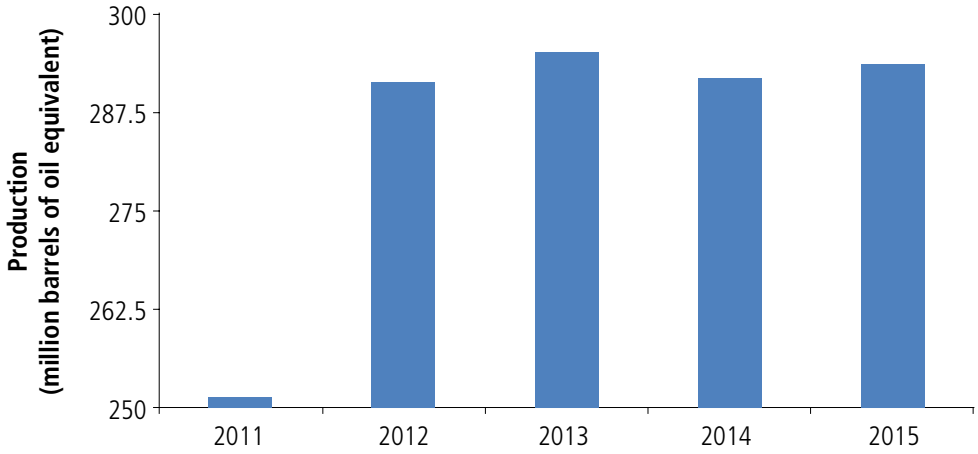
The government revenue from concessionaires' petroleum businesses are royalty, special remuneratory benefits, petroleum income tax, and revenues from the Malaysia-Thailand Joint Development Area (MTJDA). During 2011-2013, the state revenue rose steadily. However, the revenue started to decrease in 2013 and continued to go downhill until 2015 (**Figure 7.4)**.

Figure 7.4: State Revenue from Petroleum Business.

Sources: Department of Mineral Fuel, 2011-2015.

Total indigenous petroleum production from 2011-2015 was shown in **Figure 7.5**. It hit the lowest in 2011 and began to increase and level off from 2012-2015.

Figure 7.5: Total Indigenous Petroleum Production.



Source: Department of Mineral Fuels, 2015.

7.4.2 Issues and Challenges

Environmental Control

In Thailand, the concessionaire has to comply with occupational health, safety, and environment standards (ISO 14001 and ISO 18000). Before the operation starts, the concessionaire must develop the environment impact assessment report, which includes measures on the prevention and mitigation of impacts and monitoring. These environment requirements were specified in Environmental Impact Assessment reports (EIA) and concession agreement with the Thai government.

Mercury Monitoring

As mercury was a by-product of the petroleum production, mercury in tissues of bottom-feeding (demersal) fish around production platforms were randomly monitored. The monitoring conducted by Chulalongkorn and Burapa University showed that the level of Mercury was below 0.5 mg/kg (food safety standards by the Ministry of Public Health).

The seawater quality around the production platform was also monitored for Mercury. The result showed the concentration level was less than 0.1 microgram/litre of seawater, which was type 1 (seawater quality for natural resource conservation) on the standard of the National Environment Board, No. 27 (2006).

Preparation for decommissioning

The Ministerial Regulation Prescribing Plan and Estimated Cost and Security for Decommissioning of Installations Used in the Petroleum Industry of 2016, under the Petroleum Act of 1971 was issued to determine the decommissioning process. This ministerial regulation requires preparation of two specific environmental reports, which are Decommissioning Environmental Management Assessment (DEA) and Best Practicable Environmental Option (BPEO) for the decommissioning. DEA and BPEO indicate details on evaluating environment impact of decommissioning impact and decommissioning options.

Example of oil spill case: Ao Phrao, Ko Samet, Rayong Province

On 27 July 2013, approximately 54,000 litres of oil leaked from pipelines while oil was being transferred from tankers to Map Ta Phut Industrial Estate. The leaked oil was first handled by a co-operation of PTT Global Chemicals and the Thai government, using boom, skimmer, and dispersant to mitigate the impact of the oil spill. However, some oil slick reached the beach at Ao Phrao, Ko Samet, and Rayong Province on the night of 28 July 2018.

The majority of oil slick covered the beach of Ao Phrao (Figure 7.6). Some oil flowed to Ao Kham and Ao Noi Nha, Ko Samet. PTT GC and Thai government organisations, such as the Marine Department, Royal Thai Navy, and local organisations, had to clean up the shore using absorbent boom along the beach, collecting the oil slick in the sea and on the beach.

This accident affected all the human securities in the areas.

(a) Environment security: Mass of hydrocarbon from crude oil was found in the marine water. They were also found in shells and other macro benthic (TEI, 2014). The behaviour of sand crab changed because the sand was contaminated by the oil.

(b) Food security: Small organisms, such as small crab and amphipods, feed on oil contaminated food. These animals were fed by fish, which were human food. Therefore, after the accident, people refused to eat seafood from these areas.

(c) Economic security: Seafood from the areas could not be sold because people were concerned about contamination of toxic pollution in the food and waters. The tourism industry was also affected because Ko Samet was an important tourist attraction. The tourists were concerned with the negative effects of the situation.

(d) Health security: While the oil slick covered the beach, many technicians in safety suits cleaned the oil. However, there were many volunteers without safety suits who also cleaned the beaches. The impact to their health did not appear an that time. Nevertheless, their health is still under observation until now.

Figure 7.6: Oil spill at Ao Phrao, Koh Samet in Rayong Province.

Photo from: TEI

PART 3

DEVELOPMENTS IN BLUE ECONOMY

8 Drivers of Future Growth, Innovations, and Sustainability


Photo by: M.Ebarvia


Photo from: TEI

The marine resources of Thailand are blessed with rich coastal and marine ecosystems, hosting a wide range of biological resources such as fishes, shrimps, molluscs, crabs, and seaweeds. The coastal areas of the GoT and the Andaman Sea make an important contribution to the national economy of Thailand. However, Thailand's marine and coastal resources have been degrading for many years. The natural marine resources degradation, which are mangrove destruction, decline of coastal fish stocks, and saline water intrusion into agricultural lands, not only cause environmental deterioration but also adversely affect the way of life of the local fishermen and farmers, and the economy of the country.

Thailand is also facing greater pressures and risks under intensified globalization and in moving towards a world with no boundaries. At the same time, climate change has become more unpredictable which increased risks of loss or damage to livelihood, business, and public properties. International agreements have become more stringent in several aspects, such as pollution emissions, human rights, and financial regulation.

Many aspects of environmental conditions, both inside and outside the country, put unavoidable pressures that Thailand would have to adjust to and manage risk in a more sophisticated manner. Thailand attaches great importance to the concept of sustainable development, which has long taken root in the country. The current government has integrated Sustainable Development Goals (SDGs) as integral parts in the development agenda. SDGs have also been integrated in the 20-Year National Strategy Framework and the 12th National Economic and Social Development Plan (2017-2021). As a result, plans and budgets of all government agencies are in line with the SDGs.

Realising that blue economy initiatives are vital to the growth of the Thai economy, the Thailand Research Fund (TRF) have already released since 2015 a comprehensive roadmap for managing

marine interest under its Strategic Research Issue No.7- National Marine Interest and Security (SRI 7). This 3-year roadmap (2015-2017) lists several research areas and policy actions with ambitious targets. The short-term objectives of the roadmap focus on developing national state of coasts and oceans and blue economy development in Thailand.

8.1 Innovative and Sustainable Economic Activities

8.1.1 Sustainable Fisheries and Aquaculture

During the past few decades, Thailand fisheries production are among the top ten of the world. According to FAO, fisheries production increased to over 2 million for the first time in 1977. Out of the 3.9 million tonnes of the total production in 2007, 58.2 % was from marine production (FAO, n.d). The marine fisheries production dropped to less than 2 million tonnes in 2008 and the production slightly fluctuated to around 1.5 million tonnes in the same year. Overfishing was the main cause of decrease in production. Recognising the decreasing trend of fisheries production, the government recently enacted the Royal Ordinance on Fisheries of 2015. Furthermore, DOF has developed the Fisheries Management Plan, 2015-2019. These actions would pave the way for the sustainable use of fisheries resources for food security, job creation, and economic growth. In addition to to government intervention, there are many initiatives in fishing and aquaculture that involve various stakeholders, including fishers and processors, government units, academia, local communities, and NGOs.

1. The Andaman Trawl Fishery Improvement Project (FIP)

Under the Sustainable Markets Project, the Market Transformation Initiative (MTI), WWF-Thailand has started to work on the seafood sector, both wild-caught and farmed, to increase sustainability and traceability at the producer's end of the supply chain. As for the wild-caught seafood, WWF-Thailand focuses on blue swimming crab (Portunus pelagicus), trash fish, and juvenile economic fish (used as raw materials for fishmeal). WWF-Thailand and the Thai Sustainable Fisheries Roundtable (TSFR) initiated Fishery Improvement Projects (FIPs) by involving various stakeholders, including fishers and processors, government (mainly the Department of Fisheries), academia, and other local NGOs.

The outcomes of the project are as follows:

- Better understanding of an internationally accepted fisheries standard of Marine Stewardship Council (MSC) for Thai stakeholders;
- Start of a demersal trawl pilot project, which is to be adapted in other sites in Thailand and related areas;
- Participation of all stakeholders in trawl fishery management (including commercial fishers, artisanal fishers, related trawl fishery beneficiaries, governmental sectors, researchers, and NGOs);
- Understanding of marine and coastal resource dependents, both directly and indirectly;

- Minimized impacts on trawl targeted species and related ecosystems (primary and secondary species and habitats, and ETP species);
- Improvement of trawl fishery in Southern Andaman Area of Thailand; and
- Guideline for Thai stakeholders to approach MSC or equivalent standard.

WWF-Thailand and the TSFR are working together towards sustainable fisheries and aquaculture management and production through policy reform with the long-term objective of achieving MSC or ASC certification (or equivalent) for the seafood supply chain. To achieve the objective, both organisations agree to ensure all fishmeal products are sourced from fisheries that adhere to the relevant fishery standard (e.g., MSC) in capture fisheries and related processing and distribution industries. The parties also commit to ensure all fishmeal products come from traceable and environmentally and socially responsible sources; whereas supply chain transparency and awareness amongst customers, employees, and other key stakeholders are to be improved and promoted.

In this light, WWF-Thailand and the TSFR are developing the Andaman Trawl Fishery Improvement Project for feed sources associated with wild-caught forage fish. The project is envisaged to be a pilot project for other sites in Thailand and related areas. Around five provinces along the Andaman Coast of Thailand [(Southern) Phang Nga, Phuket, Krabi, Trang, and Satun] are selected as the project's targeted sites based on the less intricate stakeholders and fishery boundary.
The project is divided into four stages:

Stage 1 – Scoping: This stage involves stakeholder mapping and engagement through "focus group survey", stock assessment of fishery area, socio-economics study through "baseline survey", MSC pre-assessment, and delivery of scoping document.

Stage 2 – Action Plan Development: During the second stage, the stakeholders work together to prepare and complete FIP Action Plan, combining the information and the results derived from the study conducted in Stage 1, with stakeholder input and consensus.

Stage 3 – Implementation: Within a set timeframe, the stakeholders implement the FIP Action Plan according to their roles and responsibilities assigned in Stage 2, while progress of works can be tracked and project updates are accessible to the public.

Stage 4 – Review: The stakeholders assesses the annual progress of the fishery together, and revise and adapt the FIP Action Plan if necessary.

2. Crab Bank Model

The Thai Crab Product Group (TCPG) was formed in 2012 under the umbrella of the Thai Frozen Food Association (TFFA). TCPG, as a lead agency for the Thai Blue Swimming Crab (BSC) sustainability initiative, works in collaboration with the government, universities, NGOs, and industry. The MSC

pre-assessment was conducted in 2012, and since then, there have been numerous consultations with the Thai Department of Fisheries and WWF on the best ways to move forward. The FIP focuses in key recruitment areas in the GoT, namely Chumphon and Surat Thani. Education, stock assessment, and co-management with fishing communities are the highlights of the initiative. The major contribution of the initiative is empowering local fishing communities to ensure their food security by engaging economic instruments and collaborative community management.

The *National Plan of Action (NPOA) on Sustainable Management of Blue Swimming Crab* was initiated in 2015 to facilitate the FIP implementation with wider scope of activities at the national level. The NPOA consists of four strategies:

- Improving information on BSC fisheries and relevant resources;
- Establishing the direction on BSC restoration;
- Controlling inputs to BSC fisheries; and
- Promoting local participation and responsible BSC fishing.

3. Auditing and certification

Sureerath Shrimp Farm in Chantaburi Province was the first shrimp farm to be organically certified by a third party, an international certifying body (Naturland, Germany) in 2008. Sureerath Farm was established in 1985 by Mr.Prayoon and Mrs. Sureerath Hongrath. This 4.8-ha farm has both hatchery and grow-out units. It has an annual production of black tiger prawn (*Penaeus monodon*) and Pacific whiteleg shrimp (*Penaeus vannamei*) of 250-300 tonnes (133 grow-out ponds). The farm implemented a fully recirculating outdoor pond system, with the effluent recycled through a treatment pond containing aquatic plants, including mangroves. Based on ecological principles, the farm keeps a balance between shrimp-rearing density, amount of feeds, and water quality. Shrimps are reared at a relatively low density with a combination of formulated feeds (with mostly organically certified material) and natural-occurring seaweeds and benthic invertebrates.

4. Seasonal fishing regulation

DOF has reinforced seasonal regulations for commercial fisheries and recently implemented additional restrictions on fishing vessels in response to the continuous decline in pelagic fish catches and IUU fishing. DOF has declared a three-month fisheries closure during spawning period from February to May for the GoT, and April to June for the Andaman Sea. The closure focuses on commercial fisheries. The recovery of pelagic fish stocks has been more apparent in the Andaman Sea than the GoT, however. The Andaman Sea closure has resulted in increased fisheries productivity (DOF, 2015), especially mackerels and shrimp. Increases in quantity and value are key factors contributing to the success of this regulation.

8.1.2 Sustainable Coastal and Marine Tourism

The government of Thailand is encouraging all parties involved in tourism, such as tourists, hotel operators, transportation companies, and tour agents to go green. There are many initiatives and projects on green tourism.

1. Ko Mak Low Carbon Destination Project

The Ko Mak Low Carbon Destination Project in Trat Province is of particular interest. The objective of this project is to reduce carbon footprint, reduce pollution, and maintain and improve the environment. Thailand's first "Low Carbon" destination, Ko Mak in Trat Province was launched by DASTA and ISMED as a special area for sustainable tourism development. In order to lower emission of carbon dioxide and pollutants in the island, locals are urged to use alternatives to petroleum based fuels, implement water and waste management, and preserve local activities and the traditional way of life.

For tourists, the island offers environmentally friendly activities such as cycling, kayaking, and sailing. Moreover, business operators are now using fresh groceries, avoiding all polluting products.

2. Bor Hin Farmstay

The Bor Him Farmstay in Sikao District, Trang Province is an example of a community-initiated tourism. Recipient of the Award of Excellence in the category of Tourism Support and Promotion Organization at the 2013 Thailand Tourism Award, Bor Hin Farmstay provides a unique ecotourism experience to visitors amidst Trang's peaceful natural surroundings. In the past, people in this community depended mainly on fish cage farming and fishing. Now, many of them became tour guides, informing visitors about their community and their coastal ecosystems. Apart from exploring the local fisherman's cage culture practises and joining the mangrove reforestation activity, visitors can also spend time learning about seagrass and the importance of their conservation. Bor Hin Farmstay established a "Seagrass Seeding Bank" to help preserve the biodiversity of seagrass in Thailand.

3. Marriott Hotel and IUCN-Mangroves for the Future (MFF) collaboration

Since many private sector establishments in coastal areas are dependent on coastal resources for their business, they should be engaged as partners in sustainable tourism. The Marriott company is an example of how a private sector entity can contribute to coastal conservation and integrate supporting local economies and livelihoods in coastal areas near the Marriott properties. The IUCN-Marriott partnership has 3 main components at this stage:

Photo by: M.Ebarvia

- Mangrove restoration: Marriot collects donations from hotel guests to support mangrove restoration in four target areas in Thailand. Seven hectares were reforested in 2016.
- Sustainable seafood sourcing: IUCN works with Marriot to identify and source sustainable seafood directly from local communities nearby their properties. For example, in 2016, two Marriot properties sourced more than USD45K in seafood from 40 families in 3 villages around the properties.
- Sourcing of local products as gifts and souvenirs. IUCN also works with Marriot to source local handicrafts to be used at Marriot properties. Four of their properties present welcome bracelets to their guests. In 2016, Marriot purchased USD30,000 in bracelets from 26 families in a village near their Phukhet property.

8.1.3 Green Port

Laem ChaBang Port (LCP), located in the eastern part of Thailand, covers an area of 2,572 acres. LCP is situated in the district of Sriracha and Banglamung of Chon Buri Province. LCP's policy of development is focused on enabling the port to accommodate post paramax size ships and to be the transshipment hub of the Indo-China region. LCP has been developed to be an international port and was recently announced by Cargo-news Asia a one of the five best ports in Asia along

with Hong Kong, Singapore, Malaysia, and the Philippines. LCP has undergone two phases of development so far and is now on the third phase of construction.

LCP initiated a Green Port Programme in 2010 to mitigate its carbon dioxide emissions (Apai and Thammapredee, 2014). The port has setup a wind farm power plant as a pilot project to increase the proportion of green energy consumption. To address carbon dioxide emission cargo handling equipment and from ships calling the port, LCP's Low Carbon Port Programme encouraged all private terminal operators to switch from diesel fuel to electric power in operating cargo handling equipment and more electric supply for ships berthing at the quay wall.

Phase III expansion of Laem Chanbang Port is expected to operate in 2019 to accommodate the rapid growth of Thailand's international seaborne trade. The Port Authority of Thailand policy to create a Green Port project, which includes the third phase development of Laem Chabang Port, clearly sets targets to minimize environmental impacts on air, water, and ecological systems. There is also significant focus on energy-use efficiencies in the design and construction of new facilities to achieve the goal of creating a truly modern and green port.

8.2 Emerging Industries

Fisheries, tourism, and shipping were the major contributors to the ocean economy in Thailand for many decades. These sectors would continue to maintain their contribution with the new approach to blue economy. At the same time, there is still potential in the under developed sectors, such as ship building and repairing, desalination of seawater, renewable energy production (wind, wave, and tide, etc.), marine biotechnology, and bioprospecting.

8.2.1 Desalination

Reverse osmosis (RO) technology was used for desalination in Thailand. It was installed by many industries, such as hotels, manufacturing factories, and businesses for internal use. There were three main organizations that produce desalinised water for distribution to houses on the islands, such as Ko Samui, Ko Larn, Ko Sichang , and Phuket provinces: the Provincial Waterworks Authority, R.E.Q Company, and Eastwater group.

The Eastwater group reported that 200 m^3 and 2,200 m^3 of water per day were produced in 2017 at Ko Larn and Ko Samui, respectively. The price was USD1.75/m^3.

At present, there are three desalination plants in operation, mainly on the islands where water supply from freshwater sources is not available or scarce. The increasing demand for water supply, especially from tourism, is going to increase the need for desalination of seawater. However, the energy cost as well as the mitigation of environmental impacts have to be considered.

8.2.2 Alternative Energy: Wind Farm

The growing concern on alternative energy consumption has increased continuously, due to the policy of the Department of Alternative Energy Development and Efficiency to promote alternative energy consumption. There were several types of alternative sources of energy, such as solar energy, wind energy, small hydro power, large hydro power, biomass, biogas, and biofuels (ethanol and biodiesel). In 2015, electricity generation from alternative energy was 7,963 MW, which was 234 MW or 2.9% produced from wind energy. The investment value of wind farms in the whole country was USD0.95 billion (Alternative Energy Development and Efficiency, 2015).

In 2015, **Table 8.1** shows wind farm distribution in 12 coastal provinces with a total capacity of 16.02 MW. The biggest coastal wind farm was in Nakhon Si Thammarat (11.75 MW), Songkhla (1.53 MW), and Rayong (1.02 MW).

Table 8.1: Wind Energy Capacity (MW) in Coastal Provinces.

Provinces	Wind energy capacity (MW)
Gulf of Thailand	
Chantaburi	0.03
Rayong	1.02
Chon Buri	0.03
Chachoengsao	0.02
Samut Prakarn	0.06
Samut Sakorn	0.96
Phetchaburi	0.50
Surat Thani	0.26
Nakhon Si Thammarat	11.75
Songkhla	1.53
Pattani	0.01
Narathiwat	0.01
Andaman sea	
Phuket	0.36
Satun	0.01
Total	**16.55**

Source: Alternative Energy Development and Efficiency, 2015.

The Government of Thailand recognises the importance of wind power as one of alternative energy sources to substitute fossil-based energy. The Electricity Generating Authority of Thailand (EGAT), a state enterprise responsible for generating and transmitting electric power in Thailand, built the first wind turbine in 1983 at Promthep Cape, Phuket Province. In 2015, wind energy production has a total capacity of 16.02 MW.

8.2.3 Marine Biotechnology and Bioprospecting

Thailand is rich with marine biological resources that could be developed into medical, health care, and cosmetic products. Although the Ministry of Science and Technology has developed a marine biotechnology research and development programme, it focused mainly on aquaculture. There are also several researches on biofuel funded by PTT. Overall, there is no national policy on marine biotechnology.

8.3 Investment Opportunities

It is realized globally that the ocean still remains as one of the least developed regions on this blue planet. Many countries are planning to utilize more living and non-living ocean resources both under and beyond their national jurisdictions. It is also true that ocean resources and environments are in the declining stages close to their carrying capacities, and in some cases beyond carrying capacity. Therefore, utilization and conservation of ocean resources and environments must be designed in such a way that they can synergistically coexist now and in years to come. "Blue Economy" is expected to be a solution to this. The term was defined as a sustainable use of ocean resources for economic growth, improved livelihood and jobs, while preserving the health of marine and coastal systems (World Bank, 2017). It was also explained, formerly in the Changwon Declaration 2012, that it was a practical ocean-based economic model using green infrastructure and technologies, innovative financing mechanisms, and proactive institutional arrangements for meeting the twin goals of protecting our oceans and coasts and enhancing its potential contribution to sustainable development, including improving human well-being and reducing environmental risks and ecological scarcities. This approach was also subsequently accepted and declared in many international, regional, and national policy forums.

Based on the blue economy development concept, there are three possible types of investment opportunities (Economist Intelligence Unit, 2015):

Type 1: Where investments better account for environmental, social, and governance risk in the planning and execution of activities in the ocean, and where the environmental, social, and governance management is both good for business and good for the environment;

Type 2: Where there is a strong business case for investing in the ocean, and where a side benefit of the investment is improving the health of the ocean; and

Type 3: Where investments are solely focused on ocean health and ecosystems. This opportunity captures a whole new paradigm of investments, which are "blue" from inception.

It can be seen from the above that the first and the second types of investment opportunities are more or less being commonly practised in most of marine-related business development activities. At any rate, there are still worldwide arguments on the sustainability of these investments, especially in social and environmental aspects. While Types 1 and 2 certainly need to be improved to meet the expected environmental and social requirements, there is plenty of room for the third type.

An application of the blue economy concept to Thai marine-related business is a very important one, but is still new and at a very early stage. However, the concept corresponds to Sustainable Development, which has been recognised by the government as well as the Thai people. It is in line with the UN Sustainable Development Goals (SDGs), in particular, SDG 14 - Life Below Water. Most importantly blue economy is in accordance with the Sufficiently Economic Philosophy (SEP) delivered by the late King Rama IX. This NSOC report will be the first important step leading to the implementation of the blue economy concept. It should be pointed out that most of the maritime activities in Thailand are nearshore, mostly within 3 nautical miles of the coastline. However, by also taking into account the Exclusive Economic Zones in both the GoT and the Andaman side, there are about 320,000 km^2 of sea areas waiting for applications of such a concept.

At present, Thailand still has no overall *National Marine Policy*. However, the recent draft version of the *20-Year National Strategy (2018-2037)* includes the national strategy on growth for environment friendly and quality of life. This strategy contains a strategic issue entitled, "Building a sustainable growth on blue economy society". Under this strategic issue, there are at least two out of four sub-strategic issues related to blue economy:

1. Increase of marine bio-based economy to more than 5% of GDP; and
2. Develop and increase proportion of environmentally friendly strategies in four main maritime activities, i.e., tourism, transportation, fisheries, and energy production.

From the above sub-strategic issues, it can be seen that there will be many investment opportunities for blue economy in Thailand.

The first is utilisation of marine biotechnology, and bioprospecting, or also known as blue biotechnology. This is due to the fact that Thailand has a very rich marine biodiversity within the national maritime zone. However, most of these biological resources remain uncovered. Therefore, there are enormous opportunities for Thailand to develop marine biodiversity-based economy. Scientific knowledge is needed to identify the potential utilization of these resources at

ecosystem, species, and genetic levels. This marine-based products could be in the form of food, biofuels, pharmaceuticals, cosmetics or other related products.

For the second sub-strategic issue, i.e., tourism, transportation, fisheries, and energy production, which are the major groups of ocean economy, details of these have already been described in the previous chapter.

At the national level, the Eastern Economic Corridor (EEC) offers an opportunity for blue economy investment. This second phase of the Eastern Seaboard Project is under the Thailand 4.0 model, which focuses on a value-based economy and aims at economic prosperity, social well-being, raising human value, and environmental protection. There are eight components under this mega project:

1. Infrastructure Development Implementation Programme;
2. Targeted Industries Development Implementation Programme;
3. Human Resource, Education, Research, and Technology Development Implementation Programme;
4. Tourism Development and Promotion Implementation Programme;
5. New City and Community Development Programme;
6. Business Hub and Finance Hub Development Implementation Programme;
7. PR and Mass Engagement Implementation Programme; and
8. EEC Agriculture, Irrigation, and Environment Implementation Programme.

The infrastructure development plan includes highways, rails (high speed train), and air (U-tapao air port) and sea (Laem Chabang, Map Tha Put and Sattahip ports) to improve connectivities and to support 10 target industries (www.eeco.or.th).

In connection with the blue economy investment opportunities, emerging sectors include:

1. **Coastal and marine tourism:** Due to the fact that tourism, particularly coastal and marine tourism, will continue to grow consistently in terms of tourist number and its proportion of national income. There has already been an increasing trend in ecotourism and environmentally friendly tourism, especially along the 23 coastal provinces. However, the development of these types of tourism needs to be improved to effectively respond to the environmental and social issues at the local level. This could be done through policy interventions of relevant ministry, including environment, industry, and tourism. Although the Ministry of Tourism and Sports includes ecotourism in its policies, it still focuses more on increasing tourist number and income than environmental protection and conservation.

2. **Transportation:** Marine transportation, which consists of ships, ports, shipyards, and personnel development, still has considerable opportunities to develop into green port

and green shipping in Thailand. The Eastern Economic Corridor Project provide a good opportunity for such development as the government has invested in infrastructure development in expanding the three seaports, namely Laem Chabang, Map Ta Phut, and Sattahip. This project is under the planning stage, where the concept of blue economy can be applied. This project also aims at promoting the underdeveloped sector of ship building and repair at the Sattahip seaport.

3. **Marine fisheries:** Two types of fisheries are being conducted, i.e. capture fisheries and aquaculture. With the new approach of government in combating IUU fishing in Thailand in the last 3 years, capture fisheries will be developed toward more sustainability. In the past, most of aquaculture practices have emphasized the single carnivorous species, more efficient feed conversion, with intensive culture system along the limited coastal areas. This culture practice is rather limited in terms of area for expansion, and also creates negative impacts on surrounding environments. Offshore environment-friendly aquaculture system with multi or integrated cultured species, more efficient feed conversion, and low energy consumption is expected to be an option in the future.

4. **Energy production:** To address climate change, the government has committed a shift from fossil fuel-based, non-renewable energy to renewable energy. The target is to increase renewable energy share to 25% by 2036. There is a potential for coastal development of wind and solar energy (floating solar panel) including their hybrids or combination in the future. The coastal provinces in the south are particularly suitable for wind energy development (http://weben.dede.go.th). Due to a very high land price and risk of conflict with other land use activities, such energy production systems can be done in the offshore areas both in the GoT and the Andaman Sea.

In addition, combined activities between two sectors, or among three and four sectors are also possible for blue economy investment opportunities. Examples include fisheries and tourism development (crab bank model); waste management, fisheries, aquaculture and tourism (Laem Pak Bia); and energy and tourism (Kho Mak low carbon destination).

Photo from: TEI

PART 4

STATE OF OCEAN HEALTH UNDERPINNING THE BLUE ECONOMY

9 Marine Environment

9.1 Oceanographic Features

The shorelines of the GoT are mainly soft-sediment formed as a result of sedimentation from various river drainages: Chao Praya River; Mae Klong River from the north and northwest, and Tapi, Pak Phanang, and Pattani Rivers in the south. The Malaysia River in the southernmost and Mekong River in the easternmost of the GoT also supply loads of sediment into the gulf. The other part of the gulf shoreline, particularly the upper-south and the east part, are sandy bottom from seaward deposition.

Thailand's climate is under the influence of the monsoons. The southwest monsoon from the Indian Ocean brings rain to the provinces located along the Andaman Sea coast, as well as the east coast of the Gulf of Thailand during the rainy season from mid-May to mid-October. The period from November to February is the winter season, with a cooler but dry weather along the eastern boundary coasts due to the influence of the northeast monsoon, except the heavy rains along the west coast of the Gulf of Thailand.

The Gulf of Thailand is a large marine ecosystem connected to the South China Sea of the Pacific Ocean, with its semi-enclosed water body bounded by the Malay Peninsula on the western boundary and the coast of Southeast Asian on the northern and eastern boundaries. The Gulf extends for 810 km in length and 540 km in width with the southeast opening of 380 km wide from the southern tip of Viet Nam to the Malay-Thai boundary terminus. The average depth of the Gulf is about 44 metres (m) with its deepest basin of 86 m. Two ridges or projections extend toward the South China Sea with the sill depths of approximately 67 m (Robinson, 1974). With its triangle shape, the Gulf of Thailand is divided into the Inner or Upper Gulf and the Lower or Outer Gulf. The Inner Gulf of Thailand (IGoT) includes the area of 100x100 km2 with an average depth of 15 m (Sojisuporn, 2003). The northern and western shoreline together with some parts of the eastern shoreline of the IGoT are bounded by mangrove swamps. The lower part of the western shore as well as the eastern shore are mainly sandflat.

On the western part of Thailand along the Malay Peninsula, on the continental shelf of the Indian Ocean, is the Andaman Sea, which is a marginal sea of the Bay of Bengal. The part of Andaman Sea that belongs to Thailand extends from the coastal zone of Ranong Province on the north toward the coastal zone of Satun Province on the southern end. The depth of the Andaman Sea is far greater than that of the GoT with an average depth of 1,000 m in the northern part along

the coastlines of Ranong and Phangnga provinces and 300 m in the southern part of the coast (Department of Marine and Coastal Resources, 2013b).

Seawater in the GoT and the Andaman Sea receives a large amount of freshwater runoff from major rivers in the central and southern parts of Thailand. The temperature of the surface water observed, both in the GoT and the Andaman Sea, indicated a fluctuation in the ranges of 27°C-30°C (Koad et al., 2012).

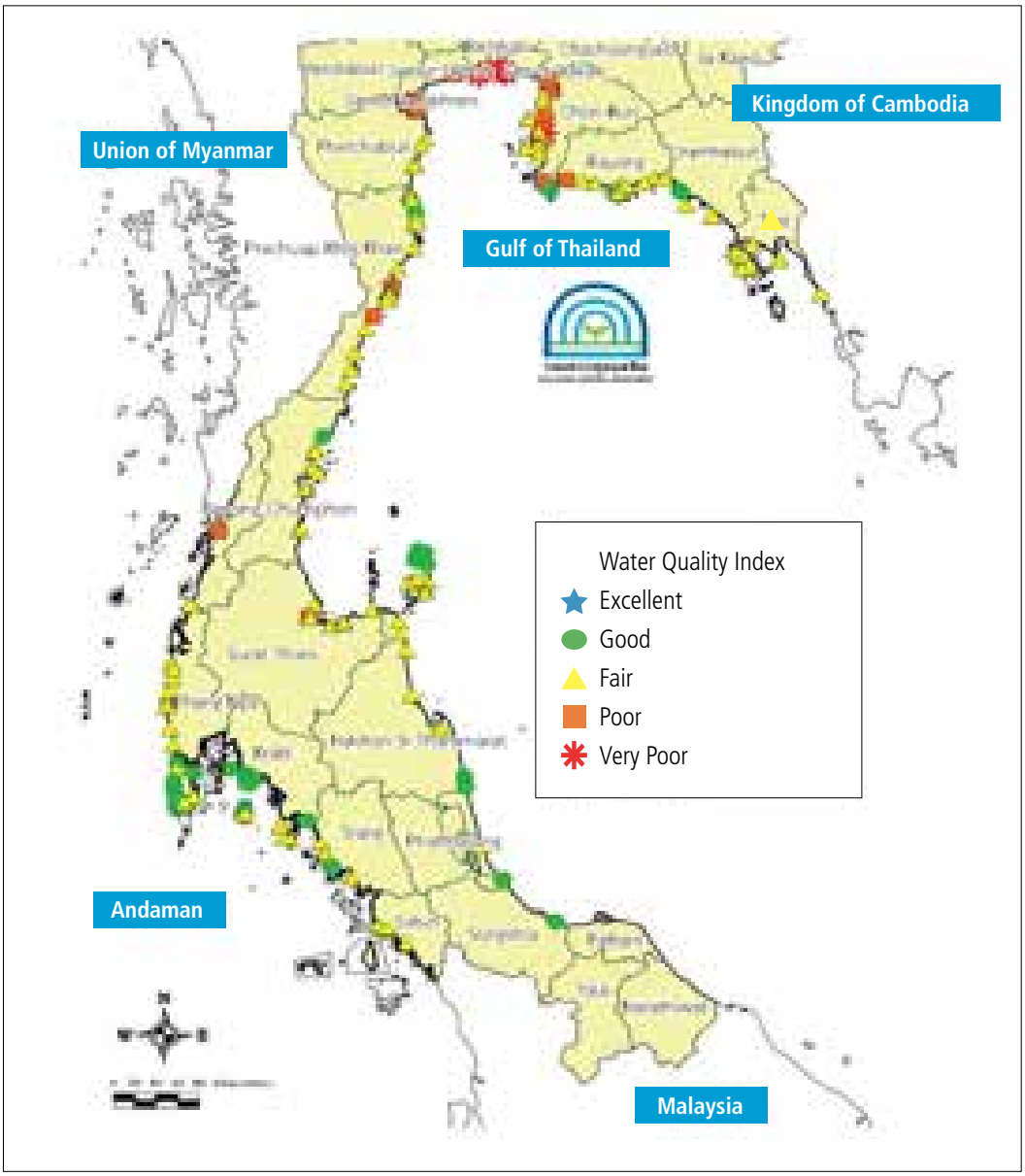
9.2 Marine Water Quality


Photo from: TEI

In terms of marine water quality, a monitoring program has been carried out by the Pollution Control Department. Water samples are collected twice annually from 202 stations along the coastlines of Thailand. The Marine Water Quality Index (MWQI) is used for assessing overall marine water quality, which is calculated from eight parametres: Dissolved Oxygen (DO), Total Coliform Bacteria, Phosphate-Phosphorus (PO_4^{3-}-P), Nitrate-Nitrogen (NO_{3-}-N), Temperature (Temp.), Suspended Solids (SS), Acidity – Alkalinity (pH), and Ammonia-Nitrogen (NH_3-N). Its values range between 0–100, with a score from 0–25 considered very poor; 25–50 is poor; 50–80 is fair ; 80–90 is good; and 90–100 is excellent.

In 2015, MWQI values indicated that water quality in most areas was in fair condition (about 70%), 16% was in good condition, 9% in poor condition, and 3% in very poor condition (**Figure 9.1**). The areas with deteriorated water were mainly in the IGoT, especially the river mouths, which receive wastewater from river runoffs and coastal establishments (PCD, 2016). The IGoT is under eutrophic conditions during the wet season due to nutrient transport from river discharges. This condition sometimes induces phytoplankton bloom or red tide which is usually reported in this area. The IGoT also acts as a source of dissolved inorganic nitrogen and phosphorus flux toward the outer GoT (Wattayakorn and Jaiboon, 2014). There were also incidents of oil spills in the eastern seaboard of the IGoT, where marine ports and marine industrial parks are located.

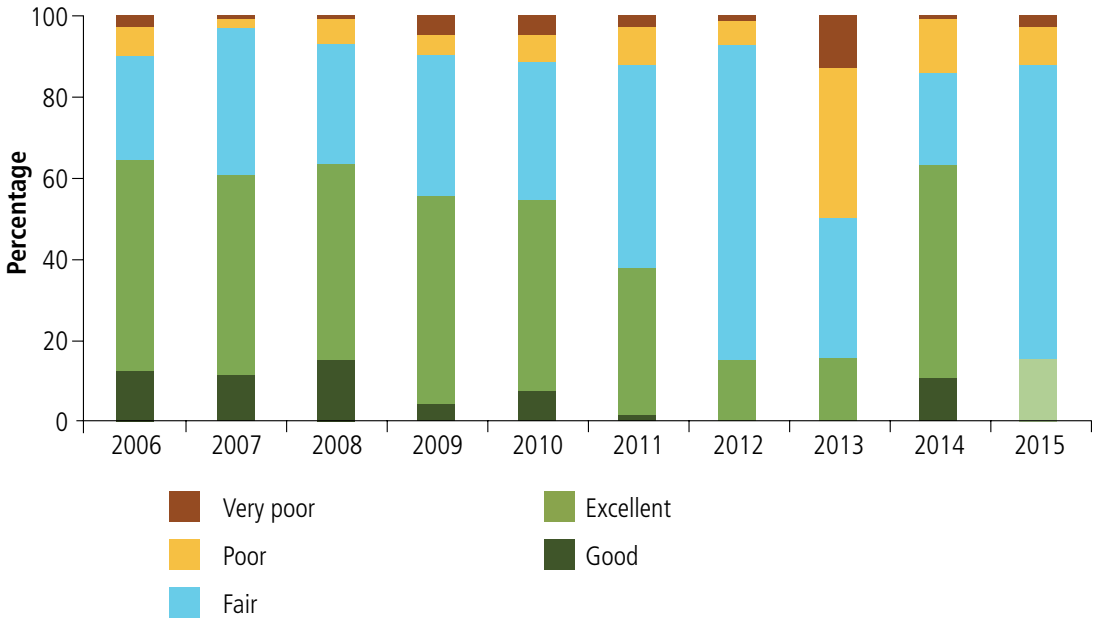
Figure 9.1: Coastal Water Quality during 2015.



Source: Pollution Control Department, 2016.

Figure 9.2 shows the marine water quality trend over the past 10 years. According to PCD, no excellent condition was found since 2006. In addition, the percentage of good condition of seawater decreased from 52% in 2006 to 16% in 2015, while the percentage of fair condition increased. The parameters that indicated seawater pollution from 2006 – 2015 were dissolved oxygen, phosphates-phosphorus, nitrates-nitrogen, and coliform bacteria. The poor and very poor quality areas were found in estuaries of major rivers, namely, Bang Pakong, Chao Phraya, Tha Chin, and Mae Klong. Furthermore, water quality at Sattahip Pier in the Eastern Seaboard has been in poor condition since 2014. Moreover, main tourism beaches, which included Kai Bae Beach, Trat and Patong Beach, Phuket, have been identified as fair condition since 2014.

Figure 9.2: Coastal Water Quality Trend, 2006–2015.



Source: Pollution Control Department, 2016.

Photo from: TEI

10 Coastal and Marine Ecosystems and Biodiversity

10.1 Key Habitats

10.1.1 Mangroves

The MCRRDI (2015) reported that mangroves are distributed along the coasts of the GoT and Andaman Sea. A total of 81 species of mangrove plants were identified. About 34 species, which were true mangrove consisted of *Rhizophora spp.* as a major species, and other common species, such as *Bruguiera parviflora*, *Bruguiera cylindrical, Bruguiera gymnorrhiza, Ceriops decandra, Ceriop stagal, Xylocarpus moluccensis, Xylocarpus granatum, Avicennia alba, Avicennia marina, Sonneratia caseolaris, Sonneratia alba, Excoecaria agallocha, Acanthus spp.*

Because of its complex structure, the mangroves provide area for shelter, feeding, and nursery grounds for various species and some economically important species. Hence, mangrove forests are an important ecosystem that provide not only ecological benefits for other species but also environmental, economic, and social benefits to human society. In general, mangrove areas of the Andaman coastline are larger than that of the GoT. The largest area is in Phangnga Province (**Table 10.1**).

Table 10.1: Distribution of Mangrove Forest in Thailand in 2014.

Coastal provinces	Mangrove area (km^2)
Gulf of Thailand	
1. Trat	95.56
2. Chantaburi	132.15
3. Rayong	16.31
4. Chon Buri	7.28
5. Chachoengsao	12.14
6. Samut Prakarn	17.03
7. Bangkok	4.04
8. Samut Sakorn	32.62
9. Samut Songkhram	29.20

Table 10.1: Distribution of Mangrove Forest in Thailand in 2014. (cont.)

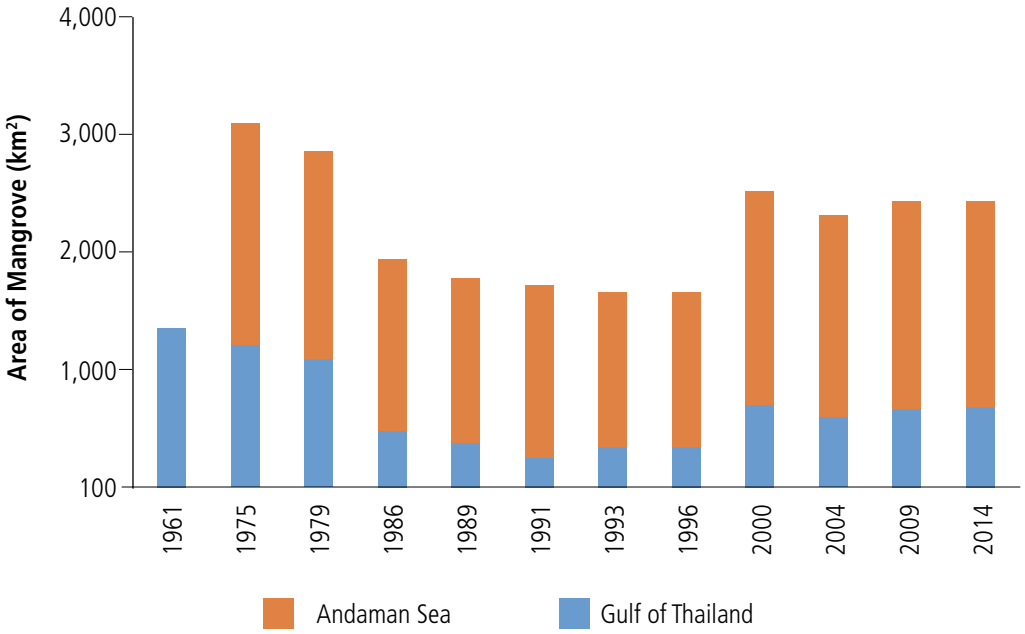
Coastal provinces	Mangrove area (km²)
10. Phetchaburi	23.74
11. Prachuap Khiri Khan	2.41
12. Chumphon	59.20
13. Surat Thani	76.53
14. Nakhon Si Thammarat	129.48
15. Phatthalung	0.71
16. Songkhla	27.49
17. Pattani	27.85
18. Narathiwat	0.12
Andaman sea	
19. Ranong	259.07
20. Phangnga	439.04
21. Phuket	21.51
22. Krabi	341.83
23. Trang	338.60
24. Satun	361.42
Total	**2,455.34**

Source: MCRRDI, 2015b.

Status of mangrove forest

The DMCR reported that during 1961-2014, the number of mangrove areas dwindled, and then later on increased (**Figure 10.1**). During 1961-2007, the mangrove areas in Thailand had dramatically decreased due to encroachment. Statistical data of mangrove areas collected in 1961 showed that the total area was 3,679.0 km^2. However, the surveys and LANDSAT-5 satellite images interpretation in 2007 showed that the remaining mangrove area was 1,675.8 km^2, a decrease of 2,003.2 km^2. The major cause of early mangrove encroachment was the overexploitation of mangroves for charcoal production and tin mining. Later on, mangrove encroachment was mainly for shrimp farming, which caused adverse impacts on mangroves. Other causes include urban and industrial expansion, construction of road, piers and other facilities, and conversion of mangroves into agriculture areas. From 1986, the rate of mangrove encroachment has been gradually decreasing because of the raised awareness among all stakeholders on conservation and rehabilitation of mangrove areas. Mangrove forests increased from 1,675.8 km^2 in 1996 to 2,455.3 km^2 in 2014, about 1.5 times of that in 1996. The increase was mainly because there are a lot of mangrove planting activities carried out by government agencies, private sectors, and NGOs.

Figure 10.1: Mangroves in Thailand.



Source: MCRRDI, 2015b.

10.1.2 Coral Reefs

Coral reefs are important coastal ecosystems providing shelter, feeding, breeding, and nursery areas for many marine organisms. In addition, coral reefs support local livelihoods and national benefits derived from being a popular tourist destination for example. Coral reef ecosystems relate to other types of ecosystems such as seagrass, mangrove, and pelagic ecosystems. Moreover, the ecological functions and services of these ecosystems have always had influences on food security and livelihoods of human society.

In 2015, about 238.3 km^2 of coral reefs in Thailand were reported, consisting of 121 km^2 in the Gulf of Thailand and 117.4 km^2 in the Andaman Sea. Coral reefs in Thailand are distributed in 16 coastal provinces namely, Chantaburi, Chon Buri, Chumphon, Krabi, Nakhon Si Thammarat, Pattani, Phangnga, Phatthalung, Phuket, Prachuap Khiri Khan, Ranong, Rayong, Satun, Songkhla, Surat Thani,

Photo from: DMCR

Trang, and Trat (**Table 10.2**). Approximately 280 coral species were reported in Thai waters (world coral species are reported at about 800) with dominant species of branching corals *Acropora spp.* and massive coral *Porites lutea* (MCRRDI, 2015b).

Table 10.2: Distribution of Coral Reefs in Thailand in 2015.

Coastal provinces	Coral reef area (km^2)
Gulf of Thailand	
1. Trat	28.41
2. Chantaburi	1.23
3. Rayong	5.04
4. Chon Buri	10.36
5. Prachuap Khiri Khan	2.32
6. Chumphon	14.66
7. Surat Thani	57.87
8. Nakhon Si Thammarat	0.66
9. Phatthalung	0.27
10. Pattani	0.13
Andaman Sea	
11. Ranong	4.52
12. Phangnga	41.80
13. Phuket	22.29
14. Krabi	22.46
15. Trang	4.82
16. Satun	21.48
Total	**238.3**

Source: MCRRDI, 2015b.

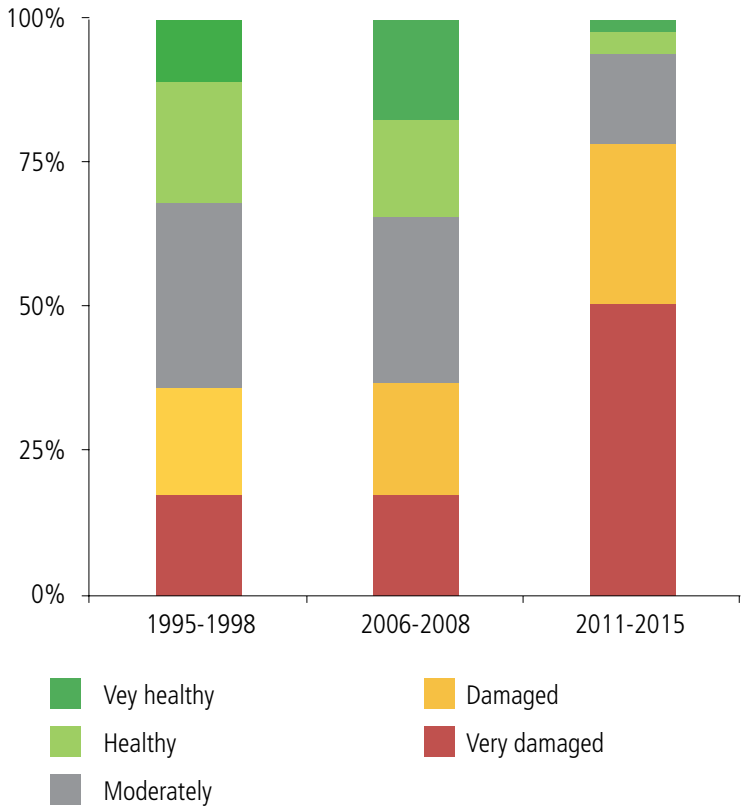
Status of coral reefs

The status of coral reefs in Thailand have been assessed using a proportion of live and dead coral coverage, usually expressed as percentages of total surveyed area. Criteria for assessing reef status are as follows (**Table 10.3**).

Table 10.3: Criteria for Assessment of Coral Reef Status.

Status	Live Coral : Dead Coral
Very healthy	≥ 3 : 1
Healthy	2 : 1
Moderate	1 : 1
Poor/damaged	1 : 2
Very poor/damaged	1 : ≥ 3

Figure 10.2: Status of Coral Reefs in Thailand.



Source: MCRRDI, 2015b.

The coral reef monitoring in the GoT from 1995 to 2015 showed that there is an increasing trend in coral degradation (**Figure 10.3**). Surveys during 2007-2015 showed that 78% of coral reefs were classified as damaged and very damaged, compared to about only 48% during 2006-2008, which is an increase of 30%. Physical damages on coral reefs were caused by various activities, such as tourism, fisheries, pollution, and other coastal development activities.

10.1.3 Seagrass

According to the surveys conducted by the DMCR in 2015, Thailand had 255.7 km^2 of seagrass distributed in 13 coastal provinces in the GoT, and six coastal provinces in the Andaman Sea. The seagrass areas in the GoT and Andaman Sea were 96.3 km2 and 159.4 km^2, respectively (**Table 10.4**). A total of 13 seagrass species were found, with Halophila ovalis and Enhalus acoroides as dominant species.

Table 10.4: Distribution of Seagrass in Thailand in 2015.

Coastal provinces	Seagrass area (km^2)
Gulf of Thailand	
1. Trat	10.16
2. Chantaburi	3.27
3. Rayong	19.08
4. Chon Buri	9.13
5. Phetchaburi	0.05
6. Prachuap Khiri Khan	0.03
7. Chumphon	18.24
8. Surat Thani	28.51
9. Nakhon Si Thammarat	0.24
10. Phatthalung	0.78
11. Songkhla	2.82
12. Pattani	3.76
13. Narathiwat	0.24
Andaman Sea	
14. Ranong	3.64
15. Phangnga	39.55
16. Phuket	9.32
17. Krabi	49.52
18. Trang	52.91
19. Satun	4.47
Total	**255.72**

Source: MCRRDI, 2015b.

Status of Seagrass in Thailand

MCRRDI assessed the status of seagrass in 2012 and 2015. The results are shown in **Table 10.5**. The percentage cover of seagrass in the GoT and Andaman Sea was 2% and 1.6%, respectively. These seagrass areas were heavily degraded due to anthropogenic disturbances. Based on surveys made in 2015, the degradation of seagrass in Thailand was caused by fisheries (trawlers), anchoring, dredging, and sedimentation caused by coastal development. Water pollution and marine debris also affect seagrass. Seasonal and spatial variation of species and their coverage were also observed.

Table 10.5: Status and Percentage Cover of Seagrass in 2012 and 2015.

Status of seagrass in2012	Coverage (%)		Status of seagrass in 2015
	2012	2015	
Healthy (51%–100% coverage)	64.15	14.01	Very healthy(>75% coverage)
	26.98	32.61	Healthy(51%-75% coverage)
Moderate(25%–50% coverage)	9.10	20.29	Moderate(26%-50% coverage)
Poor (>25% coverage)		30.78	Naturally poor (<25% coverage)
		2.08	Poor due to anthropogenic disturbances(<25% coverage)

10.1.4 Beach forest

Photo from: TEI

Beach forest is distributed along the old sandy coasts above the high-tide mark of both mainland and islands in the GoT and Andaman Sea, except the coasts of some coastal provinces, i.e., Chachoengsao, Samut Prakarn, Bangkok, Samut Sakorn, Samut Songkhram. The most abundant beach forest was recorded at Ko Tarutao in Satun Province.

Most plants found in beach forests do not have much economic value. Furthermore, those plants must be able to adapt to tolerate the changing environment. This makes those plants specific to the environment in a certain area, such as the beach pine (*Casuarina equisetifolia*), which is a pioneer plant usually found in new-aged sandy coasts. In the area where beach pine is abundant,

other plants could not grow because there was a lot of fallen pine leaves covering the ground.

Because of the area of beach forest is quite small, it serves only as temporary habitats for some animals, such as the Indian muntjac (*Muntiacus muntjak*), small Asian mongoose (*Herpestes javanicus*), and fishing cat (*Prionailurus viverrinus*), etc. Currently, animals in the beach forest are rare due to beach forest encroachment (MCRRDI, 2015b).

Status of beach forest

In 2014, the beach forests with a total area of 41.4 km^2 were found along sandy beaches of 13 coastal provinces (**Table 10.6**) – two of them were in the eastern GoT, while the rest were in the south of Thailand (Andaman Sea and GoT).

Most beach forests were found along the coasts of Andaman Sea, which are constantly threatened by encroachment from coastal development, such as construction of hotels, restaurants, houses, and piers, etc.

Table 10.6: Distribution of Beach Forests in Thailand in 2014.

Coastal provinces	Beach forest area (km^2)
Guf of Thailand	
1. Trat	0.18
2. Rayong	0.98
3. Phetchaburi	1.36
4. Prachuap Khiri Khan	0.09
5. Surat Thani	2.00
6. Songkhla	3.96
7. Pattani	0.37
Andaman Sea	
8. Ranong	1.88
9. Phangnga	17.39
10. Phuket	1.27
11. Krabi	4.25
12. Trang	7.40
13. Satun	0.23
Total	**41.35**

Source: MCRRDI, 2015b.

10.1.5 Threats to Important Ecosystems

Thailand depends on marine and coastal ecosystems, mainly mangrove forests, coral reefs, and seagrasses.. In Thailand, the utilization of these ecosystems has mainly been driven by national plans and policies, especially the National Economic and Social Development Plans and other sectoral development plans, such as fisheries, industrial, and infrastructure development plans. However, rapid coastal development and unsustainable uses of coastal and marine resources have continuously threatened these ecosystems

Mangrove

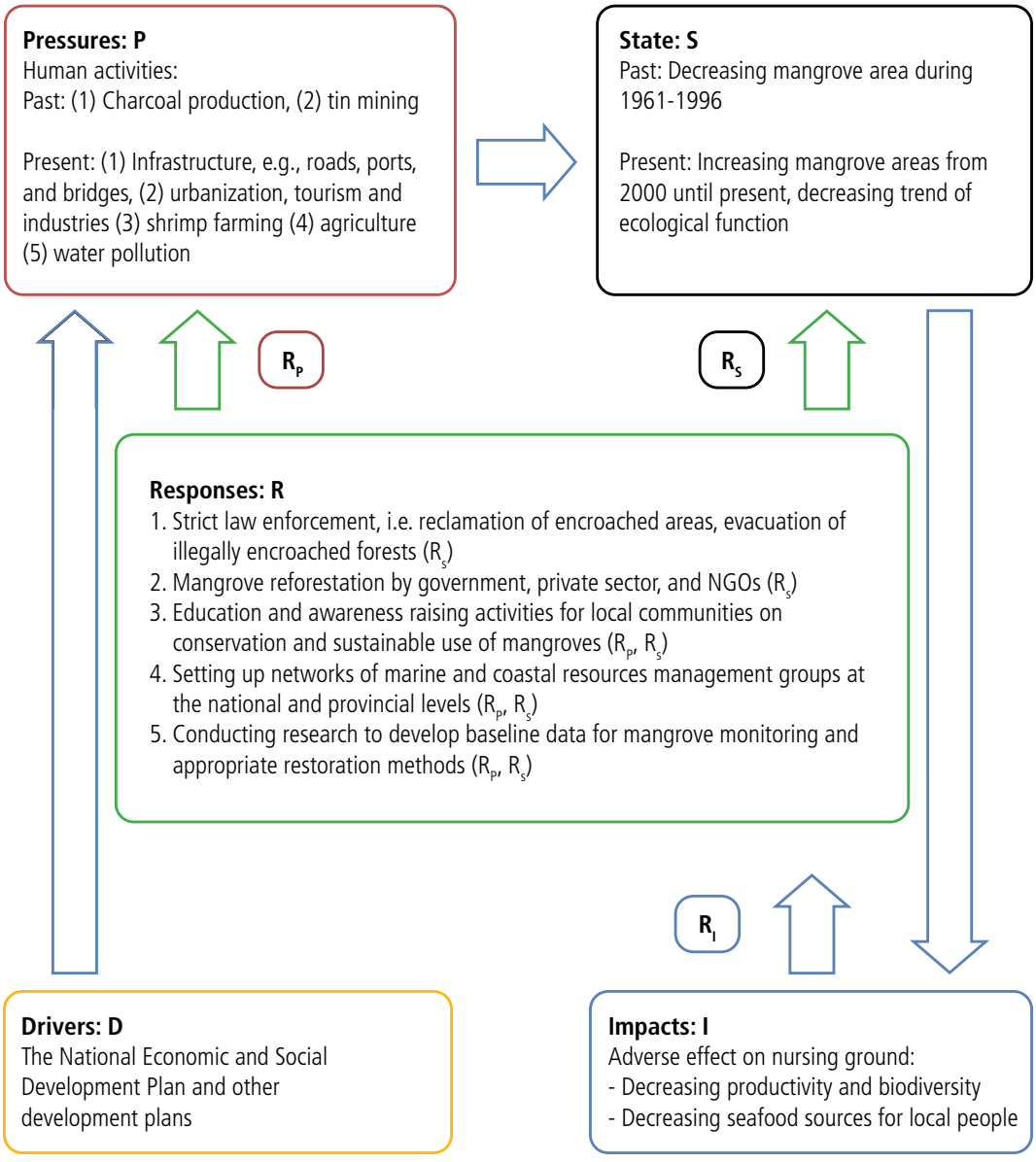
In the past, mangrove encroachment was mainly caused by charcoal production, tin mining, agriculture, and shrimp farming. Later, the increase in population has resulted in rapid urbanization and increase in construction of infrastructure (roads and ports) as well as aquaculture (shrimp), and demand for fish. These activities had dramatically decreased the mangrove area from 1961 to 1986. After that, its decreasing trend slightly improved from 1986 to 1996. In 2000, there was an increase in mangrove areas and this trend continued until 2014. The degradation of mangrove areas negatively affected the environment and consequently human food. For example, loss of mangroves decreased primary productivity, which disturbed the food chain and food web causing a decrease in seafood.

In response to the destruction of mangroves, the following measures have been established (**Figure 10.3**):

1. Strict law enforcement on illegal encroachment of mangrove conservation areas, for example, evacuation of illegally encroached forests, and establishing clear penalties for persons who pollute water resources and discharge solid waste and toxic chemicals into the waters;
2. Rehabilitation and restoration, such as mangrove reforestation and restoration of marine life;
3. Education and awareness raising on conservation, restoration, and sustainable use of mangroves and swamps;
4. Encouraging collaboration with all stakeholders and public participation by setting up networks of local communities, private sectors, and NGOs; and
5. Conducting research to develop baseline data on the composition of mangroves and appropriate restoration methods.

Photo by: M.Ebarvia

Figure 10.3: DPSIR Framework: Mangrove



Coral Reef

There is an increasing trend of coral degradation in Thailand (**Figure 10.4**). In the past, coral degradation was mainly caused by illegal fishing such as dynamite and cyanide. However, recently, the main driver of coral reef degradation is tourism. The government's promotion of tourism has caused an increase in tourist numbers and activities, such as diving and snorkeling in coral reefs in Thailand. Such tourist activities cause both direct and indirect impacts on coral reefs.

Examples of tourist activities are boat anchoring and reef trampling by snorkelers and scuba divers. Illegal fishing, such as bottom trawlers and push nets, also cause physical damage to coral reefs. Another important cause of coral reef destruction is marine debris from both land-based activities (e.g., improper disposal and treatment of solid wastes) and sea-based activities (e.g., fishing boats, tourist boats, ferries, ports, and merchant ships). Examples of marine debris are abandoned trawl nets, which covered the reefs and destroyed the corals by fragmenting or bleaching.

Good seawater quality is principally needed for living organisms including coral reefs. Increase in temperature, suspended solids and pollutants (nutrients, pesticides and heavy metals) create adverse impacts on coral reefs. Untreated wastewater discharge from land-based activities often passes through the river and empties into the sea, affecting the coastal water quality. Wastewater discharge from sea-based sources, such as tourist and recreational boats, can lower water quality, particularly in enclosed bays with limited water circulation. Similarly, exploration and production of oil and gas as well as shipping operation may discharge pollutants from their routine operation or oil spill caused by accidents. Although, the oil spill often happens in the offshore areas, they could still be carried to the coast by waves, currents, and reefs. Oil pollution could affect coastal water quality and cause significant damage to coral reefs.

Another negative impact on coral reefs is the reduction of light in water columns above coral reefs, as coral need light for photosynthesis. Reducing light penetration into the water is mainly caused by sedimentation. Urbanization, increasing coastal tourism, and construction of roads, ports, hotels, restaurants, and other facilities increase sedimentation loads into coastal water where corals live.

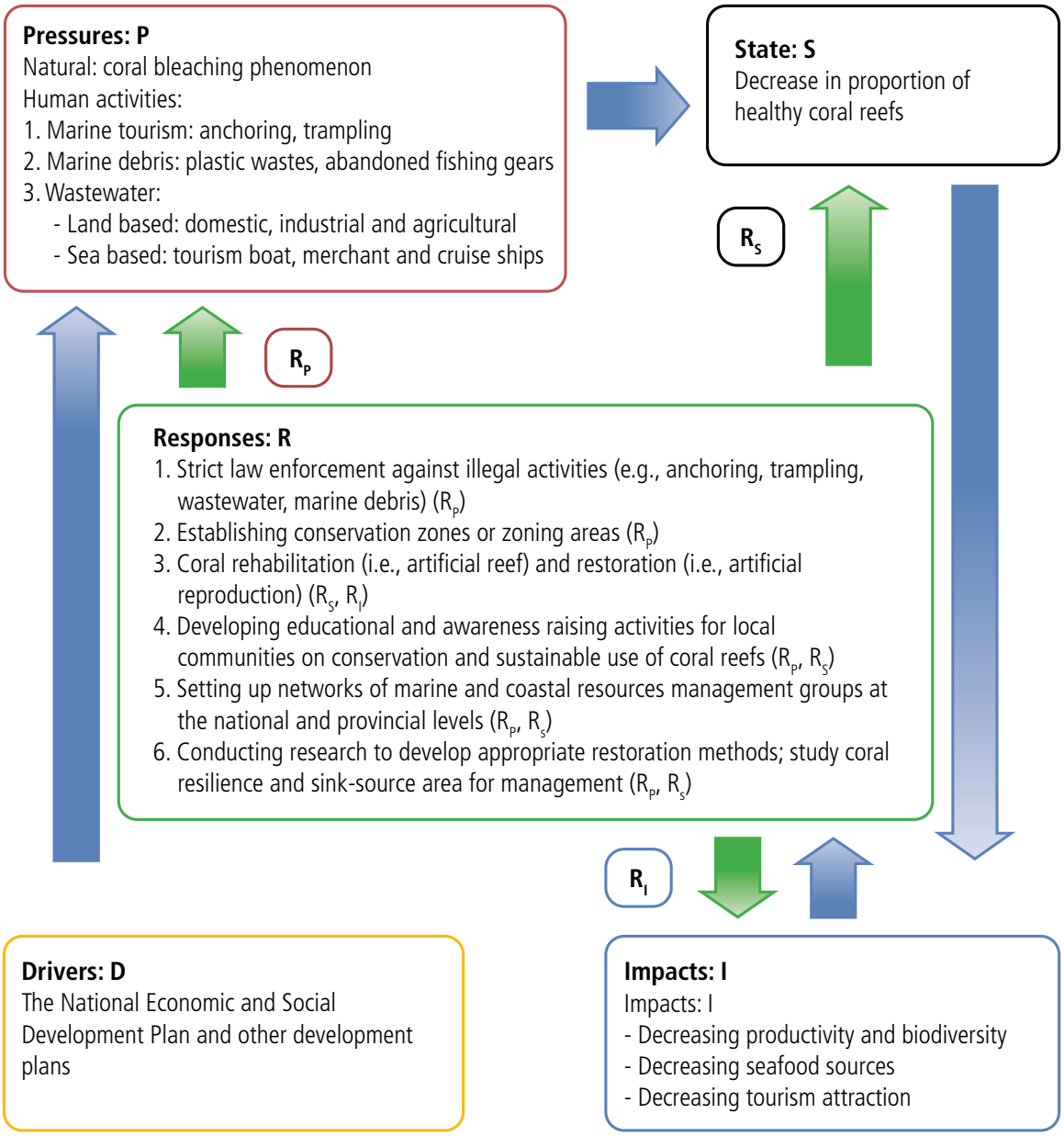
In response to the destruction of coral reefs, the following measures have been established:

1. Establishing law enforcement measures to minimize the impact from marine tourism, industry, and coastal development. Clear penalties should be set up for illegal activities, such as illegal fishing, waste dumping and discharging at sea, waste from ship dumped into the sea, etc. In addition, tourists and other coral reef users should be responsible for supporting implementation of reef conservation projects, such as coral reef restoration and reef cleaning activities;

2. Conserving and restoring coral reefs by increasing reef areas with various methods, such as conducting sexual or asexual reproduction of corals, establishing artificial reefs, and providing substrates for coral recruitment. A monitoring programme must be established to evaluate effectiveness and success of these activities;
3. Educating and raising awareness for local people and other resource users on importance of coral reef conservation;
4. Establishing conservation zones, tourism zones, etc. (marine spatial plan; coastal use plan; zoning scheme);
5. Building collaboration among all stakeholders and public participation by setting up networks of local communities, private sectors, and NGOs to promote coral reef conservation, monitoring, and sustainable uses of coral reefs; and
6. Conducting research in various aspects of coral reef utilization and management including carrying capacity of coral reef areas.

Photo from: TEI

Figure 10.4: DPSIR Framework: Coral Reefs.



Seagrass

Seagrass beds in Thailand (**Figure 10.5**) have been degraded due to human activities, mostly fishing and aquaculture, especially in some areas in Surat Thani Province where shellfish culture has been operating in seagrass beds. In addition, various activities, such as coastal agriculture, coastal urbanization, and industries discharge untreated wastewater into the sea. Coastal construction also causes sediments that can deteriorate seagrasses.

About 2% of seagrass in 2015 was in poor condition mainly due to physical damage to seagrass beds. Local fishermen normally used dredging to fish for bottom-dwelling species, particularly economically important species, such as blue swimming crabs and wing shells. The local, long-tailed boats anchoring in seagrass beds often cause damage. Another threat to seagrass is sedimentation. It reduces light penetration into the water above the seagrass and covers the seagrass meadow in cases of exceeding sedimentation. Although the nutrient from the bottom soil and water sustain seagrass life in the short term, the photosynthesis is necessary for long term survival. Sedimentation is caused by urbanization and construction of roads, ports, and other facilities in the coastal zone. In addition, oil spill incidents affect seagrass by reducing photosynthesis of seagrass, as well as contact with oil and cleanup chemicals.

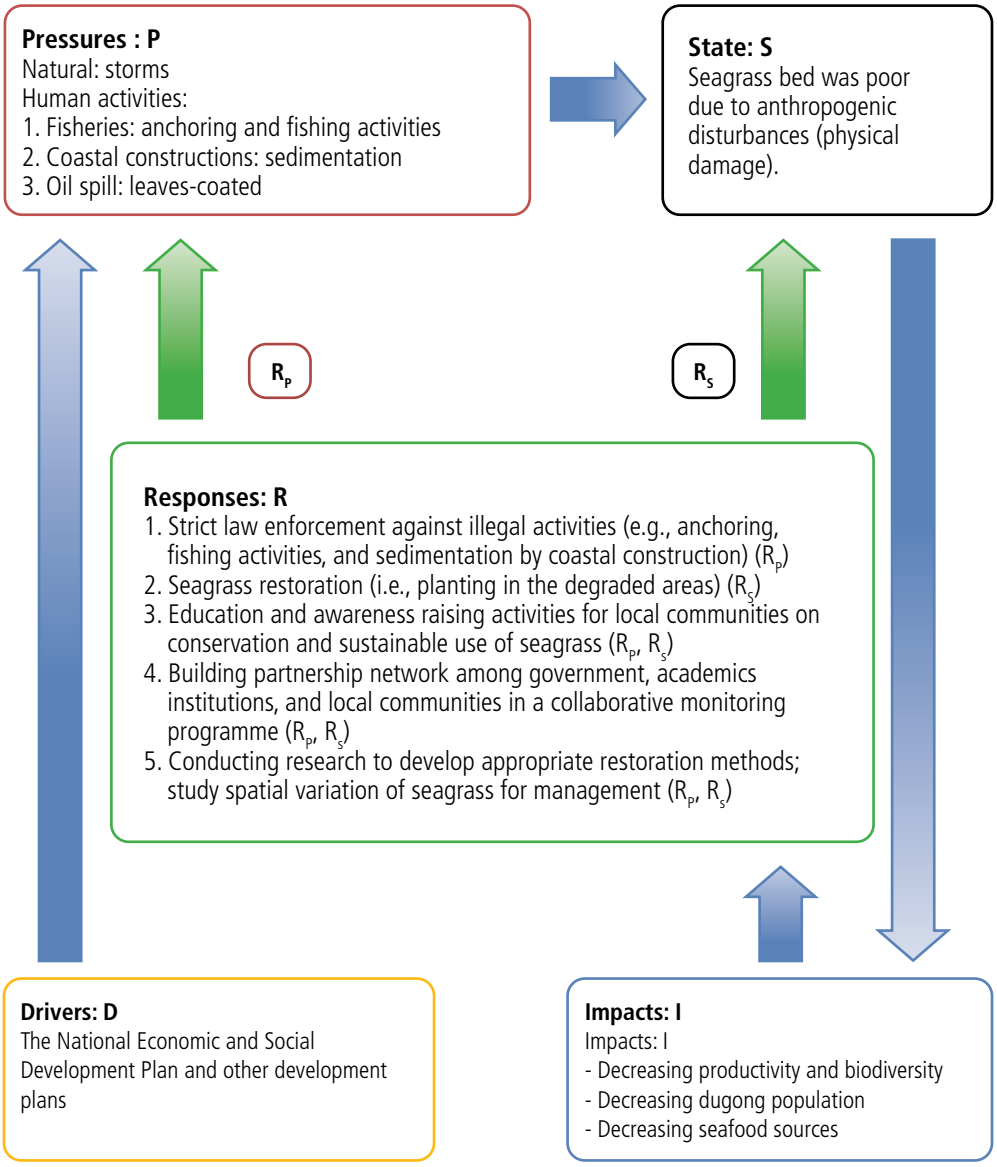
Moreover, land-based or sea-based marine debris affects seagrass meadows. Most of seagrasses were found in the intertidal zone where currents could trap the marine debris at the beds. Marine debris, such as the microplastics, impact organisms in the seagrass ecosystem. Miroplastics were found in the stomach of the benthic fauna.

Degradation of seagrass beds leads to environmental consequences, such as decline in abundance and biodiversity in the seagrass ecosystem. Dugongs that inhabit seagrass beds are one of the protected wild animals of Thailand, according to the Wild Animal Reservation and Protection Act of 1992. The degradation may also have an impact on food security as illustrated by cases of declined populations of wing shells in seagrass beds due to sedimentation.

In response to these pressures, the following priority measures were implemented:

1. Establishing measures to control any activities that cause impacts on coral reefs, such as sediment dredging; and law enforcement should be strictly and continually performed by the responsible agencies;
2. Conserving and restoring seagrass beds by promoting and supporting conservation and protection, such as seagrass plantation and transplantation;
3. Establishing zones for different utilization, e.g., conservation zones and tourism zones, and installing signs or floating marker buoys to indicate the boundaries as well as publicize the zoning scheme to relevant resource users, such as tourists, tourist operators, and fisheries;
4. Education and awareness raising among local people and other resource users about the impacts and sustainable use of seagrass beds;
5. Building collaboration among all stakeholders and public participation by setting up networks of local communities, private sectors, and NGOs to promote, conserve, and monitor seagrass beds, and to enhance public participation in formulating policies and plans for seagrass conservation; and
6. Conducting research in various aspects on seagrass conservation and restoration.

Figure 10.5: DPSIR Framework: Seagrass.



10.2 Rare, Threatened, and Endangered Species

There is a growing concern on species extinction globally. Various species are being threatened due to habitat loss and degradation. According to the current assessment of the IUCN, out of 71,576 species evaluated worldwide, 21,286 species were being threatened. Of this number, 799 species were totally extinct. About 4,286 species were critically endangered; 6,451 species were endangered; and 10,549 species were found vulnerable.

In Thailand, the Office of Natural Resources and Environmental Policy and Planning (ONEP) evaluated threatened species based on the guidelines of the Red List of Threatened Species (IUCN Ver. 3.1:2001). Based on the IUCN Red List, to date, about 611 were evaluated as threatened species as shown in **Table 10.7**.

Table 10.7: Threatened Species in Thailand.

Taxonomic groups	Number of species
Mammals	57
Birds	54
Reptiles	28
Amphibians	3
Fishes	106
Molluscs	15
Other invertebrates	196
Plants	152
Fungi and Protists	0
Total	**611**

Source: IUCN Red List Version 2017-1; Last Updated: 04 May 2017.

There are 23 marine species in the IUCN Red List, of which 9 are mammals (critically endangered: 3, endangered: 2, and vulnerable: 4), 4 are reptiles (critically endangered: 4), and 10 are fish (critically endangered: 4, endangered: 3, and vulnerable: 3). There are 152 species of migratory wild birds in Thailand, of which 21 species are seabirds and wetland birds. There are 13 species that are critically endangered, 4 species that are endangered, and 4 are vulnerable. (**Table 10.8**).

Table 10.8: Thailand Red List Data: Marine Species (2003).

Species	Critically Endangered (CR)	Endangered (EN)	Vulnerable (VU)
Marine mammals	Dugong Ginkgo-toothed beaked whale Irrawaddy dolphin	Bryde's whale Fin whale	Bottlenose dolphin Long-beaked common dolphin Humpbacked dolphin False killer whale
Reptiles	Green turtle Hawksbill sea turtle Narrow headed soft-shell turtles Saltwater crocodile	-	-
Fish	Knife-tooth sawfish Small-tooth sawfish Green sawfish Bowmouth guitarfish	Tiger shark Napoleon fish Guitar fish	Giant catfish Nurse shark Sleepy shark
Bird*	Spoon-billed sandpiper Great thick-knee Beach thick-knee Brown noddy Milky stork Asian woollyneck Storm's stork Adjutant great-billed heron Christmas island frigatebird Chinese crested tern Great crested tern Black-bellied tern	Far Eastern curlew Nordmann's greenshank Great knot Malaysian plover	Indian skimmer Brown booby Chinese egret Grey-throated sand martin

Source: Avibase and Nature Trails [available on April 9, 2018]

On 20 June 2015, MCRRDI, DMCR proposed 15 rare and endangered marine species to be enlisted as preserved and protected wildlife according to the Wildlife Preservation and Protection Act of 1992. They are :

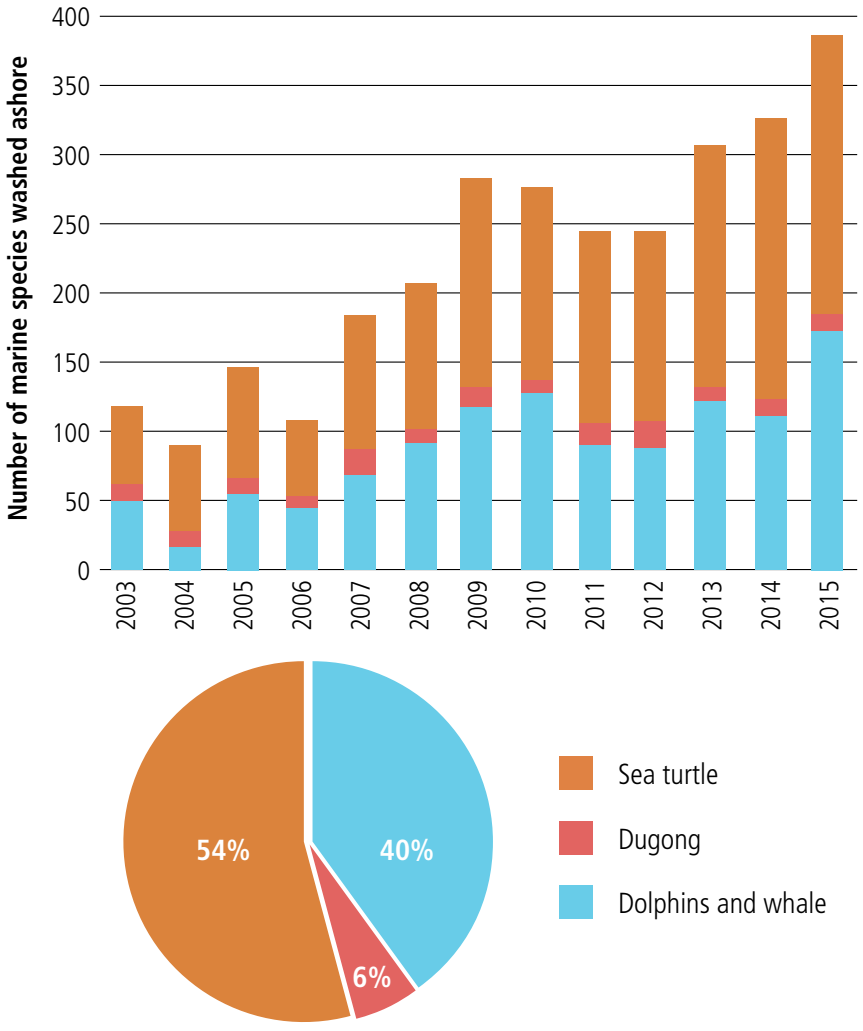
1. Proposed marine species to be enlisted as preserved wildlife:
   1.1 Bryde's whale, *Balaenoptera edeni*;
   1.2 Omura's whale, *Balaenoptera omurai*;
   1.3 Leatherback turtle, *Dermochelys coriacea*; and
   1.4 Whale Shark, *Rhincodon typus*.

2. Proposed marine species to be enlisted as protected wildlife:
   2.1 Giant manta ray, *Manta birostris*;
   2.2 Reef manta ray, *Manta alfredi*;
   2.3 Shortfin devil ray, *Mobula kuhlii*;
   2.4 Japanese devil ray, *Spinetail mobula*; *Mobula japanica*;

2.5 Bentfin devil ray, *Mobula thurstoni*;
2.6 Pygmy devil Ray, *Mobula eregoodootenkee*;
2.7 Largetooth sawfish, *Pristis pristis*;
2.8 Narrow sawfish, *Anoxypristis cuspidata*;
2.9 Green sawfish, *Pristis zijsron*;
2.10 Smalltooth sawfish, *Pristis pectinata*; and
2.11 Shark ray, *Rhina ancylostoma*.

According to the report on the status of marine and coastal resources in 2016, there was an increasing number of rare marine species (sea turtles, dugongs, dolphins, and whales) that were washed ashore during 2003-2015. The total number of marine mammals and reptiles washed ashore in 2015 were 345; 54 % of which were marine turtles, followed by dolphins and whales (40 %) and dugongs (6 %). This reflects that marine mammals and reptiles are at risk of becoming endangered in the future (**Figure 10.6**).

Figure 10.6: Number of Marine Rare Species Washed Ashore during 2003–2015.

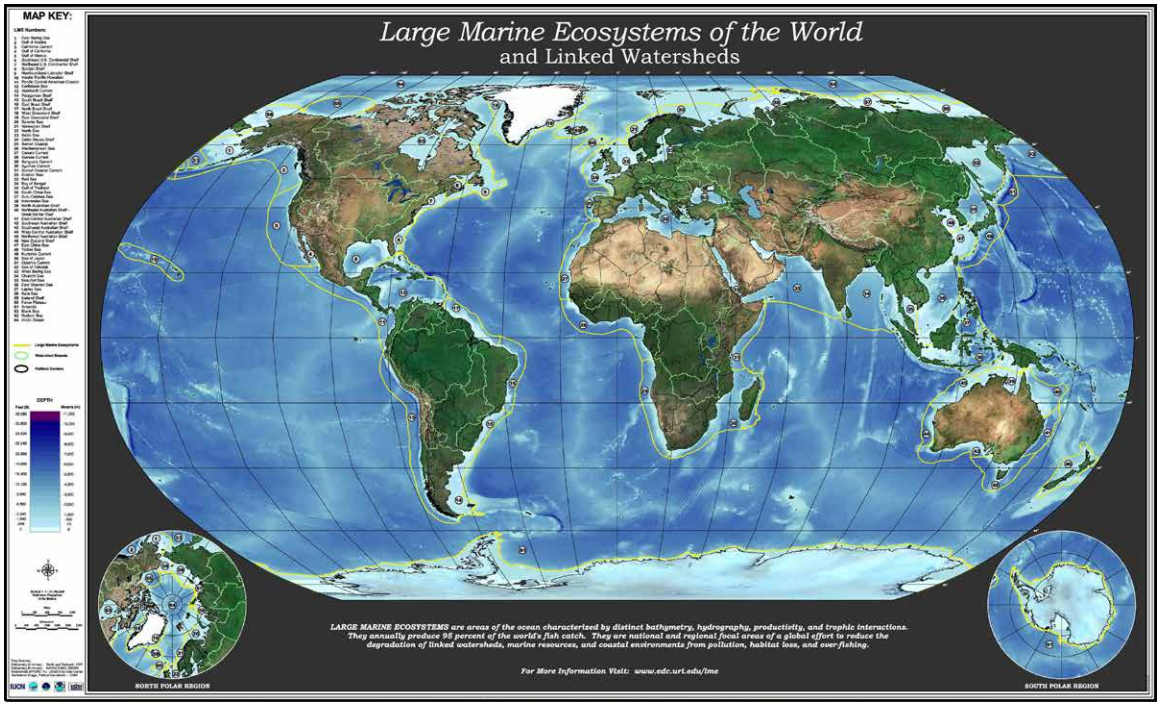


Source: DMCR, 2016.

10.3 Large Marine Ecosystems

Large marine ecosystems (LMEs) are areas of the world's oceans located around the margins of the continents. LMEs harbour various ecosystems that provide various ecological functions and important benefits, called ecosystem services, such as provisioning, regulating, supporting and cultural services.. They play crucial roles in the global primary productivity and biogeochemical process as well as carbon sequestration and climate regulation. So far, a total of 66 LMEs were recognized across the world (**Figure 11.7**). In central and southeast Asia, the Bay of Bengal and the GoT are among the LMEs.

Figure 10.7: Large Marine Ecosystems of the World.



Sources: https://celebrating200years.noaa.gov/breakthroughs/ecosystems/lme_map.jpg, accessed 27 May 2017.

As LMEs cover sea areas of many countries, the LME concept is applied as a collaborative approach for promoting and enabling ecosystem-based management, especially in the transboundary area and ecologically-bounded transnational areas. Several millions of people around the world depend on the natural living resources of LMEs for food, income, recreation, and other less tangible benefits like spirituality and inspiration. (IOC-UNESCO and UNEP, 2016; BOBLME, 2015).

10.3.1 Gulf of Thailand

General Characteristics


Photo by: M.Ebarvia

The Gulf of Thailand (GoT) is a semi-enclosed sea located in the west Pacific (west of the South China Sea), surrounded by four countries of Southeast Asia, i.e., Cambodia, Malaysia, Thailand, and Viet Nam. The boundary of the gulf is defined by the line from Cape Camau (Cape Bai Bung) in southern Viet Nam (just south of the mouth of the Mekong River) to the city of Kota Bharu on the eastern peninsular Malaysian coast. GoT is approximately 320,000 km² with a mean depth of about 45 m and maximum depth of only 80 m.

The GoT can be divided into two portions: inner Gulf (IGoT) and outer Gulf. The inner Gulf, located at the innermost area, has an inverted U-shape. This portion is the catchment basin of four large Thai rivers on the northern side, namely Bangpakong, Chao Phraya, Thachin, and Mae Klong rivers. The Chao Phraya River has the biggest volume transport in this area, with an average runoff per year of 13.22 km^3 x 103 km^3. On the west side, Phetchaburi River is also an important source of freshwater flowing into the GoT. Therefore, a large amount of nutrients and sediment is discharged from these rivers, resulting in high primary productivity in the GoT (Piyakarnchana et al., 1990). The GoT is considered as Class I, highly productive ecosystem (>300 $g^C m^{-2} yr^{-1}$). Nutrient content and dissolved oxygen levels vary seasonally in the inner Gulf. Most nutrients, except nitrate, are higher, while dissolved oxygen concentration is lower in the rainy season. Peaks of phytoplankton densities coincide with the rainy season. High nutrients lead to the phytoplankton bloom phenomena (Piyakarnchana, 1989).

The *GoT front* is located at the entrance to the Gulf. It is largely a salinity front between low-salinity waters of the GoT because of dilution by the Mekong River outflow and the seawaters of the South China Sea. The difference in salinity between the Gulf waters and the South China Sea waters varies seasonally and inter-annually, depending on the Mekong River outflow and the South China Sea circulation that carries Mekong River waters into the Gulf. The salinity difference can be up to three (3) Practical Salinity Unit (PSU) across the front. The monsoon can be an important factor for controlling the front's seasonal variation because the Mekong River outflow mainly depends on monsoon seasons. Seasonal variability of vertical stratification is a significant factor for regulating the thermal regime in the GoT. Stratification is well developed in spring owing to strong surface heating and weak winds. The Mekong River outflow may also affect stratification over most of the Gulf. The mean circulation in the Gulf may be forced by the South China Sea as

a phenomenon observed during the Northeast monsoon when water mass of the Mekong River flows into the outer Gulf. Counter clockwise eddies in the inner Gulf and the west Gulf entrance were associated with upwelling in the area. Seasonal geostrophic currents exhibited a basin-wide counter clockwise circulation during the southwest monsoon and a clockwise circulation during the northeast monsoon. (Refer to Annex 2 for more details on the oceanographic and biological features of the Bay of Bengal.)

10.3.2 Bay of Bengal

General Characteristics

The Bay of Bengal (BOB) is the largest bay in the world, with waters flowing straight out of the Himalayas through Bangladesh. Its shape is roughly triangular and is bordered by Bangladesh to the North, Myanmar and Thailand to the East, and Sri Lanka and India to the west. It has an area of 2,172,000 km^2, with many large rivers discharging to the bay. The BOB, especially along the coastal water, has high productivity of more than 300 $g^C m^{-2} yr^{-1}$ resulting from a large amount of nutrient input from rivers (Dwivedi, 1993) (Refer to Annex 2 for more details on the oceanographic and biological features of the Bay of Bengal.)

10.3.3 Threats

According to the Transboundary Diagnostic Analysis for the South China Sea and the GoT, and the Bay of Bengal (Talaue-McManus, 2000 and BOBLME 2012a,b), these LMEs are faced with two key issues or threats: 1) overexploitation of living aquatic resources; and 2) pollution of aquatic environments.

1. Overexploitation of living aquatic resources and habitat degradation

Various marine living aquatic resources, especially migratory fish and other marine species, were distributed among countries in the GoT and BOB. In the GoT, transboundary fisheries resources have been heavily exploited through several mechanisms. The key threats from fisheries have been categorized by Thailand's National Fisheries Committee, which included the problems of over-capacity and over-exploitation, use of destructive and/or unsustainable fishing gear and practices, and IUU fishing (SEAFDEC/UNEP/GEF, 2014).

Over-capitalisation and over-exploitation result from the use of subsidies and the dependence of coastal communities on fish resources for income as well as food and nutritional security. The major cause of over-exploitation in fisheries resources is a rapid increase in the number of fishing vessels and total engine capacity, and development of fishing gear technology. These factors contributed to an increase in landings, but catch per unit of effort (CPUE) has declined significantly, especially from 1961 to 1990. During this period, an early decline in the abundance

of demersal fish in the area occured during a time of heavy fishing pressure that coincided with the introduction of trawling and then purse seining in Thailand. The CPUE then plateaued out at a level that is now only 9% of the original CPUE (DOF, 2015). Most catch consisted of low value fish, as the demand from a heavily protected local fishmeal industry is at least partly responsible for the continued exploitation of an otherwise uneconomical fishery. A significant portion of the trash fish catch that consists of juveniles of important species were also reported (DOF, 2015).

The use of destructive and/or unsustainable fishing gear and practices occur across various habitat types in the GoT, especially the use of destructive fishing gears in coastal waters. Inshore trawls and push netting generally cause by-catch issues and considerable impacts on habitats. The catches are largely composed of juvenile marine species with lots of by-catch. Push nets extensively operate in coastal areas where seagrass beds and soft-bottom habitats are found, resulting in the destruction of these habitats. Although blast fishing and poisons have been illegal, these are still being done in some areas in the GoT, threatening marine species and habitats, especially coral reefs. The effects of blasting on the physical structure of coral communities are swift and direct, while taking too many coral reef fish may also affect coral reef dynamics and reef fish community. Illegal, unregulated, and unreported (IUU) fishing relate to the use of illegal and destructive fishing gear in the GoT. In addition, illegal encroachment of foreign fishing vessels into national waters is one of the issues of transboundary fisheries management in this region.

Some examples concerning the heavy exploitation of the shared fisheries resources are that the fisheries of small pelagics and tunas have also been shown retrospectively with catches reaching stable peaks, followed by a change in species composition of the fishery (Yanagawa, 1997, Peckham, 1995). The loss of marine biodiversity related to by-catch is an emerging issue in marine conservation as well as the high by-catch of commercial operations. FAO (1997) discussed the sources of wastage in fisheries. In general, wastage is composed of discards at sea and post-harvest losses. Thus, damaged target species and by-catch make up discards. Moreover, the classification of target versus non-target species is highly variable with species being classified as one or the other, depending on preferences and seasonality of market demands (Talaue-McManus, 2000).

Similar to the GoT, the overexploitation of marine living resources has been recognized in the BOB (BOBLME, 2012a,b). It could cause the declining coastal fishery resources; change in species composition; high proportion of juvenile fish caught; and change in marine biodiversity. The major threats include excessive fishing effort and overcapacity, destructive fishing methods, unselective fishing practices and gear, and IUU fishing.

In the Andaman Sea, the catch rate in Thai waters also declined steadily in the 1960s and the catch rate in 2014 was only about 25% of the 1966 value (DOF, 2015). Many of the marine living resources in the BOBLME are targeted and shared by several BOBLME countries. Fishing in one country affects the availability of stocks in another. Large pelagic species, such as tunas and billfishes, are important fisheries resources migrating and inhabiting a vast range of ocean

space and migrate through many countries both inside and outside the BOBLME. Smaller pelagic species, such as anchovies, herrings, mackerels, and shads, usually migrate through the coastal waters along the coast of the BOBLME countries. For example, hilsa shad is shared by many countries, especially in the waters of India, Bangladesh, and Myanmar. Indian mackerel is found in all countries, while the exploitation of sharks has become a global and regional conservation issue.

Some local resources are also important in terms of the transboundary issues. Some marine species, such as reef fish, lobsters, sea cucumbers, and corals, generate larvae that are dispersed to other transboundary areas. Tropical lobsters (*Panulirus spp.*), for instance, have a pelagic larval lifespan that may last from 4 to 12 months; during this period the larvae may travel many kilometres from the place of birth to the place of adult settlement. In terms of coral reefs, Myanmar has some of the region's most pristine reefs, but reef status is difficult to determine due to a lack of baseline information. Some reefs in Myanmar have been hypothesized to be important sources of coral larval supply for the coral reefs in Mu Ko Surin, the Andaman Sea, in Thailand. However, there are growing concerns that the prevalence of destructive fishing, such as trawling and long-line fishing near reefs, and blast fishing, is increasing rapidly. This may have impacts on the coral dynamics and resilience in the related reefs (BOBLME, 2012a).

2. Pollution of aquatic environments

Pollution is transboundary in nature since some of the pollutants can be transported and carried over long distances, resulting in the widespread impacts at both regional, and global scale (Tiquio et al., 2017 and Hildering et al., 2009). Both LMEs (GoT and BOB) have similar transboundary pollution issues including sewage-borne pathogens, organic load from sewage and other sources, marine debris, increasing nutrient inputs, oil pollution, persistent organic pollutants (POPs), persistent toxic substances (PTSs), and some heavy metals (Talaue-McManus, 2000 and BOBLME, 2015a,b).

Water pollution occurs seasonally and most of the cases occur locally. Land-based sources play a major role in generating the water pollution. Sewage can be generated from municipalities, industries, and the tourism sectors. Discharge of untreated wastewater from ships, fishing boats, piers/ports, and aquaculture also degrades coastal water quality. Successful measures are required to address these issues in each country and within the region.

In the GoT, transportation of crude oil has increased because of oil production in the Gulf region, and an ever-growing demand for oil by neighbouring countries. Oil spill incidents have occurred through the years. A total of 221 incidents of oil spill occured from 1973 to 2012 in coastal areas, rivers, and channels of many provinces in Thailand. Crude oil contains some toxic substances, which cause health effects on plants, animals, and humans within the areas where the oil spill occurred and dispersed. Both petroleum and non-petroleum oil can affect certain marine species and wildbirds, and important habitats, such as coral reefs, sandy beaches, tidal flats, mangroves,

seagrass beds, river, and freshwater habitats (USEPA, 1999). Oil contamination may persist in the marine environment for many years after an oil spill. Bioaccumulation of hydrocarbons in the tissues of marine organisms, especially benthic animals, such as bivalves, gastropods, crustaceans, etc., is a major issue.

Marine debris is one of emerging issues that the society is paying attention to. Plastics show a major component of marine debris, which can be globally distributed across all oceans. Because of its properties of buoyancy and durability and the absorption of toxicants, plastics are likely to cause adverse impacts on marine ecosystems (Mato et al., 2001; Teuten et al., 2007; and Eriksen et al. 2014). Plastics are also weathered and degraded into plastic fragment, called microplastics, which are dispersed in the oceans as well as accumulated in biota, sediment, water column, etc. (Barnes et al., 2009). Discarded/abandoned fishing gears have been a concern as a ghost fishing issue that may cause impacts on mortality of marine species (Putsa et al., 2016 and Stelfox et al., 2016). Those plastics and discarded/abandoned fishing gears can be transported long distances in the marine environment and are clearly a major transboundary issue. Other components of solid waste tend to remain localized near their source (BOBLME, 2012a). The data on abundance and weight of floating plastics are still limited in most countries, including Thailand.

10.3.4 Responses and Regional Collaboration

To deal with the issues on over-exploitation of living aquatic resources and habitat degradation, Thailand initiated several mechanisms, such as improvement of institution arrangement, joining the regional collaboration project as well as some international treaties and conventions.

Thailand has endorsed strategic action plans (SAP) initiated under two regional projects: the *Reversing Environmental Degradation Trends in the South China Sea* and GoT (UNEP/GEF/SCS) and *The Bay of Bengal Large Marine Ecosystem Project* (BOBLME). The SAPs were developed by compiling and integrating information from transboundary diagnostic analysis (TDA) and the national action plans (NAP), which were prepared by countries participating in the projects. The SAP under the UNEP/GEF/SCS Project aims to establish effective strategies to conserve and restore key marine and coastal resources including mangroves, seagrass beds, coral reefs, coastal wetland, and fish habitats and stocks. The SAP also focuses on creating regional collaboration and partnership to address environmental problems of the South China Sea and the GoT, covering the establishment and management of a regional database and data exchange system, regional prioritisation of environmental issues, and public awareness and education (UNEP, 2008). Similarly, a SAP was developed under the BOBLME Project aiming at sustainably managing fisheries and other living marine resources, restoring and protecting degraded and vulnerable habitats, controlling coastal and marine pollution and water quality, and addressing social and economic constraints to enhance resilience and empowerment of coastal people (BOBLME, 2015).

More importantly, Thailand has been paying great attention to the combat of IUU fishing. Several key legal instruments (Fisheries Act of 2017 and related regulations and notifications) have been enacted in order to conserve, preserve, protect, and manage fish stocks and their habitats. The DOF developed the *Thailand National Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing 2015-2019* (NPOA-IUUA) and the *National Policy for Marine Fisheries Management 2015-2019*, in which the key principles of good governance, cross-sectoral integration, adaptive management, and precautionary approach were applied (DOF, 2015). Moreover, they also established their implementation strategies during 2017-2021 which complied with international measures and practices, including SDGs, United Nations Convention on the Law of the Sea 1982 (UNCLOS), FAO Code of Conducts and Guidelines, Agreement for the Implementation of the Provision of the UNCLOS relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UNFSA), other measures established by global and regional fisheries organisations, such as the Indian Ocean Tuna Commission (IOTC), Western and Central Pacific Fisheries Commission (WCPFC), and Southern Indian Ocean Fisheries Agreement (SIOFA) (DOF, 2016).

The concept of **fisheries refugia** was developed and applied in the South China Sea and the GoT aiming at identifying and designating priority areas in which fisheries and habitat management are highly required. The overall project objective is to promote the collective management of transboundary water systems through catalyzing multi-state cooperation to rebuild marine fisheries (Paterson et al., 2013). In the BOB, the project, "*Sustainable Management of the Bay of Bengal Large Marine Ecosystem Programmememe*", was launched under the BOBLME Bangladesh in which India, Indonesia, Malaysia, Maldives, Myanmar, Sri Lanka, and Thailand are partners. The project is funded by GEF and led by FAO aiming at contributing to sustainable management of fisheries, marine living resources and their habitats in the BOB region for the benefit of coastal states and communities through several ecosystem-based activities.

The project on "*Trans-boundary dolphin conservation along the coastline of Thailand and Cambodia*" was implemented during 2015-2016. The project was funded by the Swedish Postcode Lottery and coordinated by the International Union for Conservation of Nature (IUCN). The project partners included DMCR, the Ministry of Environment of Cambodia, the Fishery Administration of Cambodia, and the provincial and local administrations. This project aims to enhance protection of the remaining populations of four dolphin and porpoise species in their marine habitat along the Thai-Cambodian border by improving fishing practices, addressing habitat degradation and pollution, strengthening local dolphin conservation networks, and sharing local knowledge and experience on dolphin conservation. It also aims to link dolphin conservation to sustainable local livelihoods by developing ecotourism and other livelihood opportunities. The project contributes several key outputs, such as (a) improved practices of local fishing communities, including enhanced spatial planning that identifies dolphin conservation areas, and (b) advancement of research and surveys on dolphin populations, migration patterns, causes of death, and threats to their habitats. Strengthened local dolphin conservation networks

in Trat, Thailand and in the Peam Krasop Wildlife Sanctuary and adjacent areas in Cambodia are in place. Knowledge and experience on dolphin conservation and coastal livelihoods are shared with local communities, enhancing their capacity to support dolphin conservation efforts. With the local dolphin conservation network, and the knowledge and conservation capacity developed in local communities, an appropriate dolphin watching tourism pilot was developed through collaboration with local administrations to ensure its sustainability (IUCN, https://www.iucn.org/regions/asia/our-work/regional-projects/trans-boundary-dolphin-conservation).

In terms of transboundary issues regarding oil pollution, Thailand ratified key IMO Conventions (e.g., MARPOL Annexes I and II, OPRC, CLC and FUND) as well as enacted corresponding national laws to implement the obligations under these international agreements, and strengthen oil spill preparedness and response. An example of a subregional agreement is the *Joint Statement on Partnership in Oil Spill Preparedness and Response in the Gulf of Thailand*. The Joint Statement was initiated by PEMSEA and signed on January 12, 2006 in Hanoi by Cambodia, Thailand, and Vietnam. This coordination mechanism aims to build the capacity of the three littoral states in the GoT in planning and response to oil spill incidents, thereby reducing the environmental impact on coastal and marine environment as well as clean-up costs and efforts. The Marine Department, Ministry of Transport is the National Contact Point in Thailand for the partnership. A valuable tool for supporting oil spill response in the GoT is the *Environmental Sensitivity Index (ESI) Atlas for the Gulf of Thailand*, which was supported by IMO, KOICA, and PEMSEA, and collaboratively developed by experts from the three littoral countries (PEMSEA, 2013). The ESI Atlas is being used as reference during the conduct of national oil spill response exercises.

In addition to the academic institutions, DMCR, in collaboration with other relevant agencies, play an important role in addressing the problems on marine debris, especially the policy formulation. Since marine debris pollution is one of the transboundary issues, the DMCR has collaborated with other countries, especially in Southeast Asia, to reduce the amount of marine debris. For example, the ASEAN Member States participated in the *ASEAN Conference on Reducing Marine Debris in ASEAN Region*, held in Thailand in 2017, in which research advancement, information, and the challenges and opportunities in addressing the issue related to marine debris pollution were shared and discussed (Association of Southeast Asian Nations, http://asean.org/asean-commits-to-reduce-marine-debris-in-the-region/). This was a good opportunity for the states to enhance regional collaborations on marine debris pollution prevention due to the large proportion of marine debris (80%) in Thailand has originated from land-based sources. The *Master Plan on National Solid Waste Management* (2016-2021) is one of waste management frameworks that fosters effective waste management processes to further prevent marine debris generation (PCD, 2017).

11 Risks and Threats

With more than 320,000 km^2 of marine area, Thailand is rich with diverse marine and coastal ecosystems such as mangroves, seagrass beds, coral reefs and fisheries resources. They provide enormous goods and services to human beings. Ocean health has been threatened by both human activities and natural disasters, particularly climate change.

11.1 Human Activities and Environmental Damage

Men have been using the seas for transportation, fishing, energy, and recreation for a long time. Ocean economy has significantly contributed to global economic growth for decades. However, as the global population is growing and land resources have depleted, we are going to depend more on the sea and its resources. Oceans and seas, which cover about 70% of the Earth's surface, have high potential for sea-based development. For example, fossil fuels, which is the main energy resource of the world, is produced from offshore platforms.

In Thailand, national economic growth was about 5% and the ocean economy contributed to approximately 30% of the national economy during 2007 – 2015. The proportion of the ocean economy may increase soon because the national policy to promote tourism is a main driving force for marine tourism. This rapid growth in ocean development boosts natural resource utilization causing degradation and depletion of marine natural resources. For example, the fisheries production has gradually declined since 2003. During 2011 – 2015, 28% and 50% of coral reefs were in damaged and very damaged conditions. The mangrove areas had been declining from 3,679.0 km^2 in 1961 to 1,675.8 km^2 in 1996. However, since 2000, mangrove areas have increased due to the government policy to promote reforestation in the old mangrove areas.

Ocean-based activities are usually affected by threats to ocean health. However, there are very few cases of a single cause of degradation. Environmental degradation was often caused by several anthropogenic activities, including ocean-based economic activities and industries. (**Table 11.1**). For example, poorly managed tourism activities and overtourism are primarily responsible for the destruction of living corals, while marine debris and water pollution can create long term degradation of coral reefs. Marine debris affects aesthetic scenery, thus, reducing satisfaction of tourist and at the same time adversely affecting the coastal and marine resources.

Table 11.1: Impacts of Human Activities on Ecosystems and Environment Matrix.

Human activities		Ecosystem / Environment								
		Fisheries resources	Coral reefs	Seagrass bed	Mangrove	Invasive species	Endangered species	Coastal water quality	Marine debris	Coastal erosion
Fisheries	Anchoring		x	x						
	Fishing gear: trawling, dredging		x	x			x			
	Overfishing	x								
	Wastewater: boat, aquaculture	x	x	x	x		x	x		
	Marine debris: net, plastic	x	x	x	x		x		x	
	Aquaculture				x	x		x		
Tourism	Anchoring, trampling		x							
	Unsustainable tourism		x				x	x		
	Wastewater: boat, tourism establishments	x	x	x	x		x	x		
	Marine debris: plastic	x	x	x	x		x		x	
Port and shipping	Oil spill	x	x	x	x		x	x		
	Crashing: ship collision		x							
	Marine debris: plastic	x	x	x	x		x		x	
	Wastewater: ship and ports	x	x	x	x		x	x		
	Ballast water					x				
Oil and gas exploration and production	Oil spill	x	x	x	x		x	x		
Coastal development (Urbanization)	Sedimentation		x	x						
	Coastal construction: road, port, hotel, restaurant, housing, shoreline protection (hard solution)				x		x			x
Land-based activities	Wastewater: domestic, industry, agriculture	x	x	x	x		x	x		
	Marine debris: improper disposal and treatment of solid wastes	x	x	x	x		x		x	

Threats to ocean health are normally caused by multiple human activities. The impacts on ocean health can be divided into four groups: ecosystems, biological resources and biodiversity, environment, and others as summarized in **Table 11.2**. Details of threats are described in the following sections.

Table 11.2: The Relationship between Threats to Ocean Health and Human Activities.

Ocean health	Threat	Human Activity
Ecosystem		
Coral reef	Physical damage	Tourism and boat/ship, anchoring, trampling Fishing: trawlers, dredges and push nets, etc.
	Marine debris:	Land-based source: tourism, urbanization, runoff Sea-based source: fishing, tourism, shipping
	Sedimentation	Construction (road, port, hotel, restaurant and other facilities), deforestation
	Wastewater discharge	Sea-based source: ports, fishing, tourist boats, cruise ships, ferries, merchant ships; Land-based source: industry, domestic, commercial, urbanization, and agriculture (non-point source)
	Oil spill	Exploration and production of oil and gas Shipping operation and accident
Seagrass bed	Physical damage	Fishing activities (damaged by fishing gears and anchoring)
	Sedimentation	Coastal constructions (road, port, housing, hotel, restaurant and other facilities)
	Oil spill	Exploration and production of oil and gas Shipping operation and accident
	Marine debris	Land based source: tourism, industry, domestic, commercial, urbanization, agriculture (non-point source) Sea-based source: fishing, tourism, shipping
	Deforestation	Charcoal and tin mining (in the past) Shrimp and salt farming Constructions (port, tourism infrastructure, housing and commercial development)
Mangrove	Wastewater discharge	Land-based source: domestic, industrial and agricultural (non-point source)
	Oil spill	Exploration and production of oil and gas Shipping operation and accident
	Marine debris	Land-based source: tourism, urbanization, industry, domestic Sea-based source: fishing, tourism, shipping

Table 11.2. The Relationship Between Threats to Ocean Health and Human Activities. (cont.)

Ocean health	Threat	Human Activity
Biological resources and biodiversity		
Coral reef	Overfishing and IUU fishing	Fishing
	Wastewater discharge	Land-based source: urbanization, domestic, industry and agriculture (non-point source) Sea-based source: tourist boats, passenger and cruise ship, merchant ships etc.
	Destruction of habitats	Tourism, industry, urbanization, agriculture, construction
Endangered species: turtles, dolphins, whales, dugongs	Marine debris and water pollution	Land-based source: tourism, domestic, industry, urbanization Sea-based source: fishing, tourism, shipping
	Physical damage	Trawling Hunting Collecting turtle eggs
	Habitat disturbance	Loss of nesting and foraging sites: urbanization, housing, industrial, and tourism development, aquaculture
Environment		
Water pollution and eutrophication	Wastewater discharge	Land-based source: urbanization, industry, domestic, agriculture and aquaculture (non-point source) Sea-based source: fishing, tourist boats, cruise ships ferries, ports, merchant ships
Marine debris	Improper disposal and treatment of solid wastes - Illegal dumping	Land-based source: tourism, domestic, industrial and commercial establishments, urbanization Sea-based source: fishing, tourism, shipping
Others		
Coastal erosion	Alteration of coastline	Urbanization, infrastructures, tourist facilities Land reclamation; deforestation; conversion of coastal habitats
	Shoreline protection	Inappropriate (hard) solutions

11.1.1 Threats to Ecosystems

Coral Reef

Improper management of marine activities (unclear rules and regulation, lack of enforcement, and unintentional actions of tourists) can worsen the condition of marine resources. Around 78% of coral reefs were classified as damaged in 2011-2015. Physical damages on coral reefs were caused by various activities, for example tourist boat anchoring in the reefs, reef trampled by snorkelers and scuba divers, and illegal fishing (e.g., bottom trawlers, dredges, and push nets). Another important cause of coral reef destruction is marine debris, from both land-based sources (e.g., improper disposal and treatment of solid wastes) and sea-based sources (e.g., fishing boats,

tourist boats, ferries, ports, and merchant ships). For example, a trawl net, which covered the reefs, destroyed the corals by fragmenting or bleaching.

Another disturbance, which made direct impact to corals, is the reduction of light in the water column above the coral reefs. The light is key to the corals' existence because 70% of energy of corals are made by photosynthesis. There were many activities that reduce the light intensity in terms of sedimentation. Urbanization and a lot of coastal tourists caused high development in coastal zones. The construction of roads, ports, hotels, restaurants, and other facilities would produce high sedimentation loads that are discharged to the coastal sea, where corals lived. Deforestation in the watershed and coastal areas also results in erosion, siltation and sedimentation.

In addition, coastal water quality is a principal need for living organisms including corals. The coastal water quality is influenced by many factors, such as temperature, suspended solids, pesticides, and heavy metal elements. Hence, the untreatable wastewater discharge, which were from land-based source through the river to the sea, affected the coastal water quality. For wastewater discharge from sea-based source, numerous tourists and recreational boats might release sewage and graywater discharge, particularly in enclosed bays with limited water circulation. In the same way, from the sea-based source, exploration and production of oil and gas and shipping operations may dispose of pollution accidentally, especially oil spills. Although, the oil spill might happen in the offshore where corals do not live, they could, however, flow, with the help of waves and wind, to the coast and reefs. These pollutants would have an impact to coastal water quality and do significant damage to the coral reefs.

Seagrass

About 2% of seagrass in 2015 was in poor condition due to anthropogenic disturbances, especially physical damage. Local fisheries normally used dredge to fish for bottom-dwelling species, particularly economically important species, such as blue swimming crabs and wing shells. The local long-tailed boats anchoring in seagrass beds often cause damage. Another threat to seagrass is sedimentation. It reduces light penetration into the water above the seagrass and covers the seagrass meadows. Although, the nutrients from the bottom soil and water maintain the seagrass life in the short term, but photosynthesis is necessary for long term survival. Sedimentation is caused by urbanization, construction of roads, ports and other facilities in coastal zones, land reclamation, and deforestation. In addition, oil spill incidents affected seagrass by reducing photosynthesis of seagrass by contact with oil and cleanup chemicals.

Moreover, marine debris from either land-based sources or sea-based sources, which were improperly disposed and untreated solid waste severely affected the seagrass meadow. Most of seagrass were found in the intertidal zone, where there was a high circulation of the current so

that their leaves could trap the marine debris to the beds. Therefore, a lot of marine debris was found there. The little amount of marine debris obviously did not affect the seagrass. They have, however, made an impact on the organisms in the seagrass ecosystem, especially microlitter or microplastic. They were found in the stomach content of the benthic fauna.

Mangrove

The dramatic decline of mangrove areas occurred during 1961-1996 as a result of charcoal production and tin mining during that period. In 1987, the business of tin mining near coastal zones became bankrupt because tin price in the world market dropped. In 1996, the Thai government canceled the mangrove concession to address the problem of mangrove degradation. Although mangrove logging had been prohibited, mangrove encroachment is still going on. For example, mangroves were converted into shrimp, rice, and salt farms. In some areas, mangroves are cleared for infrastructure development (e.g., roads and ports) to support urbanization, industry, and tourism. As a result, mangroves not only decreased in area, but also their ecosystem support functions have decreased as well.

Another anthropogenic disturbance of mangrove is wastewater discharge, especially from land-based sources. Some mangrove areas were at the estuary, where runoffs from river and canal carry wastewater from domestic, industrial, and agricultural (non-point) sources.

Oil spill in mangroves was also an issue in Thailand. In the long term, it could impact mangrove trees and organisms in the mangrove ecosystem.

Moreover, solid wastes from the inland were disposed in mangrove areas. Plastic bags, rope, and other types of solid wastes could damage trees or prop roots which were nursery grounds for organisms in the mangrove ecosystem. In the event that the marine debris broke down into microlitters or microplastics, the benthic fauna could feed on them. These microplastics can also enter the food chain of the mangrove ecosystem.

11.1.2 Threats to biological resources and biodiversity

Fisheries Resources

Fisheries production has dramatically decreased for the past few decades. Overfishing and IUU fishing were obvious threats because they directly affected the abundance of targeted and bycatch species. In 2015, Thailand was issued an official warning (yellow card) by EU because the government failed to solve the problems of IUU fishing, which caused overfishing and decreasing

fisheries resources in Thailand. In response to this issue, the government enacted the *Royal Ordinance on Fisheries of 2015*. The law should greatly relieve pressure on Thailand's fish stocks. In 2018, although the yellow card still stands, the MSY of fishing has been increasing each year since 2016. This could demonstrate an increase in fisheries production.

In addition to overfishing and IUU fishing, wastewater discharges from land-based activities (domestic, industrial, and agricultural) threaten fisheries resources. More than 70% of domestic wastewater volume are untreated and discharged into canals, rivers, and seas. Wastewater is also discharged from marine activities, especially from ships (e.g., tourist, passenger, and cruise ships). Although the sewage disposal from sea-based activities is regulated by law, it is likely to happen because of inadequate law enforcement. Wastewater would affect marine organisms including fishes. In addition, destruction of habitats (e.g., coral reefs, mangrove, and seagrass) poses a threat to fisheries resources.

Endangered Species: sea turtles, dolphins, whales, dugongs

Photo from: TEI

Photo from: TEI

The numbers of stranded sea turtles, dolphins, whales, and dugongs is increasing each year. The animal stranding was mainly caused by feeding of litters and entanglement of fishing gears. The marine debris was either from land-based sources (e.g., improper disposal and treatment of solid wastes) or sea-based sources (e.g., fishing, tourist boats, ferries, ports, and shipping). Most of the marine debris were floating plastics, which looked like prey, such as jellyfish. The sea turtles or dolphins ingest these plastics by mistaking them for food. Plastic ingestion causes damage to the digestive system of animals and sometimes death. In Thailand, plastic was found in the stomach of stranded turtles, dolphins, whales, and dugongs. Aside from consuming the marine debris, many marine organisms become entangled in the debris, causing direct physical harm and mortality in marine species.

Other types of marine debris were from fishing activities, especially derelict fishing gear (according to NOAA, this refers to nets, lines, crab/shrimp pots, fish traps, and other recreational or commercial fishing equipment that have been lost, abandoned, or discarded in the marine environment). Fishing activities can cause direct physical damage to endangered species. For example, trawling might unintentionally trap the sea turtles, dugongs, and dolphins. Stationary fishing nets for catching Mekong giant catfish in Songkhla Lake were also responsible for Irrawaddy dolphin injuries in the area.

There were other causes of threats to endangered species, especially sea turtles and dolphins, such as hunting and collecting turtle eggs. There were reports on sea turtle hunting for decoration and other human accessories. Moreover, sea turtle eggs were collected for human food. Sea turtles are also threatened by the disturbance of their nesting sites due to coastal construction, urbanization, and tourism development in the coastal area. In the case of dugongs, some local people hunt them for superstitious reasons. They believe that the tears of dugongs have magical powers.

Invasive Species

Port and shipping have a high risk of transporting invasive species through exchanging ballast water. For example, alien mussel, *Mytilopsis adamsi*, was found in Haad-kaew Lagoon and Songkhla Lake. Normally, this invasive mussel species is native to tropical west Pacific coast of Central America. It was postulated that some ships discharge ballast water containing these invasive species (Wangkulangkul and Lheknim, 2008).

Other threats to invasive species were unintentional release from aquaculture activities. Threats from aquaculture involve the release of non-native cultured species. They adversely affect native species, food web, and ecosystem processes. The series of disease outbreaks in an important aquaculture species, the giant tiger prawn (*P. monodon*), in mid-1990s have led to the introduction of the Pacific whiteleg shrimp, *P. vannamei*, a native species from the eastern Pacific Ocean for aquaculture. Aquaculture of Pacific whiteleg shrimp has rapidly expanded since 2000. Currently, the production of Pacific whiteleg shrimp has contributed to more than 95% of the total marine shrimp production. Extensive aquaculture areas allowed for the releases of large numbers of this introduced species into Thai natural waters. Senanan et al. (2007) first reported the presence of sub-adult Pacific whiteleg shrimp in the Bangpakong River mouth in eastern Thailand. Subsequent studies suggested geographic expansion of wild-caught individuals along the east coast of Thailand in both coastal and offshore areas (Panutrakul et al., 2010; Panutrakul et al., unpublished data). Threats posed by the establishment of a self-sustaining population of this species include the spread of a non-native pathogen, the Taura Virus Syndrome (TSV) (Barnette et al., 2008; Senanan et al., 2009), potential reservoir for local viruses (Barnette et al., 2008), and competition with local shrimp species (Chavanich et al., 2016). Barnette et al. (2008) detected TSV in 1.90% – 24.24% of the total number of individuals sampled in each of the local marine shrimp species examined (*Peneaus spp., Metapenaeus spp.* and *Parapenopis hungerfordi*). Chavanich et al. (2016) observed some competitive advantage of Pacific whiteleg shrimp over the local shrimp species, where Pacific whiteleg shrimp had faster feeding rates compared to those of *P. monodon, P. merguiensis, M. ensis, M. tenuipes*, and *M. affinis*.

11.1.3 Pollution

Wastewater

Marine water quality was investigated at the coastal sea areas. The overall Marine Water Quality Index (MWQI) were acceptable, but there was a critical deterioration of sea water quality in the IGoT. This area received wastewater from land-based sources through runoffs of major rivers, namely Chao Phraya, Bang Pakong, Tha Chin, and Mae Klong. The central region, where the capital city Bangkok is located, has a lot of urbanization, industry agriculture, and aquaculture. Therefore, high volume of untreated wastewater was discharged into the rivers. Moreover, the aquaculture activities release effluent with high nutrients and sediments.

The report of wastewater treatment showed that 42.6% of wastewater in the central region was not treated. Sea-based source of wastewater also threaten marine water quality. There were lots of marine activities that release wastewater, such as fishing, tourist boats, cruise ships, ferries, ports, and merchant ships. As the MWQI in the IGoT were poor, many eutrophication incidents were found in this area.


Photo from: TEI

Marine Debris: plastic, microplastic

There were two sources of marine debris: land-based source (tourism and urbanization) and sea-based source (fishing, tourism, and shipping). Major sources of marine debris are land-based because of the improper disposal and treatment of solid wastes and illegal dumping through rivers or canal or directly to the sea. A large proportion of marine debris are plastic waste, which can break into 'microplastics'(< 5 mm). Microplastics can be ingested by marine organisms and accumulated in the marine food web. Thus, much attention should be paid to the impacts of microplastics on the marine ecosystem and human health. Various measures and efforts have been proposed and promoted in order to reduce the use of plastics in all activities and sectors.

Since Thailand was ranked at the 6th place of global marine debris contributors (0.15-0.41 million tonnes/year), public attention over the effect of such pollution on marine resources has increased (PCD, 2017). The DMCR has investigated the marine debris along Thailand's coasts of over 531 km during 2009–2015 revealing that about 420,817 wastes with a total weight of 73,234 kg were found. Plastic and abandoned/discarded fishing gears are the major portion of marine debris

found in Thailand (PCD, 2017; GreenFin Thailand, http://www.greenfins-thailand.org/uploads/news/40/trash_sea.pdf). Those plastics and discarded/ abandoned fishing gears can be transported long distances in the marine environment and are clearly a major transboundary issue. Discarded/ abandoned fishing gears have been a concern as a ghost fishing issue that may cause impacts on mortality of marine species (Putsa et al., 2016 and Stelfox et al., 2016).

Oil Spills

Based on the Marine Department Statistics, oil spill incidents have occurred in Thai waters, in various areas at different times along Thailand's coast. A total of 221 incidents of oil spill occured from 1973 to 2012 on coastal areas, rivers, and channels covering the coastal areas of many provinces, such as Rayong, Chon Buri, Chachoengsao, Samut Prakarn, Bangkok, Chumphon, Surat Thani, Nakhon Si Thammarat, Songkhla, Phangnga, Phuket, Krabi, and Satun. The highest reported frequency of oil spill incidents, mostly found in Bangkok Province, is 76 cases, followed by Chon Buri (48 cases), Samut Prakarn (40 cases), Rayong (23 cases), and Chumphon (12 cases). About two cases that generated significant environmental impacts have been considered as huge oil spill incidents. The first one is the case of "Eastern Fortitude" wherein 234 tonnes of oil was spilled at Sattaheep District, Chon Buri Province. Although the oil spill was generated in Chon Buri Province, most impacts were found in Rayong Province. The second one is the case of "Dargon 1" wherein 150 tonnes of oil was spilled in Pattaya City of Chon Buri Province on 16 December 2004 (Marine Department, 2013 and DMCR, 2012). In July 2013, 50 tonnes of crude oil was leaked from the PTT pipeline during oil pumping, hit Ko Samed and other coastal areas of Rayong and Chon Buri Province, that may cause further ecological and economic damages.

Many evidences have well illustrated the significant impacts generated by oil spill incidents in both ecological and socio-economic aspect (Agbogidi et al., 2005 and Bureau of Ocean Energy Management, 2011). Crude oil contains some toxic substances, which may evaporate and cause health effects on plants, animals, and humans within the spilled areas. Both petroleum and non-petroleum oil can inevitably affect the important habitats, such as coral reefs, sandy beaches, tidal flats, mangroves, seagrass beds, river, and fresh water habitats (USEPA, 1999). Furthermore, scientists are also concerned about the long term environmental impact of oil spills, since oil contamination may persist in the marine environment for many years after an oil spill. Bioaccumulation of hydrocarbons in the tissues of marine organisms, especially benthic animals, such as bivalves, gastropods, crustaceans, etc. can be found. The concentration of petroleum hydrocarbons in their tissues is increasing through the higher trophic level within the food web (Kingston, 2002). Besides the ecological impacts, socio-economic impacts can also be generated causing economic and social damages in the affected areas, especially the tourism, fishing, and aquaculture areas (Agbogidi et al., 2005 and Bureau of Ocean Energy Management, 2011). Moreover, oil spill also causes various impacts on other coastal activities that use sea waters for their process and operation, such as salt field, aquarium, power plant, etc.

11.1.4 Coastal Erosion

Based on the national erosion survey and mapping conducted by the DMCR in 2016, there are 462 sites of eroded coastline with total length of 618.35 km or 19.62% of the total coastline. Based on the state of coastal erosion, coastlines can be classified as follows:

- Coastlines facing erosion, which have been mitigated, were 464.27 km long or 75.08% of total eroded coastline.
- Coastlines facing erosion, which have not yet been mitigated, were 154.08 km long or 24.92% of total eroded coastline.
- Coastlines vulnerable to erosion were 172.93 km long.

In Thailand, the causes of coastal erosion are natural processes, alteration of coastlines, and hard shoreline protection solutions. Natural processes, such as storm surge, waves and tides, follow seasonal variations. The level of erosion caused by natural processes depend on geology and geomorphology of the coastline. On the global scale, sea level rise can cause coastal erosion.

In fact, coastal erosion was mainly caused by human disturbance which involved the alteration of the coastline. Urbanization and development of infrastructures and tourist facilities interfere with littoral transport of sediment which causes erosion and accretion. For example, land reclamation in Map Ta Phut Industrial Estate has caused coastal erosion problems at Suchada Beach, Rayong Province.

Inappropriate shoreline protection solutions can contribute to coastal erosion. It affects the balance of the sediment. An example is the construction of an offshore breakwater at Had Suchada, which caused erosion of the nearby area. A groin method could shift erosion problem to the downstream area. The trapping of the sand can cause a deficit in the littoral drift budget. This kind of coastal protection is associated with corresponding erosion on the other side of the structure.

11.2 Natural Hazards and Climate Change

Natural hazards are a significant threat to ocean health. The weather in Thailand is under the influence of monsoons. The natural hazards, which occur every year, not only affect life and property but also create economic, social, and environmental impacts on coastal ecosystems. Due to the impact of climate change, Thailand has experienced abnormal weather patterns that include more heavy rain, thunder storms, and flooding (**Table 11.3**). Coastal areas are vulnerable to increases in the intensity of storm surge and heavy precipitation causing flood in low-lying areas, which damage properties, destroy habitats, and threaten human health and safety.

Table 11.3: Risks and Threats of Natural Hazards and Climate Change.

Natural hazards	Risks and threats to the environment
Increase in sea surface temperature	- Coral bleaching phenomenon
Storm surge	- Changing coastal process and beach morphology
Sea level rise	- Saltwater intrusion - Coastal area flooding
Ocean acidification	- Impact on ecological process - Degradation of calcifying taxa
Flooding	- Marine debris -Water pollution - Sedimentation of plankton communities
Tsunami	- Destruction of marine resources (mangroves, reefs, turtles, and dugongs)

Increase in Temperature


Photo from: TEI

Thailand is located in a tropical region with the average sea surface temperature is between 28°C-30°C (Koad et al., 2012). Increase in concentration of greenhouse gas can increase the air temperature as the ocean traps 84% of atmospheric heat energy, resulting in an increase in water temperature (Howard et al., 2013). The rising temperature in GoT and the Andaman Sea consequently affect marine organisms and ecosystems, especially corals, which are sensitive to warmer water temperature. There were two coral bleaching incidents in Thailand: in 1998 and 2010. In 2010, severe coral bleaching events occurred because the slow progress of south-west monsoon led to rising sea surface temperature to over 30°C for 3 months. This effected the zooxanthellae in coral tissue (Sutthacheep et al., 2013). Sea surface temperature increased to 30°C-34°C during March-June 2010 in both the Andaman Sea and the GoT (Yeemin et al., 2012). The survey conducted by DMCR, in collaboration with a network of Thai universities and NGOs, reported widespread and severe coral bleaching of over 80% at several reef sites. Coral mortality caused by the bleaching event is estimated at about 50%-60% within the Andaman Sea, and about 30%-40% within the GoT (Yeemin et al., 2012). According to Yeemin et al.(2012), the 2010 bleaching in GoT is similar to the 1998 event in extent, but with greater severity than that of 1998; while the bleaching in the Andaman was greater both in extent and severity.

Storm Surge

Storm surge is a big wave caused by the storm's wind near shore, pushing a mass of water onto the coastline. The amount of force and intensity depends on the storm's level and orientation of the coastline. Evidence revealed that storm surges can change coastal processes and beach morphology (Phantuwongraj et al., 2013). Storm surges can cause loss of lives and damage to properties. For example, the storm surge at Laem Taloom Pook, Nakhon Sri Thammarat in 1962 caused by tropical storm HARRIET resulted in more than 900 deaths (http://www.marine.tmd.go.th/paper/surge.html). Moreover, in 1989, Typhoon Gay struck Amphoe Tha Sae and Pa Tiew in Chumphon Province, causing extensive damages in eight provinces along the GoT, resulting in 458 deaths, 227 ship capsized, and economic loss of about USD281 million (UN Department of Humanitarian Affairs, 1989).

Sea Level Rise

Sea level rise, which is a consequence of climate change, is the major concern for several decades. The local data along the coast of the GoT showed the increasing trend of the annual local mean sea level (MSL) of about 5 mm/year from 1985-2009. Furthermore, due to land subsidence, the MSL in the IGoT was above the annual local MSL (Sojisuporn et al., 2013). The coastal area in GoT will face extended periods of flooding in addition to salt water intrusion (Marks, D., 2011). A study in a sustainability journal supports the idea that sea level rise will increase the sensitivity and affected fishing household in the coastal areas (Panpeng and Ahmad, 2017).

Ocean Acidification

The average pH in Thailand was 8.06 (PCD, 2017), while the increasing trend of atmospheric CO_2 since 1979 lead to the reduction of pH in the ocean, which mad an impact on the ecological process and calcifying taxa. The effect in Thailand was not clearly observed. There is only one study that predicts the consequence of ocean acidification. This study shows that at the lower pH at 7.6 and 7.8 can delay coral planulae for metamorphosis and settlement. This means it would block the coral recruitment process (Viyakarn et al., 2015). These processes were important for ecosystem sustainability. Therefore, there should be a plan of prevention and mitigation of coral degradation in the future.

Flooding

Climate change causes extreme weather, such as increasing storm frequency and intensity and precipitation. According to EM-DAT (2015) database, 31 tropical storms have hit Thailand from 1984 to 2013, causing an increase in precipitation throughout the country. During this period, there was one severe flooding that occurred in 2011, which affected 4,405,315 people in 65 provinces for 4-5 months. The long inundation period caused massive discharge of about 138

million m^3 of wastewater into IGoT (ONEP, 2015). Marine debris and water pollution were the major threats from this event affecting fish and plankton communities. There were reports that the mass of freshwater runoff from inland rapidly reduced dissolved oxygen and salinity resulting in deaths of benthic fauna and fish in the near-shore areas (Pollution Control Department, 2015). Moreover, the sedimentation from the discharged water changed plankton communities from micro-plankton to nano-plankton (Piamsomboon et al., 2016). Nevertheless, after the flooding event, these chemical and biological features returned to normal conditions.

Tsunami

In 26 December 2004, there was an Indian Ocean earthquake with the epicentre off the west coast of Sumatra, which triggered a series of devastating tsunamis in many countries along the coast of the Indian Ocean, such as Indonesia, Malaysia, Sri Lanka, and Thailand. This event strongly affected human life and properties near the beach, resulting in 5,395 deaths that included foreigners (Thailand Development Research Institute, 2005). The tsunami caused the fragmentation of about 80 km^2 of corals, damage to about 3.04 km^2 of the mangrove forests, and 39 stranded endangered species (DMCR, 2012). The economic cost of the destruction of these coastal resources due to the tsunami was estimated to be around USD2.43 billion (Jarayabhan *et al.*, 2009).

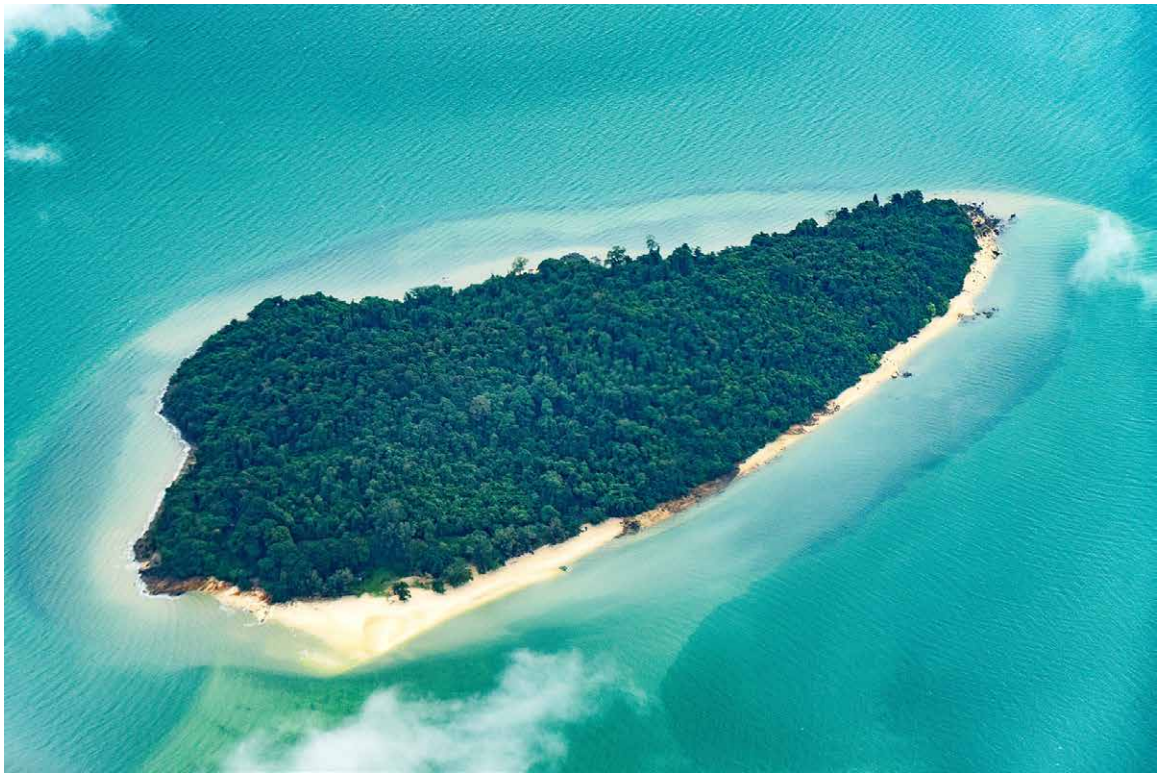


Photo from: TEI

PART 5

GOVERNANCE STRUCTURE SUPPORTING BLUE ECONOMY DEVELOPMENT

12 Institutional Arrangements and Governance

12.1 Policies, Legal Framework, and Governance Mechanisms

Although Thailand has about 3,100,000 km^2 of marine areas, which is equal to about 60% of the total land area, we have no overall national marine policies. Our main policy framework is the five-year national development plan, which guides the country development direction for every five-year period. This plan, which started in 1961, is used as a guideline for other sectoral policies and plans to be developed by their respective ministries.

With regards to legal framework, there are many laws and regulations related to marine affairs. However, some of them are quite old and need to be amended to effectively manage marine and coastal resources. Thailand has just ratified the United Nations Convention on Laws of the Seas (UNCLOS 1982), hence, all related laws have to be reviewed in order to meet the commitments under the UNCLOS.

In June 2015, the current government prepared the 20-Year (2017-2036) National Strategy, with the vision that "Thailand will be a developed country with stability, prosperity, and sustainability by the year 2036." This strategy corresponds to the government policy statements delivered to the National Legislative Assembly by General Prayut Chan-o-cha, Prime Minister in 2014. These policy statements include *Policy 9, "Maintaining the Security of the Resource Base and Creating Balance between Conservation and Sustainable Use*," which covers management of marine and coastal resources.

The 20-year national strategy focuses on the development approach based on the Sufficiency Economy Philosophy. Its vision is a developed nation with "Stability, Prosperity, and Sustainability" in accordance with the principles of the philosophy. To achieve the country's vision, six strategies have been put in place as a framework for development in the next 20 years. These include: 1) enhancing national security in all aspects; 2) strengthening national competitiveness; 3) developing and empowering human capital; 4) broadening opportunities to improve social equality and equity; 5) steering toward a green economy and society; and 6) reforming and improving public administration.

12.1.1 National Plans

Three major national plans have been developed to realize its visions in the three areas: the National Maritime Security Plan (2015-2022) for security; the 12th National Economic and Social Development Plan (2017-2022) for prosperity; and the Environmental Management Plan (2015-2021) for sustainability.

The vision of the National Maritime Security Plan (2015-2022) is that, "Thailand can protect and promote the national maritime interests in a balanced and sustainable manner in accordance with the sufficiency economy philosophy, with the participation of all parties in the management and the effective integration of national power in all areas." It contains six strategies: 1) Strategic Development for Marine National Security; 2) strategy for the protection of marine interests; 3) strategies to create peace and promote the use of the sea; 4) strategies to create the balance and sustainability of marine resources and the environment; 5) strategy for human resource development, knowledge and awareness of the sea; and 6) strategic management of maritime national interests by state agencies.

The 12th National Economic and Social Development Plan (NESDP) is a strategic plan that serves as a framework for medium term national development (2017-2022), developed to be consistent with the country's national 20-year strategy and the SDGs. Its development stems from the philosophy of sufficiency economy, sustainable development, and people-centered development. Overall, the plan emphasizes on balancing development of human, social, economic, and environmental resources. Under the plan, several critical environmental issues have been targeted to be resolved, including managing effective water resources; speed up to resolve the garbage problems; reduce 20% of greenhouse gas emissions; reduce energy consumption; adapt a low carbon society and be more environmentally friendly; and enhance the ability to prevent the effects of climate change and natural disasters.

The vision of the *National Environmental Quality Management Plan (2017-2021)* is to "conserve, restore, and utilize natural resources in a balanced and equitable manner leading to an environmental friendly society." Under this plan, there are four strategic issues that are highlighted:

1) develop a balanced and equitable management of natural resources;
2) optimize the use of natural resources in a cost-effective manner and promote a greener society;
3) manage environment quality with sufficient protection, remedy, and rehabilitation;
4) build capacity to cope with climate change, natural disasters, and promote cooperation with foreign countries.

12.1.2 Legal and Regulatory Framework

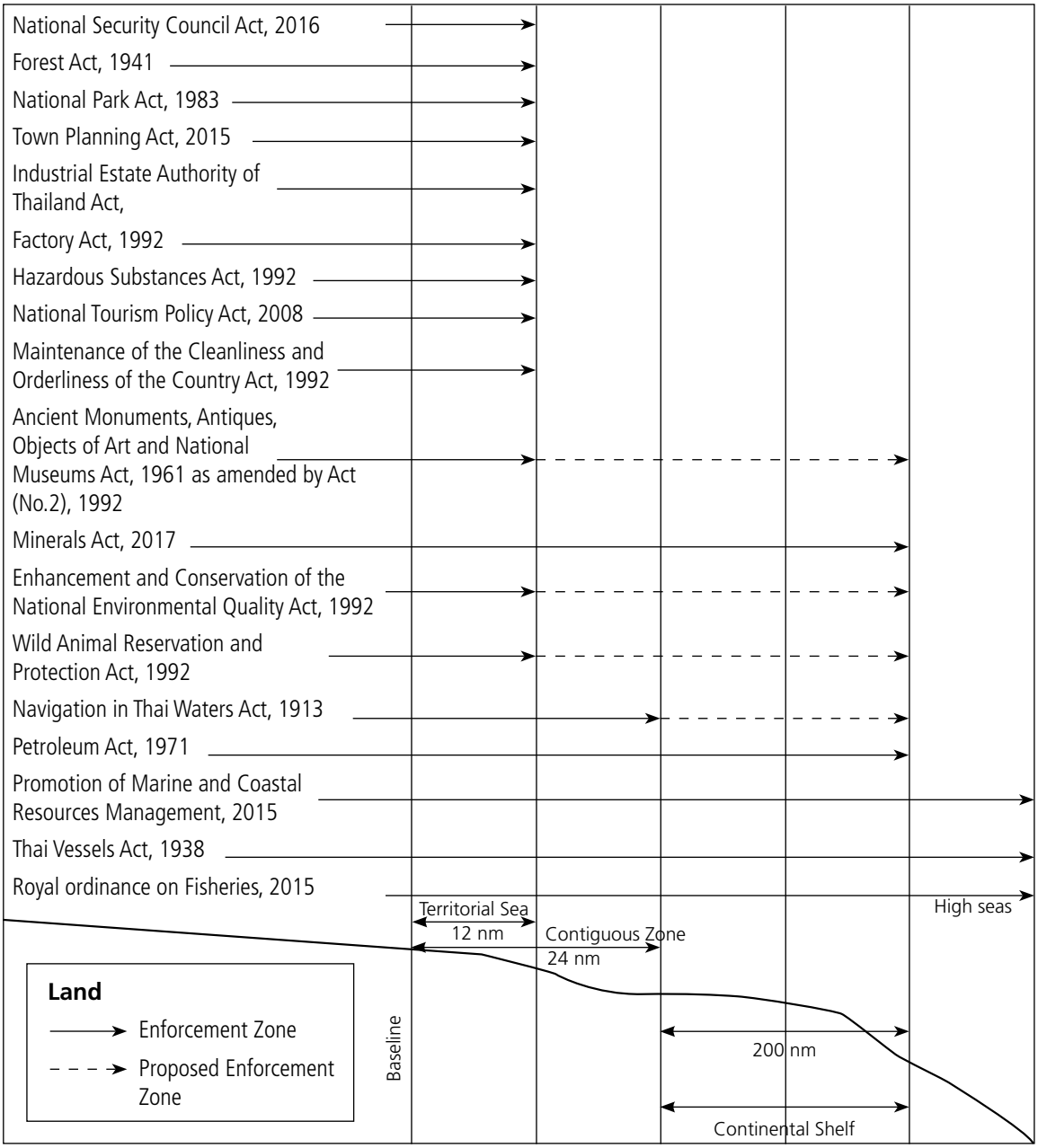
Overall, the management of Thailand's coastal resources has been governed by several laws (DMCR, 2007). The *Enhancement and Conservation of the National Environmental Quality Act, 1992* covers provisions on standard setting and monitoring of the environmental quality, environmental impact assessment system, and setting up organisations/committees responsible for solving natural resources and environmental problems. This act is applied to all natural resources and environment including coastal and marine resources.

The *Promotion of Marine and Coastal Resources Management Act, 2015* establishes a National Committee on Marine and Coastal Resources Management Policy and Planning. The committee is responsible for proposing policy and management plans for marine and coastal resources. It also has the power to establish sub-committees to take any action assigned by the committee. In addition to the national committee, the act establishes provincial committees with similar responsibilities at the provincial level, thereby promoting community participation in coastal and marine governance. The *2015 Promotion of Marine and Coastal Resources Management Act* also contains provisions on designation of marine and coastal protected areas that include:

1) Mangrove conservation areas, where mangroves are not conserved under other legislations;
2) Marine and coastal protected areas, where significant marine and coastal resources need to be conserved and are not yet declared as conservation areas under other laws;
3) Areas that require protective measures to prevent coastal erosion and loss of lives and property; and
4) Areas with specific types of marine and coastal resources that need to be protected or conserved if: (a) they are in danger of being destroyed or severely damaged; and (b) the national committee decides that they must be protected to maintain ecosystem integrity.

Other supporting acts to protect marine resources and the environment have been implemented in Thailand for a long time, an example of which is the *Fisheries Act, 1947*. However, these laws contribute to the protection of the sea in a fragmented and sectoral approach causing unsustainable and conflicting uses of resources and pollution. Furthermore, most of these acts limit their enforcement zone to the territorial zone. To solve this problem, the Nation Reform Subcommittee on Natural Resources and Environment has recently submitted its proposal SRI 7 to extend the enforcement zone of existing laws to the EEZ, such as the *Ancient Monuments, Antiques, Objects of Art and National Museums Act of 1961; Minerals Act of 2017; Enhancement and Conservation of the National Environmental Quality Act of 1992; Wild Animal Reservation and Protection Act of 1992; and the Navigation in Thai Waters Act of 1913* (**Figure 12.1**).

Figure 12.1: Major Laws Governing Maritime Activities and their Enforcement



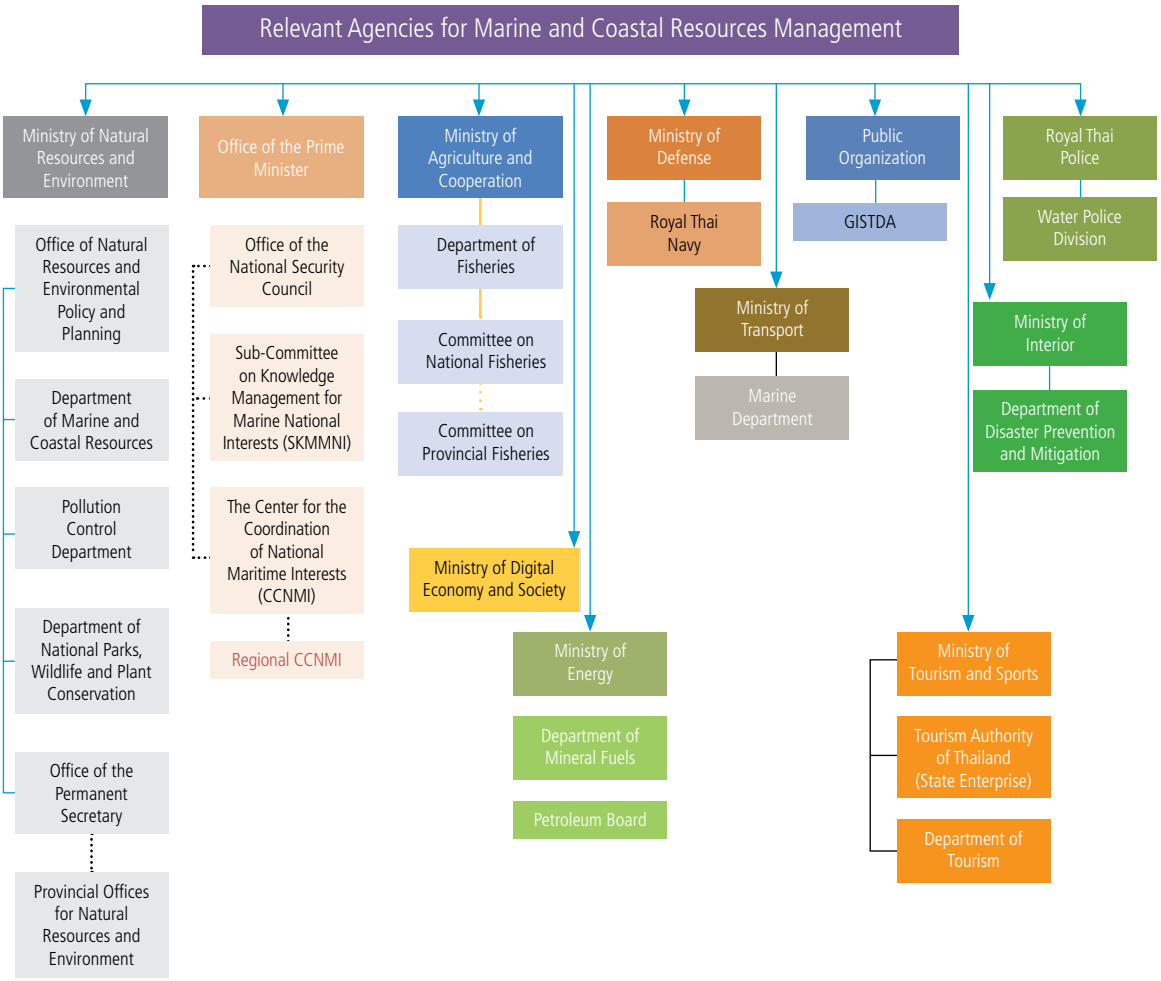
Source: The Committee of the National Reform Steering Assembly in Public Health and Environment, 2017.

At present, the government has put a lot of effort in improving marine related laws such as the *Promotion of Marine and Coastal Resources Management Act, 2015* and *Fisheries Ordinance, 2015*. The Promotion of Marine and Coastal Resources Management Act, 2015 is the first legislation, which offers a comprehensive and integrated approach to the protection of coasts and marine waters in Thailand.

12.1.3 Institutional Arrangements

Thailand, similar to many countries in the Southeast Asian region except Indonesia, has no single ministry responsible for marine affairs. The responsibilities related to the marine sectors are shared by many ministries, such as the Ministry of Agriculture and Cooperatives, Ministry of Transport, Ministry of Energy, and Ministry of Natural Resources and Environment (**Figure 12.2**).

Figure 12.2: Government Agencies Responsible for Marine and Coastal Resources Management



According to **Table 12.1**, the Ministry of Natural Resources and Environment (MNRE) is the main agency responsible for various environmental and natural resources management issues. Management of coastal and marine resources and the environment are distributed among departments within the MNRE. For example, the Office of Natural Resources and Environmental Policy and Planning (ONEP) is in charge of plan and policy formulation, environmental impact assessment, and establishment of Environmental Protected Areas. The Pollution Control Department (PCD) takes care of setting up coastal water quality standards, monitoring of coastal waters, and setting up pollution control areas. The Department of National Parks, Wildlife and Plant Conservation is responsible for managing marine parks. The Department of Marine and Coastal Resources (DMCR) is the main agency responsible for promoting the sustainable management and conservation of Thailand's marine and coastal resources, particularly mangrove forest, coral reefs, seagrasses, and endangered marine species.

Table 12.1: Functions and Departments under MNRE

Cluster	Department and/or Agency
Policy and planning	• Office of Permanent Secretary • Office of Natural Resources and Environmental Policy and Planning
Pollution	• Pollution Control Department
Information dissemination, public awareness and participation, and education	• Department of Environmental Quality Promotion
Natural resources	• National Park, Wildlife, and Plant Conservation Department • Royal Forest Department • Department of Mineral Resources • Department of Marine and Coastal Resources • Department of Water Resources • Department of Groundwater Resources

Source: DMCR, 2016

Interagency coordination has been done through various committees. In 2016, the National Committee on Marine and Coastal Resources Management Policy and Planning established three sub-committees to assist in the following aspects: 1) coastal erosion; 2) mangrove and beach forest; and 3) marine resources. Under these sub-committees, there are six working groups responsible for (1) coral reef and seagrass; (2) marine endangered species; (3) pollution; (4) artificial reef; (5) marine and coastal protected areas; and (6) oceanography.

In addition, under the *National Reform Plans and Procedures Act 2017*, the national reform committees on natural resources and environment have been established to develop the reform plan. The plan includes structural and regulatory reforms on marine and coastal resources.

12.1.4 Supporting Mechanisms

1. Marine protected area:

One of the coastal and marine ecosystems management mechanisms is the Marine Protected Area (MPA). In Thailand, there were many types of MPA. These include Marine National Parks (*National Park Act of 1961*), Non-hunting Areas (*Wild Animal Reservation and Protection Act of 1992*), National Reserved Forest (*Forest Act of 1941*), Biosphere Reserve (*UNESCO Man and Biosphere*), Environmental Protection Areas (*Enhancement and Conservation of National Environmental Quality Act of 1992*), and Plant Conservation Area (Royal Ordinance on Fisheries of 2015). Total marine protected area (minus overlapping areas) was estimated at 18,136 km2 (5.6% of the total maritime zone of Thailand). An important law, the *Promotion of Marine and Coastal Resources Management Act, 2015*, which was recetly enacted, includes a provision on designation of marine and coastal protected areas. DMCR, which is the main agency responsible for implementing the recently enacted law, has already designated many areas and is in the process of preparing to establish more marine and coastal protected areas.

2. Education and awareness raising:

Building people's awareness on the importance of environment and natural resources has been recognized and operated in the country for a long time. Several government agencies provide access to information on the environment and natural resources. Some of these information have been widely disseminated to the public in the form of annual reports using various media. In 2010, DMCR initiated a preliminary marine and coastal resources database and made it available on the DMCR website. Almost all important information related to coastal management can be easily accessed through www.dmcr.go.th as well as several other government agency websites. DMCR also cooperated with Thailand Research Fund and the Office of the National Security Council in setting up a website for dissemination of information and data on marine related issues called the **Marine Knowledge Hub** (www.mkh.in.th). It is expected that an increase in effective information sharing and communication and the level of public awareness on natural resources conservation would increase.

3. Capacity development:

Several programmes have been initiated to strengthen management capabilities of Thai agencies. These include: integrated coastal management, marine spatial planning, marine protected areas, transboundary marine protected areas, and application of DPSIR/PSR to a preparation of national and provincial state of marine and coastal environment report. In addition, specific technical regional training programmes on marine micro-plastic, ocean acid, and ocean governance have also been supported by the IOC-Westpac and IOI. To promote research and study, DMCR has organized biannual national marine science conferences with strong collaboration of several

Thai universities for more than 8 years. Such conferences provide the main national platform for information and knowledge sharing and exchange among marine and coastal resources scientist, managers, students, communities, policy makers, the private sector, and NGOs, etc.

4. Monitoring of the state of the marine and coastal resources:

DMCR is responsible for the regular monitoring of marine and coastal resources and conducting researches aimed at the conservation and rehabilitation of marine and coastal resources, especially coral reef, seagrasses, and marine endangered species (e.g., whale, dolphin and sea turtle). Such researches and studies are needed to provide technical support. Its duties are required by the *2015 Promotion of Marine and Coastal Resources Management Act*, particularly the designation of protected areas under sections 17, 20, 21, and 22. Comprehensive knowledge of the proposed areas, such as assessment of environmental impact, severity of coastal erosion, damage assessment of marine and coastal resource, and total economic value of marine and coastal resources are strongly required.

5. Research and development:

For effective management of marine and coastal resources of the country, Thailand Research Fund has offered research support on five strategic research themes linking science and policy since 2016 (TRF, 2016). These themes include: 1) management; 2) economic measures; 3) rehabilitation of marine and coastal resources; 4) involvement of communities (conflict management, adaptive capacity, community resilience and etc.); and; 5) sectoral uses of coastal and coastal resources (energy, transportation, fishery, tourism, security, etc. Further details of suggested 75 research topics can be seen in TRF (2016). TRF also supports blue econony projects.

12.1.5 Participation Mechanisms

Thailand has clear legislations enabling public participation in natural resources decision making. The *Official Information Act of 1997 and Regulations of the Office of the Prime Minister on Public Consultation 2005* provide the legal basis for public participation in environmental decision-making at all levels in Thailand. The *Information Act* establishes the right to access public information and directs all government agencies to be responsible for dissemination information and allowing public participation in the decision-making processes. The regulations enable public contribution to decision-making processes through public hearings, workshops, and public discussions. Specific number of days' notice is required before a public consultation. The responsible state agency is also required to prepare a report of the consultation and make it available to the public within 15 days. Although the Marine and Coastal Resources Management Promotion Act of 2015 has no direct provision on public participation, it states broadly that DMCR should be supporting coastal communities and local administrative organisations in the management, rehabilitation, maintenance, conservation, restoration, and utilisation of marine and coastal resources (See section 16 under the Promotion of Marine and Coastal Resources Management Act of 2015).

Photo from: DMCR

To promote greater public participation in marine and coastal resources governance, the DMCR has set up committees, working groups, and stakeholder networks. Currently, DMCR has networks of marine and coastal resources management groups at the provincial, and national levels. DMCR often conducts seminars or workshops to increase general knowledge and awareness among network members on the importance of marine and coastal resources. DMCR and network members have jointly carried out activities including creating artificial reefs, mangrove and seagrass restoration, garbage collection, and monitoring of illegal fishing vessels in the near shore area. However, there is a need to improve public participation by enhancing coordination and integration among networks and DMCR's agencies. To promote effective participation in the coastal management in Thailand, DMCR is currently drafting regulations that aim to provide practical guideline for public participation activities. The guideline includes procedures for coastal communities to provide their inputs to the development of the national or provincial marine and coastal resources management policies or plans, as well as the budget or subsidy support for communities to conduct projects on marine and coastal resources maintenance, conservation and rehabilitation in their areas.

12.1.6 Meeting International Commitments

Thailand has been participating in the global effort in addressing the ocean related environmental problems for a long time. Thailand is a party to various international and regional environmental agreements. According to **Table 12.2**, the country is a party to many ocean-related conventions, protocols, and agreements. Furthermore, Thailand is in the process of preparing for the ratification of several IMO conventions.

Table 12.2: International and Regional Environmental Agreements.

Multilateral Environmental Agreement	Status (Thailand)	Status (MEA)
Convention on Wetlands of International Importance Especially as Waterfowl Habitat or RAMSAR Convention	Signature: 1975 Ratification: 13 May 1998	Adoption: 1971 Entry into force: 1975
Convention Concerning the Protection of the World Cultural and Natural Heritage/ The World Heritage Convention	Accession:17 Sept. 1987	Entry into force December 1975
Convention on International Trade in Endangered Species of Wild Fauna and Flora or CITES	Signature: July 1975 Ratification: 21 January 1983	Adoption 3 Mar. 1973 Entry into force: 1 July 1975
Convention on Biological Diversity or CBD	Ratification: 31 October 2003	Entry into force: 29 December 1993
Convention on Migratory Species : CMS	Signature: 1 August 2003	Entry into force: 1994
The IOSEA Marine Turtle Memorandum of Understanding: CMS	Developed in1999	Entry into force: 1 September 2001

Table 12.2. International and Regional Environmental Agreements. (cont.)

Multilateral Environmental Agreement	Status (Thailand)	Status (MEA)
International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL)	Ratification: 2 November 2007 (Annex I – Oil and Annex II - Noxious Liquid Substances in Bulk) In the process of ratification: (Annex IV – Sewage and Annex V – Garbage)	Adoption: 2 November 1973 Entry into force: 2 October 1983
Convention on the Marine Pollution by Dumping of Wastes and Other Matters, 1992 or LDC	In the process of ratification	Adoption: 13 November 1972 Entry into force: 30 August 1975
International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC), 1990	Ratification: 20 April 2000	Adoption: 30 November 1990 Entry into force: 13 May 1995
Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances, 2000 (HNS Protocol)	In the process of ratification	Adoption: 15 March 2000 Entry into force: 14 June 2007
International Convention on the Control of Harmful Anti-fouling Systems on Ships (AFS), 2001	In the process of ratification	Adoption: 5 October 2001 Entry into force: 17 September 2008
International Convention for the Control and Management of Ships' Ballast Water and Sediments (BMW), 2004	In the process of ratification	Adoption: 13 February 2004 Entry into force: 8 September 2017
International Convention on Civil Liability for Oil Pollution Damage (CLC), 1969	Ratification: 7 July 2017	Adoption: 29 November 1969 Entry into force: 19 June 1975 Being replaced by 1992 Protocol: Adoption: 27 November 1992 Entry into force: 30 May 1996
1992 Protocol to the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, (FUND 1992)	Ratification: 7 July 2017	Adoption: 18 December 1971 Entry into force: 16 October 1978 Superseded 1992 Protocol: Adoption: 27 November 1992 Entry into force: 30 May 1996

1. Sustainable development agenda

Thailand attaches great importance to the concept of sustainable development guided by the *Sufficiency Economy Philosophy* (SEP) of His Majesty the Late King Bhumibol Adulyadej. Hence, Thailand has integrated the *2030 Agenda for Sustainable Development and the Sustainable Development Goals* (SDGs) in the country's strategy, plans, and policies.

The National Committee for Sustainable Development (CSD), chaired by the Prime Minister, is the main and highest mechanism for achieving the country's sustainable development. It comprises 37 members representing the government, private sectors, academia, and civil society, with the Secretary-General of National Economic and Social Development Board (NESDB) as the secretariat. The main task of CSD is formulating polices and national sustainable development strategies, and oversight their implementation, including the SDGs. It has established three sub-committees on: a) mobilizing the SDGs; b) raising awareness on sustainable development and the application of Sufficiency Economy Philosophy (SEP); and c) compiling data and statistics to support the implementation and monitoring of the SDGs.

The *20-year National Strategy* is used as a guideline for overall country development path for the period from 2017 to 2036. Based on this strategy, the *12th National Economic and Social Development Plan* (NESDP) was developed as a framework for the country's development during the first 5-year period (2017-2021).

In addition to the 20-year strategy and NESDP, Thailand committed itself to implement the *2030 Agenda for Sustainable Development* and SDGs. The government established the National Committee on Sustainable Development, of which the main task is formulating polices and strategies on national sustainable development and oversee their implementation, including the SDGs. In 2017, Thailand submitted the *Voluntary National Review* report, which outlines significant progress in 2016, approaches and good practices applied in implementing the 17 SDGs, especially the SEP for SDGs model, as well as challenges faced in achieving some of the goals.

Other plans and policies have been developed in accordance with the NESDP as well as SDGs by the respective ministries. **Table 12.3** reviews the national policies and laws, international agreements, and other supporting governance mechanisms.

2. Partnerships in coastal and ocean stewardship

Thailand has joined partnerships in ocean stewardship at the regional level. Two significant regional programmes include the UNEP/GEF South China Sea Project[1] and Bay of Bengal Large Marine Ecosystem Project (BOBLME). At the local level, Chon Buri City Municipality has also joined PEMSEA in implementing Integrated Coastal Management (ICM) Project in Chon Buri Province, the eastern coast of the Thailand.

[1] Referred to hereafter as the project entitled "Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand", was funded by the Global Environment Facility (GEF) and implemented by the United Nations Environment Programmememe (UNEP) in partnership with seven riparian states bordering the South China Sea.(Cambodia, Indonesia, Malaysia, the Philippines, Thailand, and Vietnam). Planning commences in 1996. The project became fully operational in February 2002. It was formally closed by the end of January 2009.

a) UNEP/GEF South China Sea Project

The UNEP/GEF South China Sea Project was initiated in 2002 and completed in 2008. The project was implemented by the United Nations Environment Programme (UNEP) in partnership with seven riparian states bordering the South China Sea. It addressed three priority areas of concern identified as the loss and degradation of coastal habitats, over-exploitation of fisheries, and land-based pollution. The main output of the UNEP/GEF project is Strategic Action Programme for the South China Sea that includes strategic priority actions to promote sustainable management for the coastal habitats (mangrove, coral, seagrass, and coastal wetlands) and fisheries. Under the UNEP/GEF SAP, for the fisheries component, the project title "Establishment and Operation of a Fisheries Refugee in the South China Sea and Gulf of Thailand" has been executed regionally by the Southeast Asian Fisheries Development Center (SEAFDEC) in partnership with the government agencies responsible for fisheries in the six participating countries, covering the duration of 2015-2019. The proposed actions to promote the sustainable management of the coastal habitat components (mangrove, coral, seagrass and coastal wetland) have not been implemented yet (as of writing this NSOC Report).

b) Bay of Bengal Large Marine Ecosystem Project (BOBLME)

The BOBLME[2] is rich in natural resources, including extensive mineral and energy resources; marine living resources that support major fisheries; and forest and land resources. The LME is the site of three important critical habitats – mangroves (12% of world mangrove resources); coral reefs (8% of the world's coral reefs), and seagrass. The BOBLME is an area of high biodiversity, with a large number of endangered and vulnerable species. The LME and its natural resources are of considerable social and economic importance to the bordering countries, with activities such as fishing, shrimp farming, tourism, and shipping contributing to food security, employment, and national economies. Under the BOBLME, the Strategic Action Programme (SAP) has been developed based on the Transboundary Diagnostic Analysis and adopted in 2015 by the eight countries surrounding the Bay of Bengal – Bangladesh, India, Indonesia, Malaysia, Maldives, Myanmar, Sri Lanka, and Thailand. The SAP is a negotiated policy document that sets out a programme of actions, which address the causes of the major fisheries, environmental, social, and economic issues. Four main themes are addressed under BOBLME/SAP that include: 1) Theme Marine living resources with the objective that fisheries

[2] The eight countries surrounding the Bay of Bengal – Bangladesh, India, Indonesia, Malaysia, Maldives, Myanmar, Sri Lanka, and Thailand – committed themselves to work together through the Bay of Bengal Large Marine Ecosystem (BOBLME) Project to better the lives of the coastal populations through improved regional management of the Bay of Bengal environment and its fisheries. The BOBLME Project began in April 2009 and ran until December 2015. FAO was the executing agency. The BOBLME Project was principally supported by the Global Environment Facility (GEF), the Norwegian Agency for Development Cooperation (NORAD), Sweden through the Swedish International Development Cooperation Agency (SIDA), the Food and Agriculture Organisation of the United Nations (FAO), the National Oceanic and Atmospheric Administration of the USA (NOAA), and the World Bank.

and other living marine resources have been restored and are managed sustainably; 2) Theme Critical habitats with the objective that degraded, vulnerable, and critical habitat are restored, conserved, and maintained; 3) Theme Water quality with the objective that coastal and marine pollution and water quality are controlled to meet agreed standards for human and ecosystem health; and 4) Theme Social and economic considerations with the objective that social and economic constraints are addressed, leading to increased resilience and empowerment of coastal people. Thailand, as one of the national partners, assigned the Department of Fisheries under the Ministry of Agriculture and Cooperative, and Department of Marine and Coastal Resources under the Ministry of Natural Resources and Environment asthe two main institutions responsible for implementing and coordinating SAP/NAP for the country.

c) Chon Buri Integrated Coastal Management (ICM) project

The Chon Buri Integrated Coastal Management (ICM) Project is a partnership between the Provincial Government of Chon Buri and PEMSEA in order to support capacity building of local governments to manage natural resources and environment. In 2002-2004, the Chon Buri Coastal Strategy (CS) was prepared by various stakeholders, which provides a framework for partnerships in coastal management. Action programmes from the CS were developed and had been adopted in the municipal plans of the five municipalities, and then expanded to the entire coastal municipalities. Sriracha Municipality was chosen as a pilot site in implementing the ICM action plan. Activities included specific training workshops and consultations, public awareness and stakeholder mobilization activities, and scientific studies for projects concerning the protection and rehabilitation of coastal and marine resources, such as researches on sea turtle disease and research on culture of local fish. The most significant impacts of ICM implementation in Chon Buri ICM programme are enhancing sectoral and intergovernmental integration of efforts, and enhancing ownership for and confidence in ICM implementation, which have been demonstrated by the joint effort in developing and implementing the area-wide Coastal Strategy Implementation Plan and establishment of institutional arrangements for ICM implementation. A national decentralisation policy mandating management responsibilities to local governments contributed to stronger commitment of resources for the implementation of ICM programmes.

In 2016, a project on scaling up of ICM implementation in the the provinces of Rayong, Chanthaburi, and Trat in the east coast of the GoT has been initiated with the signing of the Memorandum of Agreement between PEMSEA and MNRE. The success of ICM implementation programme in Chon Buri can contribute to capacity building of local officials and institutions and greater involvement of local and national scientific research and educational institutions.

Table 12.3. Policies and Governance.

	Ocean and coastal management	Fisheries	Marine tourism	Ports and shipping	Emerging blue economy industries	Coastal and marine ecosystems and biodiversity conservation	Pollution reduction				Climate change adaptation and mitigation
							Solid and hazardous waste	Sanitation, wastewater and nutrients	Plastic waste	Sea-based pollution	
International agreements adopted	• UNCLOS • SDG 14	• Conservation and Management of Highly Migratory Fish Convention • Agreement on Port State Measures to address IUU fishing (FAO) • SDGs 14		• MARPOL • OPRC • CLC 1992 • FUND 1992	SDGs	• CBD and Aichi biodiversity targets • Ramsar Convention • CITES	• Minimata Convention • Basel Convention	SDGs 6, 14		MARPOL	UNFCCC - Kyoto Protocol - Paris Agreement
National policies and laws	• PMCRM Act of 2015 • National Park Act of 1983	• Royal Ordinance on Fisheries of 2015 • Marine Fisheries Management Plan (2015-19)	• National Tourism Policy Act, 2008 • National Tourism Development Plan (2017-2021)	Navigation in Thai Water Act, 1913 Thai Vessels Act, 1938 • PSHEMS • IMDG Code	National 20-Year Strategy EEC Project	Promote CBD and Aichi target implementation	Hazardous Substances Act, 1992; National Solid Waste Management Master Plan (2016-20)	Clean Water Act; Wastewater Management Law	ECNEQ Act of 1992	ECNEQ Act of 1992	ECNEQ Act of 1992
Strategic action plans	Draft ASEAN Environmental Strategy for Thailand 2018-2025	Plan of Action on IUU fishing	Ecotourism Strategy				Zero Waste Action Plan	• Urban Sanitation • National wastewater	Plan of Action on Plastic Waste Management Program		• National Climate Change Strategic Plan • National Biodiversity Action Plan • Plan of action on climate change
Mandated government agencies	DMCR, DMR	DOF	DoT, TAT	PAT, MD	MOI	ONEP, DMCR			PCD		ONEP, DMCR

Table 12.3. Policies and Governance (cont.)

Government budget allocation	Yes and increased	Yes and increased	Yes and increased	Yes and increased	Yes and increased	Yes and increased	allocation Yes and increased	Yes and increased	Yes and increased	Yes and increased	Yes and increased
Other funding sourcs	GEF, UNDP, UNEP	GEF, UNDP, UNEP, WB, FAO					GEF, UNDP, UNEP, WB, ADB, UNIDO	GEF, UNDP, UNEP, WB, ADB	GEF, UNDP, UNEP, ADB	GEF, UNDP, UNEP, WB, ADB	GEF, UNDP, UNEP, WB, ADB, UNDIO
Staff allocation and capacity development	Yes, but not enough – need capacity building on monitoring and evaluation						Yes, but not enough – need capacity building on monitoring and evaluation				
Targeted research and development	• Microplastic waste impacts • Monitoring of state of coral and beaches	CPUE MSY	MPA Carrying capacity	Innovation in Green port	• Biotechnology • Wave and tidal energy • offshore wind energy	Yes and increased	waste treatment technology	waste treatment technology water quality monitoring	alternative products recycle and epicycle technology	monitoring and assessment methods	Impact of seawater temperature change, acidification and sea level rise
Public awareness; Stakeholder participation	Network of local conservation groups	Community-based projects; Crab bank projects	Education and awareness raising on marine litter, tourist impact on coral reefs	Education and awareness raising on impact of sea-based pollution	Promoting SME, community initiatives on bio-products	Education and awareness raising on ecosystem conservation, marine turtles, etc.					
Inter-agency coordination mechanism	National Committee and Sub-Committee on Coastal and Marine Resources Management	National Committee and Sub-Committee on Fisheries	National Committee and Sub-Committee on Sustainable Tourisms/Eco-tourism	National Committee and Sub-Committee on Green Port Management		National Committee and Sub-Committee on Coastal and Marine Resources Management / Biodiversity Conservation	National Committee and Sub-committee on Solid Waste and Hazardous Waste Management	National Committee and Sub-Committee on Sanitation	National Committee and Sub-Committee on Waste Management	National Committee and Sub-Committee on Solid Waste Management	National Committee and Sub-Committee on Climate Change
Partnerships (with donors, international financial institutions, NGOs, etc.)	International Coastal Clean Up	MFF Crab bank model		PEMSEA (PSHEMS ICM)		Mangrove planting, artificial reefs	EU Sustainable consumption and production SWITCH Asia Programme				

12.2 Addressing Sustainable Development in Coastal and Marine Areas

12.2.1 Fisheries Management

The introduction of trawlers in the early 1960s has made Thailand one of the top 10 countries in the world for several decades. This has led to overexploitation, stock depletion, and a continuous decline in marine fisheries production in Thai waters, particularly in the GoT.

Thailand has established a number of policies and plans to solve the problems including promotion of coastal aquaculture, mainly shrimp farming. Significant changes that occurred in 2014, in response to combat IUU, was the amendment of fisheries law resulting in the new *Fisheries Act, 2015 and the Royal Ordinance for Fisheries, 2015*. The 2015 Ordinance has greatly strengthened the government's ability to regulate illegal fishing activities as well as to facilitate sustainable fisheries practices.

To enhance the implementation of these laws, the *Marine Fisheries Management Plan* (FMP) 2015-2019 was developed to mainly combat IUU fishing. The FMP also proposes several changes on research, data and information, institutional arrangement, and strengthening the human capacity. The Thai Government commits to allocate funding as well as increase significant number of personnel for various activities of FMP implementation. The FMP will be reviewed every year with a report on progress against the objectives. A major evaluation and review of this plan will be carried out every 2 years, and if appropriate, the issues, goals, and objectives will be modified.

12.2.2 Sustainable Tourism

The tourism industry is of great economic significance to the economy of Thailand. Its contribution to Thailand's GDP was 16.6% in 2015. In addition to its GDP contribution, the industry created more than 4.2 million employments or 11% of total national employment. Despite its strong contributions to the economy, accelerated growth of the tourism industry has major impacts to the environment.

In order to promote tourism in Thailand, the government has set up the vision which is "2036, Thailand will be a World's leading quality destination, through balanced development while leveraging Thainess to contribute signicantly to the country's socio-economic development and wealth distribution inclusively and sustainably." The *2nd National Tourism Development Plan (2017-2021)* was formulated by the Ministry of Tourism and Sport to realize the 2036 vision. There are five strategies under this plan, one of which is "Development of tourism attractions, products, and services including the encouragement of sustainability, environmental friendly, and Thainess integrity of attractions." One of the initiatives under this strategy recommends actions to protect and restore the fragile beaches and environmental attractions using both strict limitation on the number of tourists allowed and the education of preservative behaviour to tourists. The

success of this strategy, however, is dependent upon the priority set by the government and the capacity of concerned agencies to implement the plan.

12.2.3 Marine and Coastal Protected Area (MCPA) and Ecosystem Conservation

The sub-committee on mobilizing the SDGs established working groups responsible for implementing all SDGs, including SDG14 (Chaired by representative from DMCR).


Photo from: TEI

Thailand has given particular importance to SGD14 target "to conserve at least 10% of coastal and marine areas, consistent with national and international laws based on the best available scientific information by 2020". With Thailand's effort to help achieve this goal, in February 2016, DMCR has designated nine important marine and coastal areas as the marine protected areas under the 2015 Promotion of Marine and Coastal Resources Act. Other types of coastal and marine protected areas (under the National Park Act and the National Environmental Quality Act) have also been proposed to be designated to fulfill Thailand's conservation goal by 2020.

However, Target 11[3] under the *Aichi Biodiversity Targets* emphasizes that establishing protected areas alone will not achieve conservation objectives and that attention needs to be provided to improving the management of existing sites in addition to ensuring good management of newly created sites.

As such, in 2012, IUCN and the Department of National Parks, Wildlife and Plant Conservation conducted an assessment of management effectiveness of Thailand's marine and coastal protected areas as part of the Mangroves for the Future programme, consisting of both system level assessment and a site level assessment of 16 marine national parks. Poaching, encroachment, damage from tourists and visitors, incompatible surrounding land use, coral bleaching, pollution, and impacts of fishing were reported as the most significant threats to marine and coastal protected areas.

Marine and coastal protected areas (MCPAs) are very important for biodiversity conservation, economic development, and livelihood security for Thailand. Therefore, a well-managed,

[2] Aichi Target 11: By 2020, at least 17% of terrestrial and inland water, and 10% of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.

representative MCPA system in Thailand lies at the heart of achieving a balanced and healthy marine and coastal system as a foundation for sustainable development and livelihood security.

a. MFF Trans-boundary dolphin conservation along Thailand and Cambodia coastline

Mangrove for the Future (MFF) is a partnership initiative to address challenges to coastal ecosystems (e.g., coral reefs, estuaries, lagoons, sandy beaches, seagrasses, and wetlands) as well as promote sustainable livelihood of local communities. Co-chaired by IUCN and UNDP, MFF provides small, medium, and large grants to support national initiatives that provide practical, hands-on demonstrations of effective coastal management in action. It initially focused on the tsunami worst affected countries, i.e., India, Indonesia, Maldives, Seychelles, Sri Lanka, and Thailand, and later expanded to include Bangladesh, Cambodia, Myanmar, Pakistan, and Viet Nam. MFF also promotes transboundary cooperation among participating countries. Trans-boundary dolphin conservation along the Thai-Cambodian border was implemented in 2015-2016 to foster cooperation on the sustainable management of shared marine resources along the coastline of Thailand and Cambodia. The main objective of the project is to protect the remaining populations of four dolphin and porpoise species along the coastline of Trat Province of Thailand and Ko Kong Province of Cambodia. The project aims to improve fishing practices and address habitat degradation and pollution, which are the main threats to dolphin population. The project was also intended to strengthen local dolphin conservation networks and encourage sharing of local knowledge and experience on dolphin conservation. It also promoted ecotourism (dolphin watching) and other livelihood opportunities for local people through collaboration with local administrations to ensure its sustainability.

b. The Kung Krabaen Bay Royal Development Study Center

Over the years, the spirit of unity inspired by the Sufficiency Economy Principle has helped bring together an array of like-minded talents focused on protecting and rehabilitating the country's marine resources. Founded in 1981, the Kung Krabaen Bay Royal Development Study Centre, which is located in Thamai District, Chantaburi Province, has had notable success in restoring mangroves, promoting eco-tourism, improving livelihoods, and increasing the output of local fisheries and shrimp farms. The total implementation area of the Kung Krabaen Bay Royal Development Study Centre covers 131 km2, divided into 6.4 km2 of the center area, 85.6 km2 of the implementation area outside the centre, and 38.9 km2 of the expanded area, which also include the 33 surrounding villages (DOF, 2017). The coastal resource management of Kung Krabaen Bay is done by various stakeholders (e.g., several government agencies, private sector, academia, local community, and media) in an "interdisciplinary" manner. The activities started from the mountains downward through agricultural lands to coastlines and the sea. These activities are relatively managed together using integrated approaches to create

an understanding among local people of the means to use coastal resources, which create sustainability as well as promote development-oriented tourism. The activities include:

- Marine seed production;
- Oyster seed bed development and hanging culture in outlet canals;
- Seagrass conservation and management;
- Mangrove reforestation;
- Mangrove forest conservation;
- Reallocation of deteriorated mangrove areas for coastal aquaculture activities;
- Extension of shrimp culture with environmental conservation; and
- Eco-tourism.

c. Green Fins

Green Fins was initiated in 2004 and coordinated by the Secretariat of COBSEA, United Nations Environmental Programme (UNEP) as part of the efforts to increase public awareness on diving and snorkeling practises that will contribute to the conservation of coral reefs and reduce current unsustainable tourism practises. Its mission is "to protect and conserve coral reefs by establishing and implementing environmentally friendly guidelines to promote a sustainable diving tourism industry."

Thailand started the Green Fins Programme in 2004. The project has been implemented on Ko Phi Phi, Ko Lanta in Phuket, Ko Tao, Ko Samui in Surat Thani and Ko Phra Thong, Takua Pa, Ko Lipe, Khao Lak, and Pattaya. And the network continues to grow. The Phuket Marine Biological Centre, led by Green Fins Thailand Network Leader, Niphon Phongsuwan, has been training SCUBA diving and snorkeling operators for many years. In addition to implementing the Green Fins Code of Conduct, other activities, such as beach and coastal clean-ups and coral reef monitoring are also encouraged.

12.2.4 Integrated Coastal Management

Chon Buri ICM Site

The Chon Buri Integrated Coastal Management (ICM) Project was initiated by the Provincial Government of Chon Buri with PEMSEA's support to strengthen capacity of local governments on coastal and marine resources management. Central government agencies, local government units, and local stakeholders were involved in project planning and development since the beginning of the project in November 1999. The ICM Project was initiated at a most opportune time after the implementation of the decentralization policy, which delegated responsibility and provided more authority to local governments to manage their natural resources and environment.

a) Chon Buri Coastal Strategy

In 2002-2004, the *Chon Buri Coastal Strategy* (CS), based on scientific data and information and in consultation with various stakeholders, was prepared as a framework for partnerships in coastal management among the participating municipalities, government agencies, and other stakeholders. A Declaration was signed to start effective and systematic implementation of the Coastal Strategy on 21 September 2004. This became the basis for reorganizing the PCC and developing action plans for the implementation of the CS. Action programmes from the CS had been adopted by five municipalities first, and then later on by the entire 24 coastal municipalities. The CS has been incorporated in their municipal plans.

b) Coastal Strategy Implementation Plan

The *ICM Action Plan for Chon Buri Province for 2006-2008* (CS Implementation Plan or CSIP) specifies necessary action programmes and collaborations to preserve natural resources, environment, customs, and culture for the next generations in Chon Buri Province. This was prepared by the Project Management Committee and Working Group composed of relevant authorities and agencies from both public and private sectors, and approved by the Municipal Councils of the five participating municipalities and the Provincial Government. Sriracha Municipality initially served as a pilot site in developing and implementing an ICM Action Plan in order to serve as a model for the other municipalities.

The CSIP focuses on protection and rehabilitation of natural resources and marine environment. The Municipality worked in close cooperation with relevant authorities, state enterprises, private sector, people, and educational institutions and received support in terms of knowledge, materials, equipment, and joint implementation. Activities included specific training workshops and consultations, public awareness and stakeholder mobilization activities, and scientific studies for projects concerning the protection and rehabilitation of coastal and marine resources.

c) Environmental Risk Assessment

The *Chon Buri Initial Risk Assessment* (IRA) identified priority environmental issues of concern in the area as well as the technical gaps. The results of the IRA have been used as inputs in the development of programmes for priority implementation.

d) Integrated Information Management System

The *Integrated Information Management System* (IIMS) consolidates a wide-range of information to support environmental decision-making, although its applications as decision-support system for coastal management and governance is yet to be fully utilized.

e) Linkage with science

The importance of scientific information to support better coastal management was widely recognized, and linkages with scientific institutions and experts have been strengthened. Management-related scientific studies have been implemented and utilized to guide planning and implementation of various ICM activities, including researches on sea turtle disease to support the sea turtle conservation programme and research on culture of local fish species to support local livelihood.

f) Stakeholder participation in habitat restoration, biodiversity conservation and waste management

Mangroves have also been re-planted in various municipalities. Various structures have been set up to protect and conserve blue swimming crabs. The sea turtle release programme has been an annual event, releasing around 100 turtles yearly. Beaches and coastlines are cleaner due to the clean-up drives. Public participation in waste management has improved with the garbage banks. Wide stakeholder participation characterized all activities. The ecological and socio-economic impacts of these activities may not be immediately evident, but with sustained efforts and proper monitoring, positive impacts are expected.

g) Crab Condominium Project

The blue swimming crab is among the economically important species in Thailand, However, the production has been declining due to overfishing and environmental degradation. The low stock abundance has direct impact on local fishermen whose livelihood depend on the harvest of blue swimming crab. In response, a project was initiated to rehabilitate blue swimming crab population in Sriracha district, Chon Buri Province by using man-made underwater structures called "crab condominium" or "crab condo" as a nursery for gravid crabs. The crab condo consists of a stack of baskets where gravid female crabs are kept inside until the eggs are released. With technical support from Kasetsart University, local fishers were made responsible for the maintenance of the crab condo, which was placed in the sea near the coast. The Sriracha crab condominium project has been a success in increasing the crab population and raising public awareness on crab conservation. The crab condominium model was implemented in other coastal fishery villages in Chon Buri Province.

On the whole, the most significant impacts of ICM implementation in Chon Buri ICM programme are the enhanced multi-sectoral, vertical and horizontal integration of efforts, and enhanced ownership for and confidence in ICM implementation, which have been demonstrated by the joint effort in developing and implementing the area-wide CSIP and establishment of institutional arrangements for ICM implementation. The CSIP, which has been approved at the municipal and provincial levels, provides the commitments of the government and participating sectors for coastal and ocean management in Chon Buri. Although prepared for the short-term, the benefits to be derived from its implementation are expected to catalyze follow on programmes

using the integrated approach to promote the Coastal Strategy and the SDS-SEA in relation to the continuous scaling up of the ICM area.

Scoping of existing and new ICM sites under the GEF/UNDP/PEMSEA Project on Scaling up the Implementation of the SDS-SEA was undertaken in 2016 in Thailand. The project aims to extend ICM programme coverage to 20% of the country's coastline, with scaled-up local ICM programme implementation in four participating provinces (Chon Buri, Rayong, Chanthaburi, and Trat). This will contribute towards achieving the target of 20% (45,000 km) of the EAS region's coastline covered by ICM programmes (geographical scaling up) with essential ICM governance mechanisms in place and operational. The scaling up of the ICM project in Thailand is now moving onward with the organization of an inception/planning workshop with the DMCR, MNRE.

Saensuk Municipality, Chon Buri ICM Site

One of the first municipalities in Chonburi to be part of the PEMSEA ICM Demonstration Project in 2001, Saensuk Municipality is implementing measures to protect its marine and coastal resources:

- Guide and support the implementation of the National Act;
- Utilizing ICM planning and implementation mechanisms already established in the municipality since 2001; and
- Stakeholder engagement and partnership building as a major feature of the management of Saensuk's coastal area and resources.

In line with the Coastal Strategy adopted as a long-term framework for cooperation in marine and coastal resources management in the province in 2004, Saensuk Municipality prepares a Coastal Strategy Implementation Plan (CSIP) or ICM Action Plan every 3 years in line with the government planning cycle. Considering available scientific information, the CSIP for 2013-2015 identified as priorities coastal erosion management, local oil spill management, waste management, and habitat and crab conservation.

a) Coastal erosion

Coastal erosion has been a problem in the coastlines of the GoT and the Andaman Sea with over 200 km of affected areas. The SDS-SEA project will support the development of an integrated coastal erosion management plan for Saensuk.

b) Oil spills

Due to the large number of shipping activities and volume of oil passing through Chonburi waters and proximity of Saensuk's beach to oil tankard and international seaports, the province, including Saensuk, is vulnerable to oil spill impacts, mostly from unknown sources. Thailand has a National

Oil Spill Response Plan (OSRP), which specifies roles for local governments in oil spill shoreline response and clean up.

To strengthen the capacity of local governments to support national oil spill response, PEMSEA facilitated the development of a provincial oil spill contingency plan (OSCP) for Chonburi, which was adopted in November 2010. It was a multi-stakeholder effort involving Thailand's Marine Department, the Royal Thai Navy, Chonburi Disaster Prevention and Mitigation Office, the local governments in coastal municipalities in Chonburi, the port authorities, and the private oil industry companies through the Industry Environmental Safety Group.

The SDS-SEA project supports capacity building and development of an operational plan for the provincial OSCP. The ICM Coordinator of Saensuk was involved in providing training related to oil spill contingency planning as part of the implementation of the Gulf of Thailand Framework Programme for joint oil spill preparedness and response (among Thailand, Cambodia, and Viet Nam). The training was facilitated by PEMSEA.

In 2015, in collaboration with the key agencies at the national, provincial and local levels, and with key stakeholders from various sectors, Saensuk Municipality developed and adopted a local oil spill contingency plan, organized their response mechanisms, and conducted necessary trainings on shoreline response and clean up. The Environmental Sensitivity Index (ESI) map that was prepared with support from PEMSEA, was used in preparing the oil spill contingency plan for Saensuk. Continuing capacity building in support of the local OSCP is incorporated into the municipal work plan and budget.

The effectiveness of the implementation of Saensuk's local OSCP was exemplified with the timely and organized response to the oil spill that affected the municipality's Bangsaen beach in September 2016. The following response measures were undertaken:

- Beach clean-up was done together with several partners, and the 2.5 km beach area was opened to tourists the following day;
- Health care was provided to affected tourists/responders in collaboration with health institutions; and
- Environmental monitoring, including seawater and seafood were done in collaboration with Burapha University, a PEMSEA ICM Learning Centre.

12.2.5 Marine Pollution Reduction

Marine pollution, particularly from land-based activities, has been one of the most serious threats to the marine environment. Marine pollution is mainly caused by wastewater and solid waste discharged from land.

For overall pollution management in Thailand, the government has established the 20-Year Pollution Management Strategy and Pollution Management Plan 2017-2021.

Wastewater from urban areas is one of the most serious pollution problems facing Thailand. There are about 100 treatment plants constructed in Thailand with the treatment capacity of about 23% of domestic wastewater generated. Current measures on water quality management in Bangkok include: implementation of central wastewater treatment projects; improvement of the community wastewater treatment plants, improvement of canal water and canal cleanup campaign, effective enforcement of effluent standards; and, public education and awareness raising.

Similar to wastewater, solid waste is a major problem in Thailand. A significant amount of uncollected and improper disposal of wastes, particularly plastic wastes from inland areas, have been transported into the sea. When these wastes reach the marine environment and become marine debris, they are very difficult to manage. In order to prevent the problem of marine debris from land-based sources, plans and policies related to solid waste management were implemented:

- *Roadmap on Waste and Hazardous Waste Management;*
- *National Solid Waste Management Master Plan (2016-2020); and*
- *Thailand Zero Waste Action Plan (2016-2017).*

At the high-level United Nations Conference to Support the Implementation of Sustainable Development Goal 14 held at the UN Headquarters in New York on 5-9 June 2017, Thailand made voluntary commitments to mitigate marine debris, which include coastal cleanup in all coastal provinces, implementing plastic waste reduction measures in all 549 coastal municipalities, undertaking researches on situation and impacts of plastic debris in marine environment, and establishing a national database of marine debris.

a) Laem Puk Bia Environmental Research and Development Project

The Laeam Pak Bia Environmental Research and Development (LERD) Project is a Royal initiative of the Chaipattanna Foundation. The main objective of the project is to develop natural wastewater and waste treatment methods. Aside from research on environmental waste treatment techniques, LERD has begun raising awareness and providing communities and businesses with the environmental knowledge necessary to implement LERD's methods throughout Thailand. The project has built wastewater and waste treatment models ideal for Thai communities, which are simple, natural, and low cost.

Wastewater treatment models developed by LERD include: oxidation pond treatment system, grass filtration system, artificially constructed wetland systems, and mangrove ecosystems. This is beneficial because the most suitable waste treatment method can then be chosen for each area

and client. The research environmental methods have been adapted for wide implementation throughout Thai communities and industries.

LERD focuses on researching and developing waste and wastewater management technologies as well as providing academic service while transferring the knowledge to others. The contribution of LERD is to raise awareness to environmental protection and provide services to underprivileged communities and industries that lack financial and technical support to have access to clean water and sustainable waste treatment.

b) Port Safety, Health, and Environmental Management System (PSHEMS)

The PAT recognized that PSHEMS is an integrated management system, designed to provide a management framework for enhancing efficiency, cost-effectiveness, and profit for their operations. PAT therefore implemented PSHEMS at the Bangkok Port after the explosion that occurred at the dangerous cargo warehouse in March 1991. Taking into consideration the availability of resources, manpower, and time constraints, the initial phase of PSHEMS initiative covered only dangerous goods handling since it is one of the core processes in port operations and has the highest threat level to safety, health, and environment. With the development and implementation of PSHEMS, remarkable improvements were experienced in the handling of dangerous cargo. Several measures were undertaken to prevent accidents in the dangerous goods area to prevent potential environmental hazards. The scope of PSHEMS was later broadened to include all other services in the organization.

For Laem Chabang Port, a series of trainings on PSHEMS were conducted by the PEMSEA Resource Facility (PRF) for relevant stakeholders, such as the port officers, Customs, Marine Department, private terminal operators, and dangerous goods warehouse operator at Laem Chabang Port.

Status of PSHEMS implementation in Thailand:

Bangkok Port:

- Technical assistance conducted by PEMSEA 2005 to 2006
- PSHEMS Level 1 Certificate of Recognition issued by PEMSEA since 2006; Annual surveillance audit requested by Bangkok Port from PEMSEA including continual improvement trainings. Certificate of Recognition re-issued 2009, 2012, 2015, 2018
- Recently received PSHEMS Level 1 Certificate of Recognition last March 2018
- Bangkok Port started the development of the PEMSEA PSHEMS Level 2, their goal is to receive the PEMSEA PSHEMS Level 2 certificate by 2019.

Laem Chabang Port:

- Technical assistance conducted by PEMSEA 2008 to 2009
- PSHEMS development started in 2008 with participation of Terminal Leasing Companies: LCB Container Terminal 1 Limited, LCMT Company Limited, and JWD Info Logistics Co., Ltd.
- PSHEMS Level 1 Certificate of Recognition issued by PEMSEA in 2009; Annual surveillance audit requested by Laem Chabang Port from PEMSEA including continual improvement trainings. Certificate of Recognition re-issued 2012 and 2016
- Laem Chabang Port requested PEMSEA for technical assistance for the PSHEMS Level 2, their goal is to receive the PEMSEA PSHEMS Level 2 certificate by 2019.

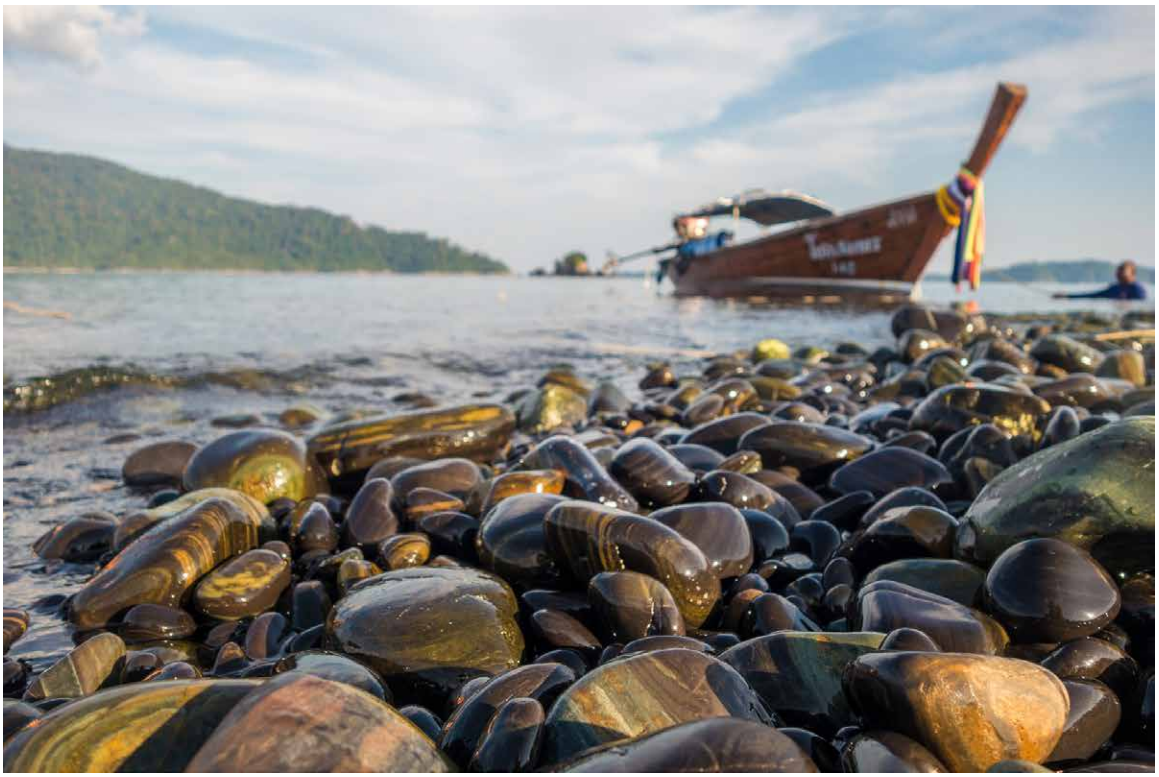
12.2.6 Sub-regional Arrangement: Oil Spill Preparedness, Response and Cooperation in the Gulf of Thailand (GoT Programme)

On 12 January 2006, ministers from three GoT littoral states, namely Cambodia, Thailand, and Viet Nam, signed the *Joint Statement on Partnership in Oil Spill Preparedness and Response in the Gulf of Thailand*, and endorsed the *Framework Programme for Joint Oil Spill Preparedness and Response in the GOT*. The framework aims to enhance national capacity and promote regional partnership in oil pollution prevention, preparedness, and response by exchanging information, research and conducting oil spill response exercises. It outlined the following strategies to strengthen policy and legal frameworks to develop and support national system for oil preparedness and response:

- Developing/enhancing national/local oil spill contingency plans;
- Information sharing;
- Joint training of relevant personnel; and
- Oil spill exercise conducted in partnership with IMO, ITOPF, NOAA, OSRL, and IESG. PEMSEA provided technical support to participating countries in the preparation, adoption, and implementation of the framework.

The Marine Department, Ministry of Transport is the National Contact Point in Thailand for the partnership in GoT.

With support from IMO, KOICA, and PEMSEA, the *ESI Atlas for the GoT* was developed through collaboration of sub-regional and national technical teams. The ESI Atlas provides maps to guide the planning and response to oil spill incidents. It is being used as reference during oil spill response exercises. The ESI Atlas can be accessed from the Marine Department's website.



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PART 6

SUMMARY AND CONCLUSION

13 Summary, Conclusion, and Recommendations

The maritime zone of Thailand covers an area of 323,488.40 km^2 with GoT having an area of 202,676.20 km^2 with an average depth of about 44 m and the deepest basin of 86 m. The Andaman Sea covers an area of 120,812.20 km^2 with an average depth of about 1,000 m in the northern part and 300 m in the southern part. The coastline, which is 3,148 km long, is divided into two parts- the Gulf of Thailand on the east (2,055 km) and the Andaman Sea on the west (1,093 km). Coastal province population in 2015 was 15,410,429 people or 23.44% of the total population (65,729,098).

13.1 State of Ocean Health

In 2017, Thailand ranked 75th in terms of the Ocean Health Index (OHI) among 221 countries and territories with an overall score of 71 (www.oceanhealthindex.org/). The highest score was 86 in 'coastal livelihoods and economies' and in 'biodiversity', and the lowest score was in the 'sense of place' and 'clean water'.

13.1.1 Coastal and marine ecosystems

Mangrove, coral reefs, and seagrass are important coastal ecosystems in Thailand. The main problem of these ecosystems was deterioration which significantly reduce the ability of these ecosystems to provide services to people (**Table 13.1**).

Table 13.1: Status and Value of Coastal and Marine Ecosystems.

Habitat	Area (km^2)	Valuation (USD million)	Status
Mangroves	4,591.18 (2014)	6,175.5 (2012)	Past: Decreasing mangrove area during 1961-1996 Present: Increasing mangrove areas from 2000 until 2014, mainly by planting of mangrove forest
Coral reefs	238.30 (2015)	1,061.7 (2013)	In 2011 – 2015: decrease in proportion of very healthy and healthy coral reefs (4%)
Seagrass	255.70 (2015)	2,144.1 (2012)	In 2015: poor condition due to anthropogenic disturbances (2%)

Major risks and threats

Increasing coastal developments (e.g., tourism, industry, transportation, and urbanization) and overexploitation of the marine living resources have threatened coastal ecosystems, such as the coral reefs, mangroves, and seagrasses. Threats to these ecosystems were pollution (nutrients from wastewater and marine litters), destruction of habitats, and overexploitation of biological resources.

Responses

The Government of Thailand has developed laws, strategies, plans, and measures to address the anthropogenic impacts on coastal and marine ecosystem, including:

- Promotion of Marine and Coastal Resources Management Act of 2015;
- The Enhancement and Conservation of National Environmental Quality Act of 1992;
- National Park Act of 1961;
- Royal Ordinance on Fisheries of 2015;
- Strategies and action plan on coral reef management of 2009;
- Strategies and action plan for seagrass and dugong management of 2008;
- The National Maritime Security Plan of 2015-2022;
- The National Environmental Quality Management Plan of 2017-2021;
- The 20-Year Ministry of Natural Resources and Environment Strategy of 2017- 2036; and
- Measures for mangrove reclamation.

Marine protected area

One of the methods of anthropogenic management activities on coastal and marine ecosystems was the establishment of the marine protected area (MPA). In Thailand, there are many types of MPA, which include Marine National Parks (National Park Act of 1961), Non-hunting Areas (Wild Animal Reservation and Protection Act of 1992), National Reserved Forest (Forest Act of 1941), Biosphere Reserve (UNESCO Man and Biosphere), Environmental Protection Areas (The Enhancement and Conservation of National Environmental Quality Act of 1992), and Plant Conservation Area (Royal Ordinance on Fisheries 0f 2015). Total area (minus overlapping areas) was estimated at 18,136 km2 (5.6 % of total maritime zone of Thailand).

13.1.2 Marine Water Quality

Marine water quality is being monitored. In 2015, all parameters were acceptable, as shown in **Table 13.2**. IGoT has the worst water quality, where phosphates are found to be at poor level.

Table 13.2: Status of Coastal and Marine Ecosystems.

Parameters	Rating	Note
DO	Good - Excellent	
pH	Good - Excellent	
Nitrates	Fair - Good	
Ammonia	Excellent	
Phosphates	Good*	Except the IGOT, phosphates is poor
Total coliform	Fair - Good	
Heavy metals**	Excellent	Heavy metals include arsenic, cadmium, copper, lead, and zinc

Note: Rating is percentage of stations that comply with the water quality criteria and standards, and fully support the intended use or classification of the water body: Excellent: 98%-100%; Good: 75%-97%; Fair: 50%-74%; and Poor: less than 50%.

Major risks and threats

The marine water quality in the Gulf of Thailand is deteriorating because of discharges of untreated wastewater from domestic, agricultural, and industrial sources as well as from uncollected solid waste and marine plastic debris.

Responses

From the anthropogenic impacts to marine water quality, the Government of Thailand regulated the land use activities with the implementation of laws, strategies, plans, and measures, such as:

- The Enhancement and Conservation of National Environmental Quality Act of 1992;
- Public Health Act of 1992;
- The Maintenance of the Cleanliness and Orderliness of the Country Act of 1992.
- 20-Year Pollution Management Strategy;
- Pollution Management Plan 2017-2021

Photo from: TEI

13.2 Ocean Economy

The contribution of the ocean economy to the national economy in Thailand is shown in **Table 13.3**. The total value of ocean economy in 2015 was USD118.19 billion, which is 30% of the GDP (Jarayabhand, et al., 2018)..

Table 13.3: Gross Provincial Product in 23 Coastal Provinces, 2015 (at constant price)

Parameters	USD billion
GVA of marine sectors in 23 coastal provinces*	118.19
Gross Domestic Product (GDP)	399.21
Percentage of GVA of marine sectors in 23 coastal provinces	29.61

**Estimated using GPP (sum of GVA of economic activities) of 23 coastal provinces, less GVA of non-marine sectors); does not include GPP of Bangkok.*

Coastal employment

There are 9,969,331 employees in 23 coastal provinces compared to 38,016,170 total employees in the country. The percentage of employment in the coastal provinces to the total employment in the country is 26.22%.

13.2.1 Fisheries and Aquaculture

Thailand is among the top marine fisheries producers and exporters for several decades, however, the production started to decline in 2006 and dropped to less than 1.5×10^6 tonnes from 2008. This was mainly due to overfishing and IUU fishing. Most of the marine capture fisheries production is consumed within the country, while aquaculture production, mainly shrimp farming, is for export. Thailand has no problem in terms of food security. Consumption of fish and fish products was 24.83 kg/capita/yr in 2003 compared to the world consumption of 18.98 kg/capita/yr. In terms of sustainability, catch per unit effort (CPUE) for the GoT and the Andaman Sea are 25 kg/hr and 140 kg/hr, respectively. The actual harvest in 2016 of demersal fish, anchovies, and other pelagic fish in both maritime areas were below the MSY of the same year. Threats to fisheries include destruction of habitats, which are the breeding, nursery and feeding grounds, and pollution from land- and sea-based sources. In addressing threats to fisheries, Thailand implemented the Marine Fisheries Management Plan (2015-2019), which aims to address IUU fishing and other issues.

13.2.2 Coastal and Marine Tourism

Major marine and coastal tourism sites are Phuket, Pattaya, and Ko Samui. The natural conditions of these provinces attract many tourists each year. In addition, Thailand's marine national parks are popular tourist destinations because of the coral reefs. Tourism in 23 coastal provinces

contributed to about USD24 billion in 2015. Tourism also provided 820,713 of employment in the hotel and food sector in the coastal provinces. Major threats to tourism include degradation of coastal ecosystems particularly coral reefs, and pollution from wastewater and marine litters. Degradation of the marine environment is mainly caused by overtourism, which consequently adversely affects tourism itself. Therefore, future tourism development should take into account the carrying capacity of the marine environment.

13.2.3 Ports and Shipping

There are two ports that provide services to international shipping of goods: Bangkok and Leam Chabang port,. Overall performance of Laem Chabang Port is better than Bangkok port.

Contribution of ports and shipping to the economy was significant with total revenue of about USD280 billion. The transportation sector, which included rail and road, employed 395,496 people in 2015. Growth in this sector is expected to increase with the implementation of the projected EEC. The challenge is in managing waste from ships due to the increasing number of ship calls and container and cargo throughput. Green port development should be applied to the third phase development of Laem Chabang and Map Ta Phut.

13.2.4 Offshore Oil and Gas

Offshore oil and gas is another major contributor to ocean economy. In 2015, production was equivalent to 293.7 million barrels of oil. The sector provided income for the government consisting of royalty, special remuneratory benefits, and petroleum income tax of USD3.8 billion. The government also received remuneration from the MTJDA valued at USD0.54 billion. Thailand is facing the challenge of decommissioning the offshore platforms at the end of their production. At present, consultation is going on between oil companies and the government to explore decommissioning options, including rig-to-reef decommissioning.

13.3 Blue Economy Initiatives

Development of the blue economy was initiated in some coastal areas. Section 3 of this NSOC report describes the different initiatives leading to the transformation towards a more sustainable, inclusive, and climate resilient blue economy. These include sustainable fisheries and aquaculture, ecotourism, green ports, and renewable energy. There were some projects, which would be maintained in the future because there is cooperation among the private and public sectors and the people. Description of some of these projects to protect ocean health and support the blue economy are shown in **Table 13.4**.

Table 13.4: Initiatives to Protect Ocean Health and Support Blue Economy.

Initiative	Laem Phak Bia Environmental Study and Development Project
Location	Phetchaburi Province
Innovations and best practices	Researching and developing natural wastewater and waste treatment methods.
Benefits and outcomes	Low cost waste treatment methods that can be developed for other areas.
Supporting policies and institutional arrangements	The project is a Royal initiative of the Chaipattanna Foundation.
SDGs being achieved	SDG 6 (Clean water and sanitation); SDG 14 (Life under water)

Initiative	Low Carbon Tourist Destination Project
Innovations and best practices	Using alternative energy, implement water and waste management, preserve local activities and traditional way of life, and establish environmental friendly tourist activities (e.g., cycling, kayaking & sailing)
Benefits and outcomes	Reduced carbon footprint, reduced pollution, and maintained and improved environment. Cooperation among relevant agencies.
Location	Ko Mak, Trat Province
Supporting policies and institutional arrangements	The National Climate Change Master Plan (2015 -2050) DASTA, ISMED
SDGs being achieved	SDG 7 (Affordable and clean energy); SDG 13 (Climate action); SDG 14 (Life under water); SDG 17 (Partnerships for the goals)

Initiative	Crab Bank Model
Location	Chumporn and Surat Thani
Innovations and best practices	Educating and empowering the local fisheries community to ensure their food security by engaging economic instruments and collaborative community management.
Benefits and outcomes	Achieved sustainable management of blue swimming crab
Supporting policies and institutional arrangements	Policies and laws: Royal Ordinance on Fisheries B.E. 2558 (2015); The Thai Crab Product Group (TCPG) formed in 2012 under the umbrella of the Thai Frozen Food Association (TFFA); and Department of Fisheries responsible for fisheries resources
SDGs being achieved	SDG 7 (Affordable and clean energy); SDG 13 (Climate action); SDG 14 (Life under water); SDG 17 (Partnerships for the goals)

13.4 Summary and Recommendations

There is an increasing trend in marine development activities from the past until present, both in terms of quantity and value, with the exception in fisheries. Overall development of the marine sector will increase in both types and numbers. This is because a continuous increase in population

at the global and regional levels (except for national levels) creates an increased demand for food and other necessities for living.

The limited land resources will be another driving force in ocean-based development. This driving force is coupled with a conventional development approach focusing on economic development, which the government has been using for a long time. This approach is still applied as evident in the current strategies and plans to pull Thailand out of the middle income trap. With the continuous response of the private sector, it has carried out marine activities without proper plan and control. This has resulted in continuous degradation of the marine and coastal ecosystems (e.g., coral reefs, mangrove forests, and seagrasses) in terms of quality. The marine and coastal resources, especially the coral reefs, have continuously and greatly been degraded, and in some cases, beyond carrying capacity of the ecosystems. Moreover, the environment issues - pollution, particularly marine litter and coastal erosion, were the main concerns in the 22 coastal provinces (Summary detail in **Table 13.5**. Also, see **Table 12.3**).

Based on gaps in policy and plans identified in this report, the following are recommendations for future actions:

13.4.1 National Ocean Policy and Strategy

In response to a lack of an overall national ocean policy, an integrated national marine policy should be developed in order to balance prosperity and sustainability. The national marine policy should:

1. Promote the development of blue economy by integrating the 20-year National Strategy, the 12th National Economic and Social Development Plan, the National Maritime Security Plan, the National Environmental Management Plan, and other related plans; and
2. Provide a framework for amending existing ocean-related laws to be in compliance with UNCLOS to facilitate the right of ocean users within and outside national jurisdictions.

13.4.2 Marine and Coastal Resources Development Activities

There is an increasing trend in coastal and marine development activities, particularly emerging activities, such as marine renewable energy and offshore aquaculture. All these activities can cause impacts on marine ecosystem, resources, and environment. Therefore, policies and measures are needed to mitigate and prevent these problems:

1) Framework of guidelines for each development activity, which includes marine mapping, marine spatial planning, and zoning. Such framework will include delineation of allowed, regulated and restricted uses and zoning for specific types and size of activities, as well as mitigation measures for each activity.
2) Application of User Pays Principle (UPP) to the management and development of ecosystem

services. In cases where resource uses are unavoidable, the beneficiary should be responsible for the cost of mitigating environmental impact of those uses. Examples of UPP measures which can be initially done are resource entrance fee for visiting islands, diving fee, and voluntary contribution from hotel guests in protecting marine environment. If successful, measures in the next step can include pollution fee, using the Polluter Pays Principle. Collection of such fees can be earmarked as another source of fund for management of marine and coastal resources.

3) Application of the concept of blue economy to ocean based economies, particularly in new and emerging sectors such as renewable energy, ship building and repair, biotechnology and bioprospecting, ecotourism and sustainable fisheries, and aquaculture.
4) Promote economic valuation of marine and coastal resources and environment uses including the importance of natural capital and ecosystem services. Such evaluation will be used to support decision making in developing guidelines, policies, and plans for ocean based development activities, such as coastal tourism and decommissioning of oil and gas production installations in the future.

13.4.3 Management of Marine and Coastal Resources

Based on the state of marine and coastal resources and environment, the following responses are recommended:

1) Establish measures and a clear approach for actions to control the use of marine and coastal resources, which directly and indirectly affect the ecosystem, resources, and environment, such as code of conduct on ecotourism, regulations on community waste treatment system, measures to promote reduction of plastic wastes, enhancing the establishment of local waste treatment system, as well as effective enforcement of laws and regulations and punishment.
2) Develop plans for conservation and rehabilitation of ecosystems, natural resources, and environment, such as conservation of coral reef as nursery ground of marine organisms, and rehabilitation of seagrasses as feeding ground for dugong. Furthermore, integration of these plans should be promoted at the local level.
3) Establish knowledge on the management of marine and coastal resources which integrate technical and traditional knowledge as well as raise public awareness on conservation of marine and coastal resources, particularly on issues that have global impact, such as marine litter.
4) Promote participation of all stakeholders in the assessment of the problems, identifying mitigation measures in addressing the problems, and prevention of problems in the future.

13.4.4 Scientific Research and Studies

Economic valuation and ocean accounts

Growth in social and economic development based on direct and indirect uses of marine and coastal

resources has caused continuous degradation of marine and coastal resources. Therefore, it is necessary to establish a decision-making system to create a balance among marine and coastal resource uses, and conservation and protection measures. Scientific research is needed to assess natural capital and ecosystem services, environmental damage, and tradeoffs, and make such information available to policy-makers to achieve inclusive and sustainable development. Linkage of scientific information on the marine environment, ecosystems and biodiversity to modeling and economic research is critical to enhance policy- and decision-making and improve development plans.

Specific data system should be designed and developed for ocean economic sectors, coastal and marine resources, and impacts of human activities, climate change, and governance in order to provide necessary information for assessment of the state of the ocean and coast of the country. In particular, the development of ocean accounts as part of the national income accounting system is needed to show the contribution of oceans to national and provincial economies, family incomes, jobs, livelihood, food security, climate protection, and well-being, and assess the multiplier effects.

13.4.5 Research and Development (Jarayabhand, et al., 2018.)

Research and development support is needed for innovative technologies, biotechnology, climate-smart aquaculture, green ports, and marine renewable energy. Incentives for deployment of R&D products would facilitate their application in traditional ocean economic activities, and boost the shift from the business-as-usual approach to innovative and sustainable blue economy.

Table 13.5: State of Ocean Health and Economy: Key Policies, Initiatives, and Challenges.

Initiative	Status	Response		Major issues and challenges
		Key policies/laws; national action plan	Example of best practice or initiative	
State of ocean health				
Mangroves: area 1961 - 1986 1989 - 1996 1996 - 2014	 ↓ - ↑	- Forest Act of 1941 - Mangrove reclamation measure - Mangrove replanting measure	- Integrated Coastal Management (ICM) : The Kung Krabaen Bay Royal Development Study Centre, Chantaburi Province - MFF	*Issues:* - Conversion of mangrove area - Wastewater and marine debris - Oil spill *Challenges:* - Monitoring of replanted forests - Community management in mangrove forest

Table 13.5: State of Ocean Health and Economy: Key Policies, Initiatives, and Challenges (cont.)

Initiative	Status	Response		Major issues and challenges
		Key policies/laws; national action plan	Example of best practice or initiative	
Coral reefs: area and condition	↓	- PMCRM Act of 2015 - National Park Act of 1961 - Strategies and action plan on coral reef management (2009)	- Seasonal closure of marine national park (e.g., coral bleaching phenomenon) - MFF - Ecotourism - Green Fins	*Issues:* - Improper management of marine activities - Urbanization and coastal construction - Wastewater and marine debris - Physical damage *Challenges:* - Sustainable tourism - Improvement of marine park management
Seagrass beds: area and condition	↓	- PMCRM Act of 2015 - Strategies and action plan for seagrass and dugong management (2008)	- Bor Hin Farmstay, Trang Province - The Kung Krabaen Bay Royal Development Study Centre, Chantaburi Province	*Issues:* - Illegal fishing - Sedimentation from coastal utilization
Fish stock (Catch Per Unit Effort, CPUE)	-	- Royal Ordinance on Fishries of 2015 - Marine Fisheries Management Plan of Thailand (2015-2019)	- Andaman Trawl Fisheries Improvement Project - Seasonal regulations - Crab seed bank initiatives	*Issues:* - Depletion of fish stock - Incomplete database *Challenge:* - Scientific-based Maximum Sustainable Yield (MSY)
Rare, threatened and endangered species	↓	- Wild Animal Reservation and Protection Act of 1992 - Royal Ordinance on Fisheries of 2015	- The marine rescue and monitoring centre - MFF - Bor Hin Farmstay, Trang Province	*Issues:* - Plastic litters ingestion and entanglement - Fisheries by-catch - Destruction of nesting site and feeding ground
Marine water quality (DO, N, P, TSS, etc.)	↓	- ECNEQ Act of 1992 - Public Health Act of 1992	- Laem Phak Bia environmental research and development projects (Wastewater treatment model)	*Issues:* - Released mass of wastewater without treatment into the rivers - Local impact from coliform bacteria and eutrophication *Challenges:* - Effective operation of existing treatment plant

Table 13.5: State of Ocean Health and Economy: Key Policies, Initiatives, and Challenges (cont.)

Initiative	Status	Response		Major issues and challenges
		Key policies/laws; national action plan	Example of best practice or initiative	
Marine protected areas (MPA) (% of territorial waters)	↑ (5.6%)	-Forest Act of 1941 - National Park Act, of 1961 - ECNEQ Act of 1992 - PMCRM Act of 2015 - Wild Animal Reservation and Protection Act of 1992	- Marine national parks, e.g., Ko Phi Phi, Ko Surin, Mo Ko Tarutao national park, Ko Kra (Nakhon Si Thammarat Province)	*Issue:* - Law enforcement *Challenges:* - Enforcement of carrying capacity - Increasing the number of effective MPAs
Coastal erosion and sedimentation	↑	- PMCRM Act of 2015	- Eco-DRR; Krabi, Nakhon Si Thammarat and Trang Province	*Challenge:* - Integrated spatial planning for prevention and mitigation - Set back zone
Wastewater management	↓	- ECNEQ Act of 1992 - Public Health Act of 1992 - Factory Act of 1992 - Roadmap on Waste and Hazardous Waste Management - National Solid Waste Management Master Plan (2016-2020) - Thailand Zero Waste Action Plan (2016-2017)	- Laem Phak Bia environmental research and development Projects (wastewater treatment model)	*Issue:* - Land- and sea-based pollutions *Challenge:* - Effective water treatment
State of ocean economy				
Ocean economy - Value - Contribution to GDP	↑ -	- The 20-Year National Strategy (2017-2036) - The 12th NESDP (2017-2022)	- National Maritime Policy	*Issues:* - Lack of appropriate innovation and technology - Lack of awareness as maritime nation *Challenge:* - Government support and coordination
Tourism - No. of tourists Value	↑ ↑	- 2nd National Tourism Development Plan (2017-2021) - 4th Tourism and Sport development plan and policy (2017-2021)	- Sustainable tourism (Low carbon tourist destination project) - Increase public awareness on diving and snorkeling practices (Green Fins) - Ecotourism (Bor Hin Farmstay)	*Issues:* - Deterioration of marine ecosystem - Wastewater and marine debris *Challenges:* - Sustainable tourism

Table 13.5: State of Ocean Health and Economy: Key Policies, Initiatives, and Challenges (cont.)

Initiative	Status	Response		Major issues and challenges
		Key policies/laws; national action plan	Example of best practice or initiative	
Fisheries - Value Aquaculture - Value	↓ ↓	- Royal Ordinance on Fisheries of 2015 - 2015-2019 Fisheries Management Plan	- Crab seed bank initiatives - Andaman Trawl Fisheries Improvement Project - Artificial Reef under South China Sea Fisheries Refugia Initiative - Good Aquaculture Practice (GAP)	*Issue:* - Overfishing and IUU fishing - Alien species - Wastewater and marine debris - Shrimp farms *Challenge:* - Effectiveness of action plans - Ecosystem based fisheries management
Offshore oil and gas - Production - Value	↓ -	- Petroleum Act of 1971	N/A	*Challenges:* - Decommision
Alternative Energy: wind farm - capacity	↑	- AEDP 2015-2036	N/A	*Challenge:* Increasing proportion of alternative energy capacity

Photos from: DMCR

Photos from: DMCR

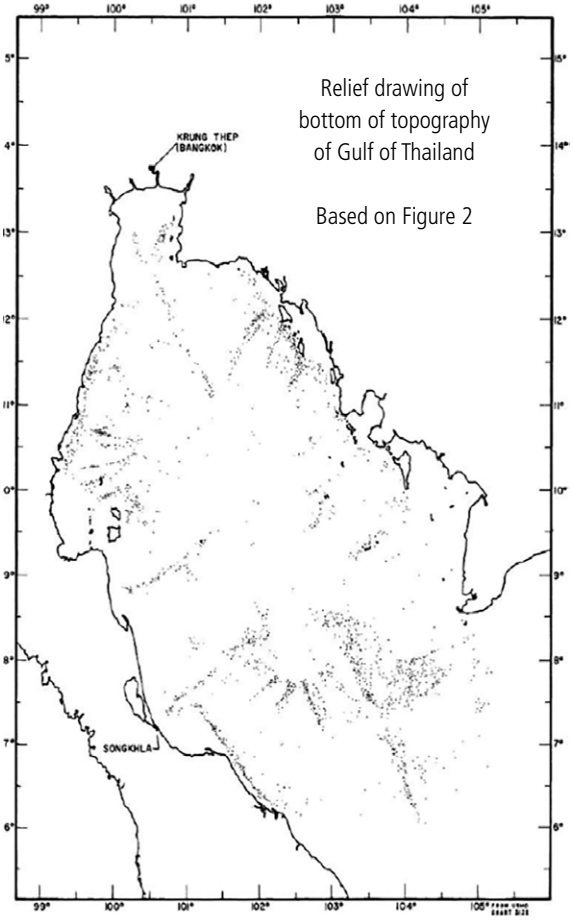
ANNEXES

Annex 1: Large Marine Ecosystems

The sea of Thailand is divided into two parts: the Gulf of Thailand (or Gulf of Siam) and the Andaman Sea.

1. Gulf of Thailand

Figure A.1: Bottom Topography of the Gulf of Thailand.

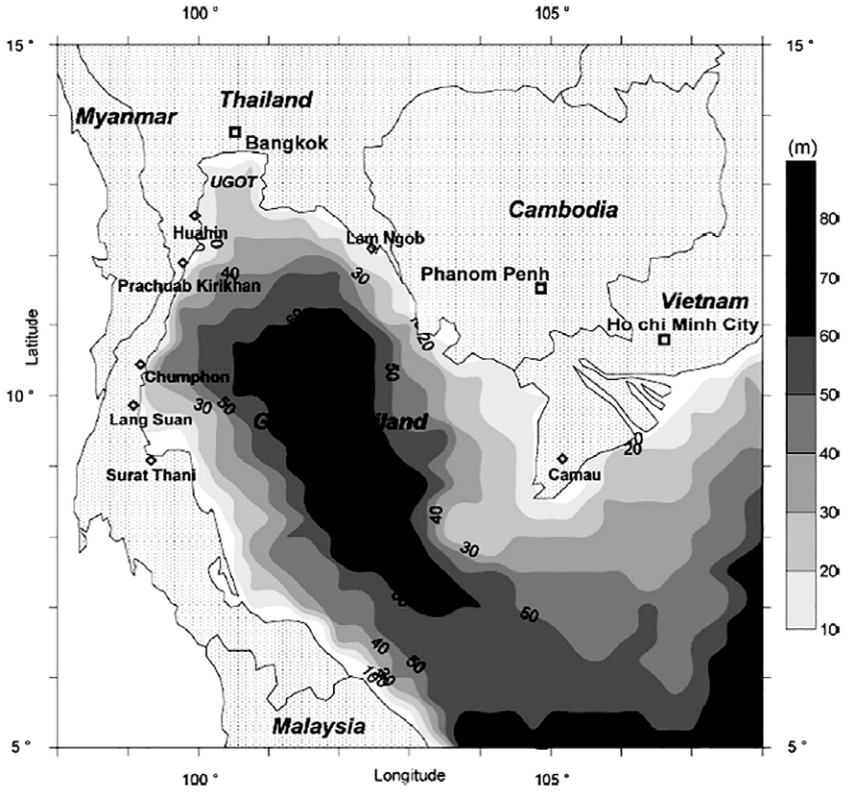


Source: Robinson, 1974

1.1 Oceanographic features

The Gulf of Thailand (GoT) is a semi-enclosed bay with the coast of Malay Peninsula on its western side and the Southeast Asian mainland on its northern and eastern boundaries. The opening of the GoT and the only connection with the South China Sea is located at the southeast part of the gulf, with the southern limit of the gulf as a straight line from the western extreme of Camau Point (8°36'N) to the northern point on the east side of the estuary of the Kelantan River (6°14'N 102°15'E). The average depth of GoT is 44 m. The innermost part of the GoT called the inner GoT (IGoT), which is a historic water, has an average depth of 15 m. The central part of the GoT, with an average depth of 60 m, is a drowned river valley basin with the deepest part being 86 m. Two elongated ridges are situated parallel to the axis of the basin in the southward opening of the gulf toward the South China Sea. The western ridge extends 160 km from Kotabaru of Malaysia in the northeast direction, at a 50 m depth. The shallower second ridge lies at a distance of 100 km, from Camau point in Viet Nam to the south-west direction, with a depth of 25 m. These central ridges control the bottom water flow in the gulf. The sill depth between these two ridges is 67 m. (**Figure A.1** and **Figure A.2**)

Figure A.2: Depth of Seafloor of the Gulf of Thailand.

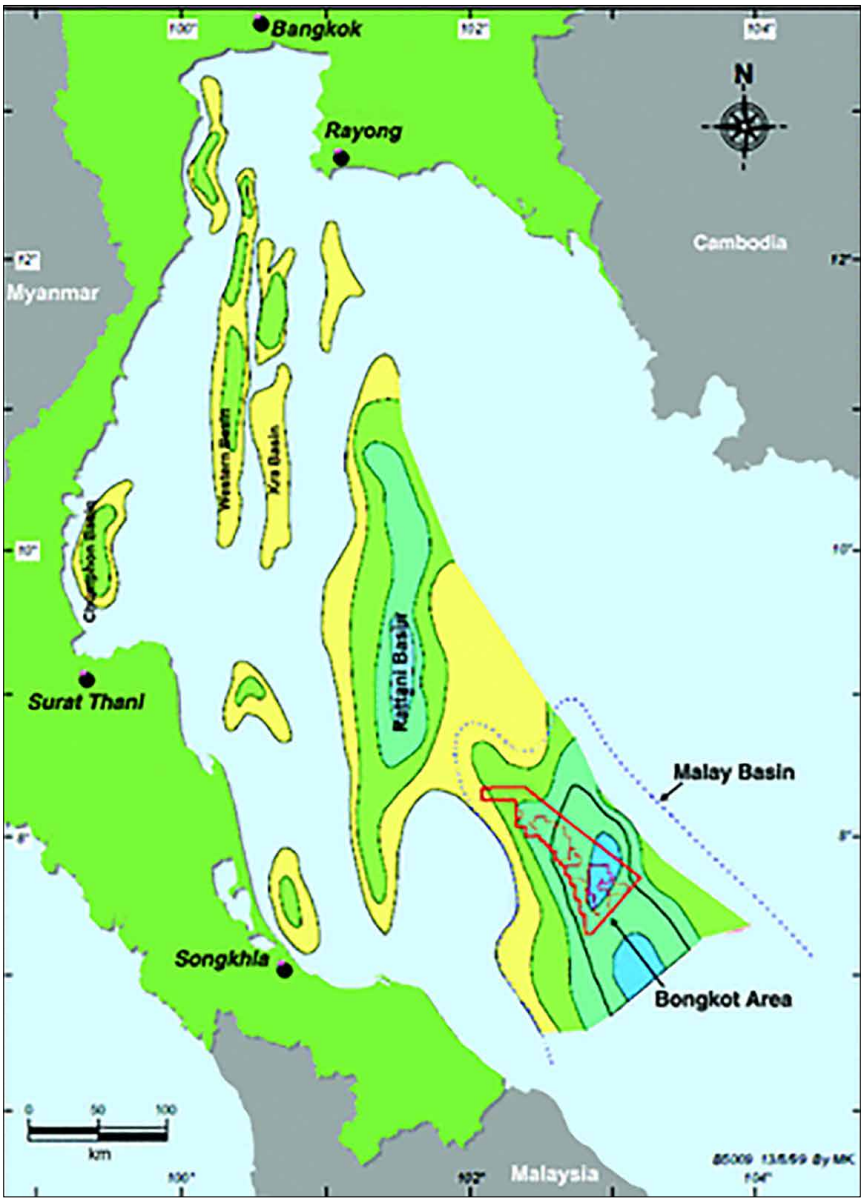


Source: Sojisuporn, 2010

Within the total area of 270,000 km^2, the volume of the GoT is about 12,510 km^3 (Robinson, 1974). The coastal shore on the northeast part is shallower and smoother than the western coast. The western coast of the upper south of GoT locates the Chumphon basin which is a Tertiary basin, 4000 m-5000 m thick. The basin in the central GoT, which originated from the accumulation of sediments, can be divided into two sub-basins: the western basin and eastern basin.

The basin rocks, from the Eocene age, are composed of igneous rocks and sedimentary rocks (Jitmahantakul, 2012). This central basin is divided into two parts, with the Pattani trough (Pattani basin) and northern Malay trough in the southern GoT (**Figure A.3**). The larger Pattani trough with its ellipsoid shape and several sub-basins arranged in the north-south direction, is 70 km wide and 400 km in length. The bedrock of Pattani trough formed during the tertiary, with the thickness of 8,000 m on top of the Cretaceous (72-145 Ma) granite and Paleozoic (254-358 Ma) metamorphic rock. The sediment accumulated in the basin are from the Oligocene lagoon and Miocene river delta. The Malay basin, which is also the tertiary basin, is located in the southern part of the GoT. It covers the area in both Thailand's territory as well as part of the Malaysian coastal zone. This basin has the same morphology and thickness as the Pattani basin and is comprised of several small sub-basins arranged in the northwest-southeast direction. These tertiary basins in the GoT are important sites for oil and natural gas resources. (http://www.dmr.go.th/main.php?filename =aothai_geo)

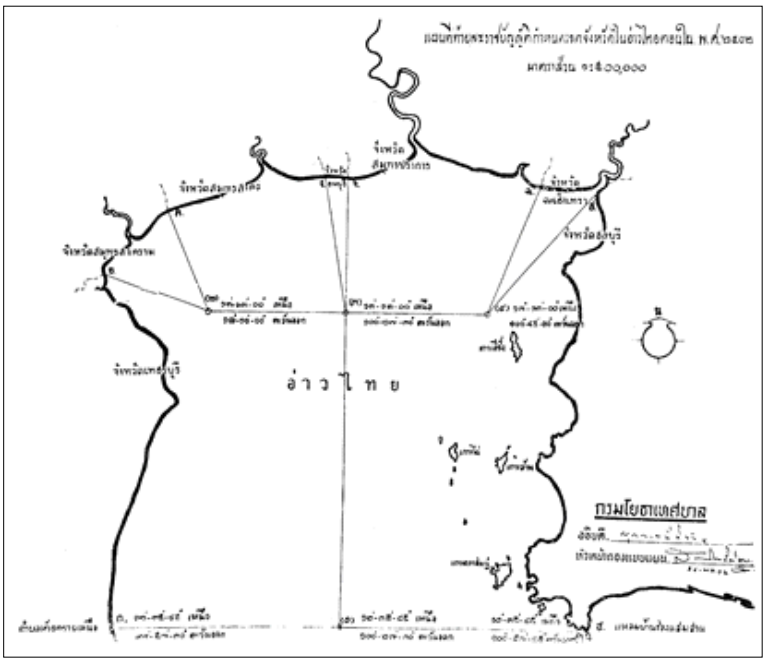
Figure A.3: Bottom Geomorphology of the Gulf of Thailand.



Source: http://interpretation.geoscienceworld.org/content/gsint/2/1/SB57/F1.medium.gif

The GoT is divided into 2 parts: (i) the inner Gulf of Thailand (IGoT) or the upper Gulf, and (ii) the outer gulf or lower gulf. The IGoT, the innermost part of GoT, with its square shape similar to the first alphabet in Thai language " ก " or "kor", is a semi-enclosed area with connection to the central part of the gulf. This southern opening is a straight line from the west coast in Phetchaburi Province at 12°35'45"N and 49°47'30"E across the water body in the gulf to the eastern shore of the gulf in Chonburi Province at 12°35'45"N and 100°27'30"E (**Figure A.4**)

Figure A.4: Boundaries of the Inner Gulf of Thailand.



Source: https://th.wikipedia.org/wiki/อ่าวไทย

The IGoT covers an area of 100 km^2 x 100 km^2, with a surface area of 10,360 km^2 and an average depth of 15 m. The seafloor on the west side of the gulf is shallower than the east side, with a slope of 0.2 m/km and the deepest part being 40 m (Sojisuporn, 2003 referred to Nedeco 1965 and Pinyoporn, 1986).

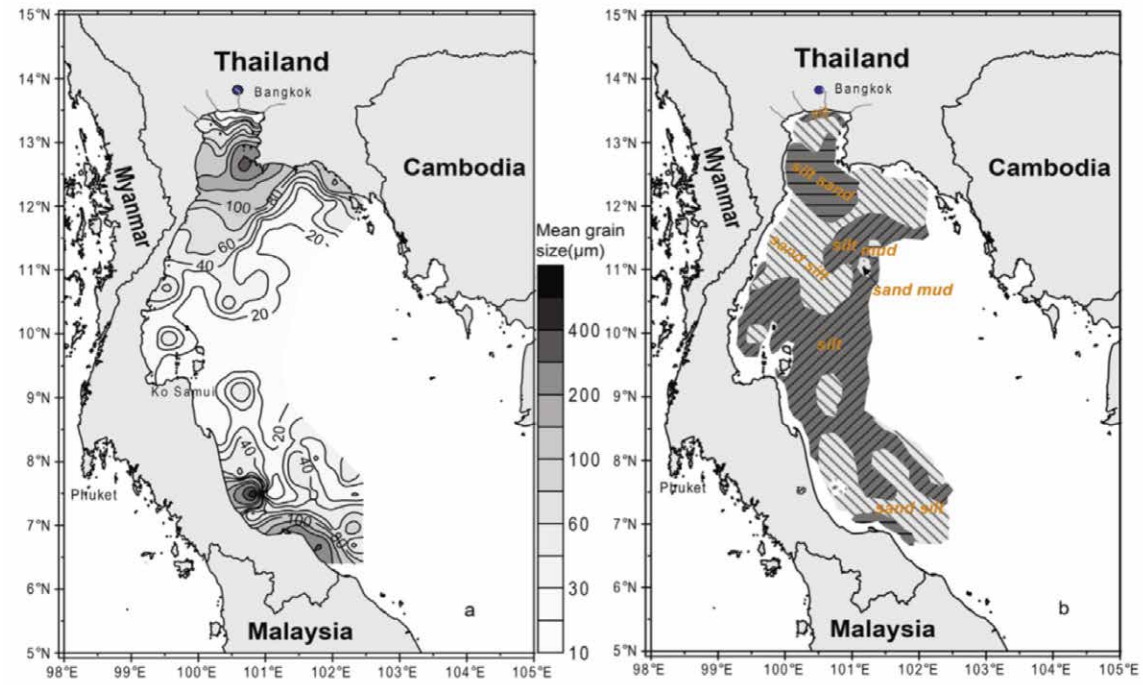
The IGoT is a large estuarine environment by nature since the four major rivers in the country empty into this area. The salinity of seawater in the IGoT is diluted with freshwater during the rainy season. An average salinity in the whole IGoT ranges from 30.5-32.5 PSU (Practical Salinity Unit), particularly in the dry season.[5] Aside from the suspended sediment being carried out, river run-offs also bring loads of dissolved organic and inorganic nutrients toward the IGoT especially during the rainy season. This situation supports the primary production as well as the fishery production in this area. The resulting tidal flats along the northern part of the IGoT are important habitats for economically important marine animals and permanent and migrating birds (Wattayakorn, 2006 referred to Erftemeijer and Jugmongkol, 1999).

Based on geological records, sediments in the IGoT can be divided into two layers. Surface sediment, called "Bangkok clay" accumulated by a sea level rise in the Holocene or about 0.1 million years ago, and can be as thick as 19 m below the present mean sea level. It appears in olive gray and medium to dark gray in color with some marine shells and fossil mangrove trees

[1] https://en.wikipedia.org/wiki/Gulf_of_Thailand

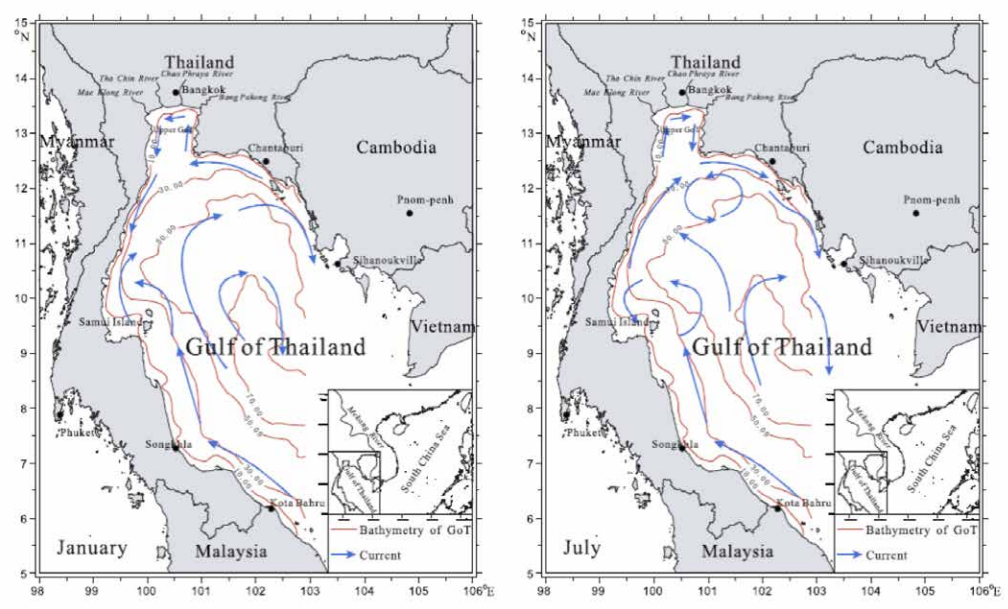
(Choowong, 2002). The lower layer (below 19 m), or the "stiff lower clay", was formed during the Pleistocene (ca. 0.1-1.8 million of years) and appears as yellow brown to brown sand with some red and yellow mottles. The lower layer extends as a large channel throughout the GoT (Choowong, 2002 and Marine Geology, 2012). Recent study in 2010-2012 (Qiao et. al., 2015 and Hu et. al., 2016) indicated that surface sediment in the GoT consisted of silt and silty sand and sandy silt with mean grain size of 52.9 mm (11.5-547.6 mm) as shown in Figure 5.5. The fine grain, such as silt particle deposits in the northern part of the IGoT, is a result of fluvial influences from four major rivers that carry 6.32 million tonnes of total suspended sediments per year into the IGoT (Srisuksawad et al., 1997). The estuarine area of the IGoT, particularly the Chao Phraya River mouth, was reported to be covered with olive gray or dark gray silty sediments with an average mesh size of < 30 μm. It is also associated with a strong rotten egg smell. There is also the spatial heterogeneity of sediment grain size in the IGoT, since sediment in the west coast of the IGoT near Mae Klong River and Ta Chin River appears to be coarser with a mesh size of >55 μm. Away from the river mouths, sediment type changes to sandy silt with shell fragments, and appears in dark gray followed by coarse-grained silty sand with abundant shell fragments, with particle sizes that are > 110 μm in the lower part of GoT. The placement of this sediment type is subjected to a combination of wind-driven currents, tides, and its bottom topography. (Qiao et. al., 2015 and Hu et. al., 2016)

Figure A.5: Mean Grain Size and Types of Surface Sediment Found in the Gulf of Thailand.



Source: Hu et al., 2016

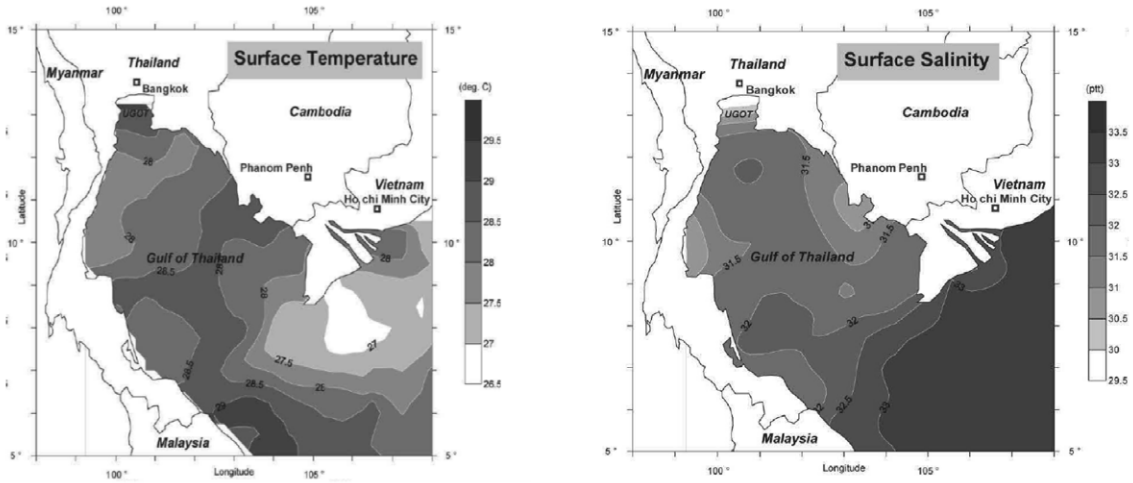
Figure A.6: Surface Circulation in the Gulf of Thailand during Northeast Monsoon (January) and Southwest Monsoon (July) Season.



Source: Shi et al., 2015

In general, sea surface temperature in the GoT ranges from 26°C to 29°C with higher temperature in the IGoT and the southern GoT near the Thailand-Malaysia border. The surface salinity contour, however, appears in opposite direction. The salinity in the GoT are controlled by both the inflow of seawater from the South China Sea, which brings high saline water into the Gulf and the river runoff from the north coast of the IGoT, as well as a small freshwater runoff from the rivers on the Malay peninsula on the western coast and on the east coast of the Thai-Cambodia border (**Figure A.7**).

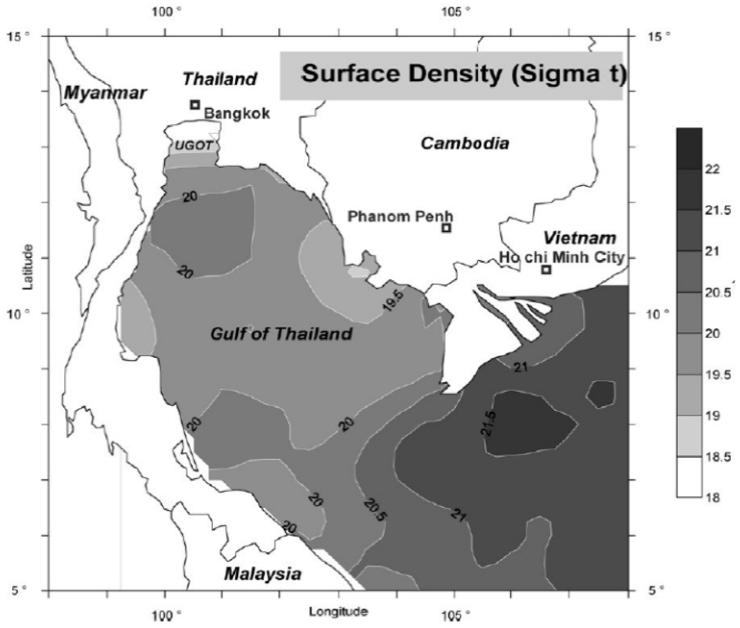
Figure A.7: Temperature and Salinity of Surface Water in The Gulf of Thailand.



Source: Sojisuporn et al., 2010

The combination of temperature and salinity also affects the surface density (sigma-t) pattern in **Figure A.8**. The inflow of seawater from South China Sea induces higher density seawater (sigma-t >20) into the southern end of the GoT; while sea surface temperature and salinity of the gulf also causes another water mass of high density in the central part of the GoT, offshore of Prachuap Khiri Khan.

Figure A.8: Density of Surface Water in the Gulf of Thailand.



Source: Sojisuporn et al., 2010

1.2. Natural Resources

Mangrove Forest

A large area of mangroves in the GoT have been damaged because of the impacts from human settlement, industrialization, and shrimp farming. The mangroves along the GoT's coast distribute mainly as isolated narrow strips. However, large mangrove areas remain at several locations with an estimated area of 2,440.0 km^2 (DMCR, 2012).

In Cambodia, the mangrove forests cover about 851.0km^2, i.e., 637.0 km^2 (75%) in Koh Kong Province, 135.0 km^2 (16%) in Sihanoukville and 79.0 km2 (9%) in both Kampot Province and Kep Resort City along the coastal areas of the GoT (Vo et. al., 2013).

In Viet Nam, the mangrove forest areas were about 3.2 km^2 in Kien Giang Province and 582.9 km^2 in Ca Mau Province. The mangrove populations and communities in the coastal area of Mekong River delta consist of 33 true mangrove tree species, 68 associated mangrove tree species, 119 phytoplankton species, 79 zooplankton species, 52 mollusc species, 30 crustacean species, 69

fish species, 171 bird species, 6 amphibian species, 34 reptile species, and 28 mammal species (State Sea Programme, 1995; Vo et al., 2013).

Seagrass

Seagrass beds cover an approximate area of 189.9 km^2 in the GoT (DMCR, 2012) and are classified into three types: mangrove-associated beds, shallow sandy bottom beds, and coral reef associated beds (Poovachiranon, 2000). About 10 seagrass species occur in waters adjacent to the 13 coastal provinces in the GoT.

Seagrass beds can be observed in most shallow coastal areas of Cambodia. The total area of seagrass in Cambodia's waters is 324.9 km^2 (DOF, 2004). Extensive seagrass beds occur in Kampot Province and Kep Municipality, where seagrass and/or mixed seagrass and macroalgae (Caulerpa sp.) communities are found along the entire coast to the Cambodia-Viet Nam border. The seagrass area at Kampot was 252.4 km^2 and can be divided into three communities: 18.0 km^2 in PrekTrapeangAmpil - PrekKdat, 3.8 km^2 in PrekKdat - PrekKoh Torch, and 230.7 km^2 in PrekKoh Torch - Kep Town (Ethirmannasingam, 1996 in Nelson, 1999).

Seagrass beds can be found in Phu Quoc Islands, Viet Nam which have a total area of 36.5 km^2, including 20 km^2 in Bai Bon, 9 km^2 in Rach Vem, 2 km^2 in Da Bac, 2 km^2 in Trau Nam, 1.2 km^2 in Ong Doi, 1 km^2 in Bai Dam, and other small islands (Vo et al., 2013).

Coral Reefs

The coral communities in the GoT are distributed along the eastern, western, and southern coasts and upper part of the GoT. Diversity of certain major groups of coral reef sites in the GoT include 130 species of stony corals, 194 species of echinoderms, 113 species of reef fishes, and many species of sponges, crustaceans and macroalgae (Satapoomin, 2000; UNEP, 2007; Sutthacheep et al., 2013; Vo et al., 2013; and Yeemin et al., 2013).

Coral communities in Cambodia are mostly distributed as fringing reefs along parts of the mainland, especially headlands, and around many islands. Coral communities near the shore have adapted to living in turbid environments; whereas offshore coral communities have higher species diversity. At least 70 species of corals in 33 genera and 11 families have been recorded at Koh Tang, in Sihanoukville (Nelson, 1999). Coral reefs in Cambodia are in fair to good condition, with coral cover ranging from 23.1% in the Sdach Island group of Koh Kong Province to 58.1% at Takiev Island group of Sihanoukville (UNEP, 2007; Vo et al., 2013).

In the south of Viet Nam, coral reefs have developed in locations adjacent to the offshore islands of Phu Quoc, Nam Du, and Tho Chu. A large coral reef grew in Tho Chu, Nam Du, and Phu Quoc islands. About 270 hard coral species belonging to 64 genera have been reported at these reef

sites. Approximately 135 reef fish species belonging to 27 families and 60 genera were recorded in major reef sites in coastal areas of Phu Quoc Island. A total of 3,500 tonnes of mackerels and 12,500 tonnes of anchovies were landed in Phu Quoc Island in 2001. High abundance of the sea urchin Diademasetosum is observed around Phu Quoc and Nam Du islands in the GoT (Grigg et al., 1990; UNEP, 2007; and Vo et al., 2013).

Marine Endangered Species

Distribution and important nesting areas of two sea turtle species, e.g., Green turtle (*Cheloniamydas*) and Hawksbill turtle (*Erethmochelys imbricate*), have been reported at Kham Island (Chon Buri Province), the IGoT and Kra Island (Nakhon Si Thammarat Province), the western GoT (Chantrapornsyl, 1993; Monanunsap and Kittiwattanawong, 2009). The green turtle had been included in the list of endangered marine species, while the hawksbill turtle is in the list of critically endangered marine species, under the IUCN Red List of Threatened Species (http://www.iucnredlist.org). These two sea turtles are also commonly observed and known to nest along the coastline of Cambodia. In Viet Nam, scattered hawksbill turtle nesting is observed on the islands in the GoT, offshore from the Kien Giang Province, southern Viet Nam. Many females of the green turtles nested every year on the islands in the GoT (Hamann et al., 2006; Chanrachkij et al., 2010; and UNEP, 2008b).

Dugong (*Dugong dugon*) were observed in the provinces of Chantaburi, Chon Buri, Chumphon, Pattani, Rayong, Surat Thani, and Trat in the GoT. The dugong population is estimated to be around 50 dugongs in the GoT (Nateekanjanalarp and Sudara, 1992; Adulyanukosol, 1999; and Adulyanukosol, 2007). Dugong populations were also recorded at Sihanoukville and Kampot Bay, Cambodia and Phu Quoc Island, Viet Nam (Hines et al., 2007 and UNEP, 2008b). Dugong sightings in Phu Quoc Island range from occasional sightings in the eastern and southern sides of the island, to frequent sightings in the eastern town of Ham Ninh and the northern village of Bai Thom. The dugong population in this area of Viet Nam is estimated to have approximately 100-300 dugongs.

There are many species of whales that were recorded in the GoT, i.e., fin whale (Balaenoptera physalus), Bryde's whale (*Balaenoptera edeni*), Omura's whale (*Balaenoptera omurai*), pygmy sperm whale (Kogia breviceps), killer whale (*Orcinus orca*), false killer whale (*Pseudorca crassidens*), pygmy killer whale (*Feresa attenuata*), short-finned pilot whales (*Globicephala macrorhynchus*), and melon-headed whale (*Peponocephala electra*). The Irrawaddy dolphin and spinner dolphin were also found in Sihanoukville and Kampot Bay, Cambodia (UNEP, 2008b). In Viet Nam, many species of dolphins are found. The common species include the Irrawaddy dolphin (Orcaella brevirostris), finless porpoise (Neophocaena phocasniodes), Indo-pacific bottlenose dolphin (*Tursiops aduncus*), Indo-Pacific humback dolphin (Sousa chinensis), spinner dolphin (*Stenella longirostris*), spotted dolphin (Stenella attenuata), and Fraser's dolphin (*Lagenodelphi shosei*) (Sea Alarm Foundation, 2013).

1.3. Human Activity

The population in the coastal areas of the GoT is over 112 million (Talua-Manus, 2000 and Wilkinson et al., 2005). The resources in the GoT have provided important benefits to the coastal communities in this region. The key economic activities in the bordering countries are tourism, fisheries, mariculture, industrial estate, and seaport.

The hotspots of tourist destination in the GoT include:

- Thailand: Ko Samui, Ko Phangan, Mu Ko Angthong and Ko Tao (Surat Thani Province, Thailand), Huahin (Prachuab kirikhan, Thailand), Cha-am (Phetchaburi Province, Thailand), Pattaya (Chon Buri Province, Thailand), Mu Ko Samet (Rayong Province, Thailand), Mu Ko Chang (Trat Province, Thailand),
- Cambodia: Koh Puos, Victoria, Sokha, Occheuteal and Ou Treh beaches (Preah Sihanouk Province, Cambodia),
- Viet Nam: Phu Quoc Island (Kien Giang Province, Viet Nam), and Ca Mau (Ca Mau Province, Viet Nam).

Total reported fish landings were up to 700,000 tonnes in 2004. The countries bordering the GoT have received a lot of benefits from these marine fisheries. However, there is much evidence that marine fishing has affected the GoT at the ecosystem level and has caused a primary driving force of biomass change. Overfishing caused by overcapacity of the local trawl fisheries is clearly reported (Pauly, 1979; Christensen, 1998; Piyakarnchana, 1999; Pauly and Chuenpagdee, 2003; and Chuenpagdee and Pauly, 2004).

Mariculture plays a major role in food security and the economy of countries in the GoT. Mariculture was initiated with the introduction of intensive culture technologies and has become the most successful in terms of income. The depletion of coastal resources due to overfishing, degradation of coastal habitats, and marine pollution has also encouraged mariculture.

Some finfish species like the groupers and barramundi are reared and cultured in cages and ponds. The total number of farms in production was 6,482, covering approximately 7.2 km^2 in 2002. The finfish farms are mostly located in Samut Prakarn, Samut Sakhon, Prachuab Kiri Khan Songkhla, and Pattani. Moreover, green mussels farming and shrimp farming were also popular. Marine shrimp culture was first introduced to Cambodia in the early 1990s in Koh Kong Province and quickly extended to Sihanoukville and Kampot (Try, 2003). Finfish cage culture, mainly seabass, grouper and snapper, was also operated (Gillett, 2004). Seaweed culture was also practiced in Cambodia. Currently, aquaculture accounts for about 6% of all fishery production in Cambodia (FAO, 2009).

The Kian Giang and Ca Mau Provinces in Viet Nam have the most diversified farming activities that include various intensification levels of giant tiger prawn culture and mangrove-cum-aquaculture. The farming of giant tiger prawn (*Penaeus monodon*) reached the production level of 290,000 tonnes in 2004. Other species, such as spiny lobster (*Panulirus spp.*), groupers (*Epinephelus spp.*), mud crab (*Scylla spp.*) and bivalves (*Meretrix lyrata* and *Anadara granosa*), are also produced at differing levels of intensification and extent. Total production from marine cages reached 2,327 tonnes, of which lobster production accounted for 1,830 tonnes. Bivalves are mostly farmed in the coastal provinces in the GoT with a total production of 130,474 tonnes (MoFI, 2004). The mariculture sector in Vietnam has great potential to continue its current growth.

In the GoT, transportation of crude oil has increased because of augmented production in the Gulf region, and an ever-growing demand from neighbouring countries. Moreover, the GoT is extensively used as a shipping route for transportation of goods, commodities, fishery products, etc. In Thailand, shipping activities are prominent. It is considered as an important transportation hub in this region. The shipping activities rely on sea transport, which is an important mode of international transport accounting for a total international freight of 192 million tonnes in 2010. Most of them are found in the GoT. Furthermore, sea transport handles more than 88% of all international transport compared with other transport modes (NESDB, 2011). Many seaports were built to support shipping activities as well as fisheries, tourism, and passenger transportation. Based on the records of the Marine Department of Thailand, about 222 ports are distributed along the coasts of the GoT. Most of them are fishing ports followed by cargo ports (Marine Department, 2005).

In Thailand, the Map Ta Phut Industrial Estate, founded in 1990, is a large industrial area located in the Map Ta Phut Town in Rayong Province. It is a part of Thailand's eastern seaboard economic region and the country's largest industrial estate. It is managed by the Industrial Estate Authority of Thailand, a government agency under the Ministry of Industry.

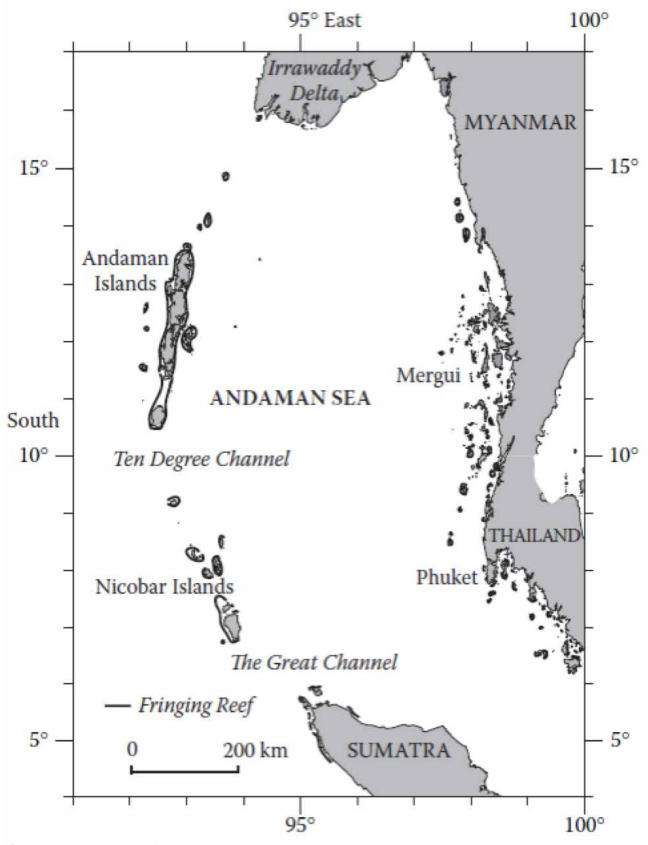
The shipping activities in Cambodia are busy in Sihanoukville Province where the international port is located. In 2009, the total quantity of cargo was 3,533,637 tonnes (Sisovanna, 2011). In Cambodia, construction of the city and international port began in 1955 and expanded with the construction of the 226 km highway and 263 km railroad to Phnom Penh (Sihanoukvile Coastal Strategy). The international port is managed by the Port Authority of Sihanoukvile, which offers services for the main import and export cargos that include food products, raw materials, equipment and fuel. The government of Cambodia has constructed new ports and industrial and economic development zones along the northern coastline of Stung Hav and KeoPhos, called Stung Hav Sihanoukvile Industrial Zone, in order to meet the increasing demand. The industrial zone includes petrochemical productions, food processing based on the local fisheries in the area, and timber processing (UNEP, 2008a). There are also several factories that have been established in the town, such as shoes, garments, brewery, and food products.

2. Andaman Sea

2.1. Oceanographic Features

The Andaman Sea is a closed basin that is part of the continental shelf of the Indian Ocean between the Malay Peninsula to the east and the Andaman-Nicobar Islands to the west, and connects to the Bay of Bengal on the eastern part (**Figure A.9**). The depth of the basin reaches a depth of 4,000 m on the western side of the Andaman Sea near Nicobar Islands (Rizal et al., 2012). The Andaman Sea that is part of Thailand's EEZ has a maximum depth of 2,400 m, and covers the area of 110,000 km^2, of which more than 90% of the area lies between 100 m to 600 m depth (Bussarawit et al., 2008).

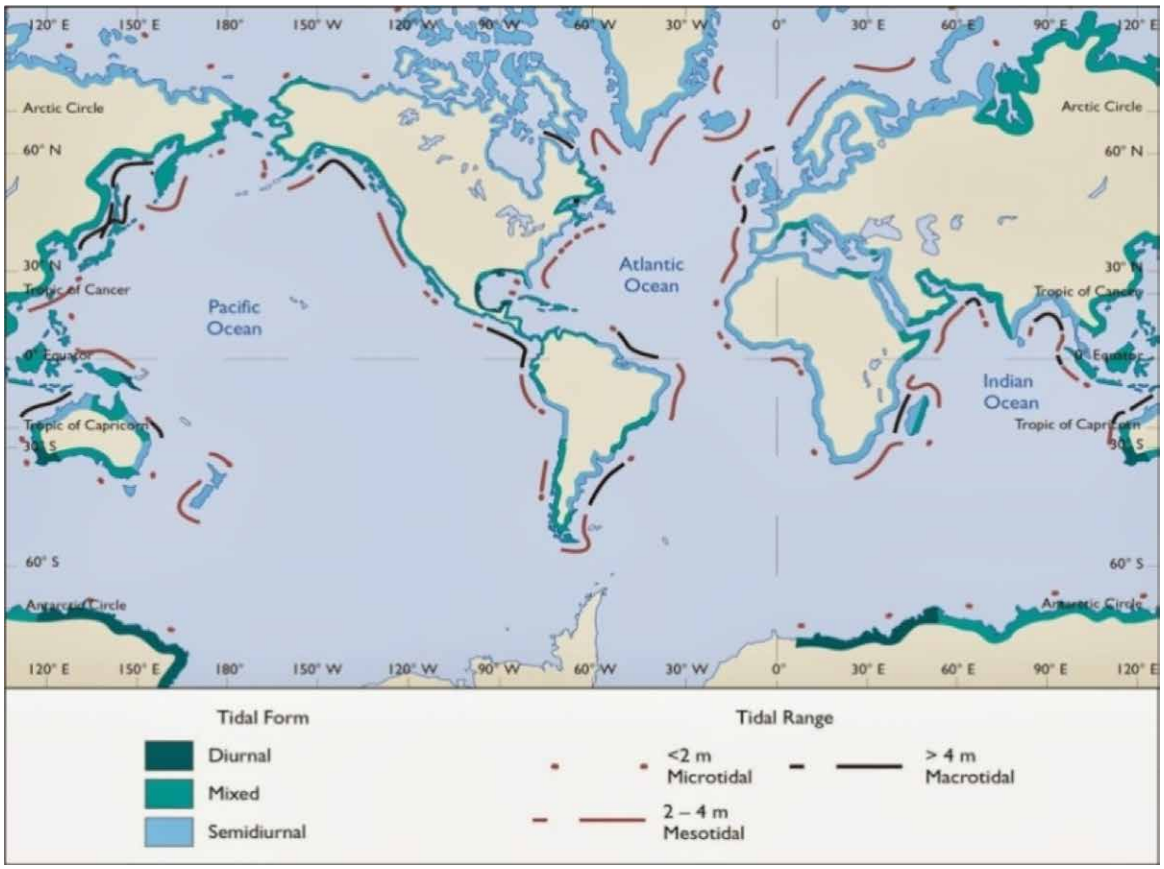
Figure A.9: The Andaman Sea.



Source: Brown, 2007

The Andaman Sea or the west coast of the Malay Peninsula is also under the influences of the monsoon system. The south-west (SW) monsoon period starts in June throughout September and the north-east (NE) monsoon is active from December through February. During the SW monsoon, strong winds from the sea lead to maximum rainfall. Tidal current in the Andaman Sea is semi-diurnal with a prevailing mixed tide (Rizal et al., 2012) as shown in **Figure A.10**. The high and low water is 3.60 m and 0.38 m, respectively, with a tidal amplitude of 3.22 m (DCMR, http:// marinegiscenter. dmcr.go.th/ km/oceanography-of-andaman-sea/)

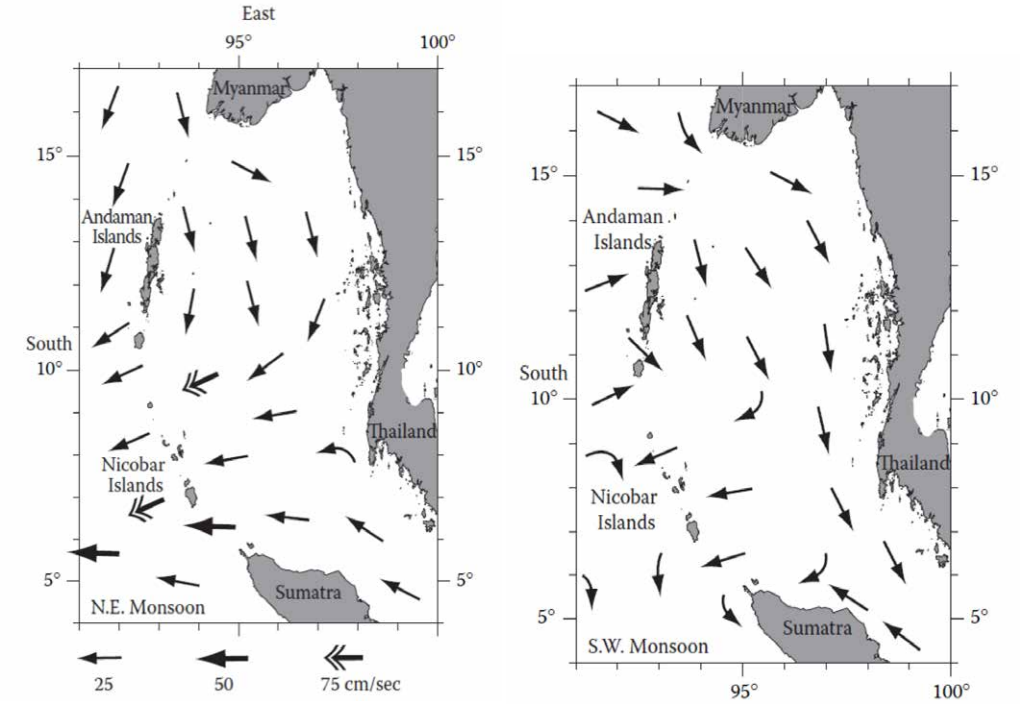
Figure A.10: Tidal Forms along the Coastal Areas, Bays and Gulfs.



Source: http://rukshanmaliq.blogspot.com

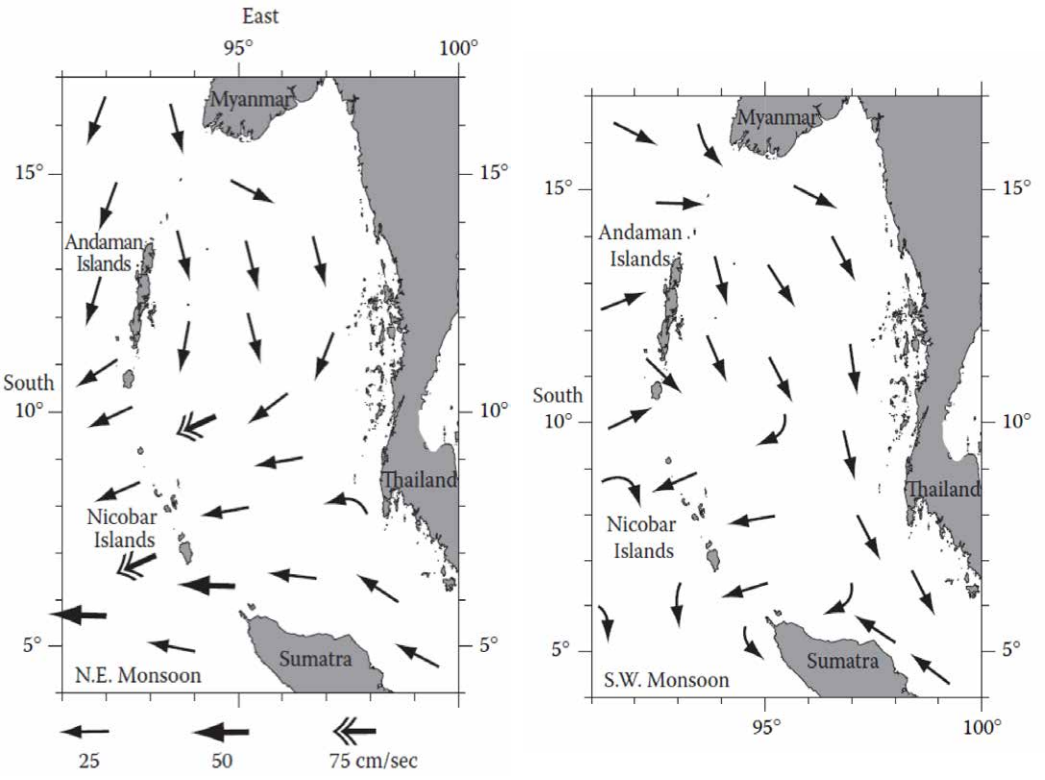
During the NE monsoon, two current systems enter the Andaman Sea. The inflow from the Bay of Bengal appears from the north with velocities of 1.0 m/s – 1.3 m/s while another current flows into the area from the southern connection with the Malacca Strait of about 0.3 m/s. The merging currents cause the westward outflow toward the Ten Degree Channel between the Andaman Islands and the Nicobar Islands. The intense easterly current flows during the transition period from NE to SW monsoon with a speed of ≥ 0.7 m/s. In rainy season, under the SW monsoon influence, the current moves in a north-south direction from the Bay of Bengal into the Andaman Sea, and exits via westward and southward flows (**Figure A.11** and **Figure A.12**)

Figure A.11: Inter-monsoon Transition before the NE Monsoon is Characterized by the Jet Flow Eastward.



Source: Brown, 2007

Figure A.12: Surface Current in the Andaman Sea and Bay of Bengal.



Source: Brown, 2007

Seawater temperature in the Andaman Sea ranges from 27.8°C-28.1°C in January to 29.5°C-29.8°C in May (Brown, 2007). The salinity profile of the Andaman Sea of Thailand is quite limited, with the study reporting the salinity range between 32 PSU-33 PSU in the Andaman Sea and the coastal water of Phuket. However, the salinity range can be as low as 25 PSU in the northern Andaman Sea during the SW monsoon (Brown, 2007).

2.2. Natural Resources

Mangrove forests

Mangroves are important resources in the Bay of Bengal where it supports about 12% of the global area of mangroves (Giri et al., 2008). It was reported that a total of 45 species of mangroves are found in the bay. The highest diversity is along the eastern coast of Myanmar, Thailand, and Malaysia. The highest percentage of mangrove forest was reported in Myanmar compared to other countries in the bay (Polidoro 2010).

Coral reefs

At least 300 species of reef-building coral are found distributed throughout most of the countries in the BOB (Keesing and Irving 2005), contributing to about 8% of the world's coral reef area. The coral reefs in Maldives showed the largest one among other countries in this region, accounting for 4,513 km^2 (Naseer and Hatcher, 2004), followed by India, Myanmar, Indonesia, and Thailand (SAUP, 2011). Furthermore, the diversity of marine fish in this region was very high, reaching up to 800 species (Keesing and Irving, 2005). Deepsea corals are also found in this region along the continental shelf below 200 m in the Andaman Sea and in Maldives. The Andaman Sea contains a diverse variety of deep water geomorphology and habitats (BOBLME, 2015).

Seagrass

In the Indo-Pacific, the Bay of Bengal showed the highest seagrass diversities having as many as 15 species of seagrass (Green and Short 2003; Waycott et al., 2009), especially in Palk Bay - Gulf of Mannar region in southeastern India and adjacent to Sri Lanka. Other areas, e.g., the Strait of Malacca, the Nicobar, and Andaman coasts and islands, also have high seagrass diversity. These areas are quite shallow with open sandy substrate giving them higher diversity and biomass (Jagtap et al., 2003). Moreover, seagrass also provides a fertile and productive habitat supporting other species like fishes and invertebrates (Jagtap et al., 2003 and BOBLME, 2015).

2.3. Human Activities and Utilization

Marine tourism in the Bay of Bengal have been increasing in terms of popularity because there are many beaches and tropical islands in this region. The Andaman Sea and Nicobar Islands are well-

known and becoming the most popular hotspots to visit for tourists from many countries. Aside from the tropical islands and archipelagos, there are several beaches lying along the mainland coasts of Malaysia, Thailand, Burma, India, Bangladesh, Sri Lanka, and Maldives. According to the world tourism statistics in 2015, there were about 18.3 million and 104.6 million tourist visits to South Asia and South East Asia regions, respectively. The increasing trends were also reported in both regions (UNWTO, 2016). Tourism is creating a range of new opportunities for those living in coastal and marine areas around the Bay of Bengal. Services related to tourism create opportunities for increased income and employment in local communities.

According to the State of Fisheries and Aquaculture reported by FAO, the Eastern Indian Ocean (the Bay of Bengal and the Andaman Sea) is still showing an increasing trend in landings, up to 50 % in the last decade to a total of 8.1 million tonnes, 28.3 % increase from the average landings in 2012-2013. Landings from the Bay of Bengal and the Andaman Sea regions have increased steadily and tend to increase in the future. Approximately 42 % of the catches in this area, however, were involved in the category "marine fishes not identified". This may cause difficulties and challenges for the monitoring of stock status and trends as well as for setting future appropriate fishery management policies. In this case, improvement of data collection is highly required. A growing number of landings may be influenced by the expansion of fishing to new areas or species. (FAO, 2016).

Like other developing countries, mariculture and aquaculture in the BOB have been rapidly developing, especially shrimp farming. The extensive coastal and brackish-water areas have been making a significant contribution to the growth of national export benefits. Aquaculture in this region is now a significant part in both the local and national economies. Based on statistics in FAO (2016), the combined output of the region's farmed shrimp and fish in 2014 was estimated at about 7.3 million tonnes, equivalent to 10 % of global total production aquaculture. It should be noted, however, that these statistics are based on the countries' total production and not only that from the Bay of Bengal LME, although most of the aquaculture production come from this LME (FAO, 2016 and Heileman et al., 2017).

Annex 2: NSOC Technical Working Group

TWG Members

In preparation of the NSOC Report, the Technical Working Group (TWG) was set up by DMCR. The NSOC TWG members is comprised of representatives from the national and local government agencies, institutions, and universities who attended the inception workshop held on May 2017. The NSOC TWG is responsible for providing technical support as well as relevant data and information for the preparation of the NSOC Report.

The NSOC TWG was chaired by Professor Padermsak Jarayabhand, Acting President of TEI (May 2016-November 2017), with the Director of the Office of Marine and Coastal Conservation, DMCR as Vice-chair. The list of NSOC TWG members are as follows:

1.	Dr. Padermsak Jarayabhand Professor, Multidisciplinary Graduate Program in Maritime Administration (MARAD), Graduate School, Chulalongkorn University; and Acting Director of Thailand Environment Institution (TEI)	Chair
2.	Director Marine Resources Conservation Division Department of Marine and Coastal Resources (DMCR)	Vice-chair
3.	Dr. Suvaluck Satumanatpan Assoc. Prof., Environment and Resources Faculty, Mahidol University	Member
4.	Dr. Soparatana Jarusombat Assoc. Prof., Faculty of Political Science, Thammasat University	Member
5.	Dr. Orapan Srisaowalak Assoc. Prof., School of Economics Sukhothai Thammathirat Open University	Member
6.	Dr. Ajcharaporn Piumsomboon Assoc. Prof., Aquatic Resources Research Institute, Chulalongkorn University	Member
7.	Dr. Thammasak Yeemin Asst. Prof., Faculty of Science, Ramkhamhaeng University	Member
8.	Dr. Praparsiri Barnette Asst. Prof., Faculty of Science, Burapha University	Member
9.	Dr. Suchai Worachananant Asst. Prof., Department of Marine Science, Kasetsart University	Member

10. Dr. Watcharapong Ratisukapim Faculty of Economics, Chulalongkorn University	Member
11. Mr. Sakanan Plathong Lecturer, Faculty of Science, Prince of Songkhla University	Member
12. Dr. Nawarat Krairapanond Office of Natural Resources and Environmental Policy and Planning (ONEP)	Member
13. Ms. Nisakorn Wiwekwin Seansook Municipality, Chon Buri Province	Member
14. Representative of Department of Tourism	Member
15. Representative of Pollution Control Department	Member
16. Representative of Marine Department	Member
17. Representative of Department of Mineral Fuels	Member
18. Representative of Department of Fishery	Member
19. Representative of Department of National Park, Wild Life and Plants (DNP)	Member
20. Representative of National Statistical Office	Member
21. Representative of the Office of Natural Resources and Environment International Cooperation	Member
22. Ms. Wilailak Suraphruk Senior Programme Officer, Thailand Environment Institution (TEI)	Secretary and Member
23. Ms. Tipawan Saema Department of Marine and Coastal Resources (DMCR)	Assistant Secretary and Member
24. Dr. Wansuk Senanan Faculty of Science, Burapha University	Member
25. Mr. Chanachai Lertsuchatavanich	Member
26. Mr. Niti Pongsuksatian Research Assistant, Marine Affairs and Policy, Chulalongkorn University	Member
27. Ms. Wipada LaLitpattarakit Research Assistant, Marine Affairs and Policy, Chulalongkorn University	Member

Scope of Work

The scope of work carried out by the NSOC TWG and authors is summarized as follows:

1. Inception Workshop

An Inception Workshop was held in Bangkok, Thailand on 28 March 2017 to discuss the framework, scope, and content of the report. Presentations were made by key agencies on available information that can be used in the development of the NSOC for Thailand. Based on

the presentations and discussions, the outline for the NSOC for Thailand was revised to be in accordance with data availability and applicability to Thailand.

2. Consultation Workshop

NSOC TWG consultation was held on 28 April 2017 to review available data and identify lead author for each section. The outline template was reviewed and sources of information were identified. Representatives of relevant government agencies were requested to provide available information.

Members of the TWG who are experts on specific issues were assigned as lead authors on their respective sections:
Assoc. Prof. Dr. Ajcharaporn Piumsomboon: Physical features
Asst. Prof. Dr. Thammasak Yeemin: Biological features (marine and coastal habitats)
Assoc. Prof. Dr. Praparsiri Barnette/Dr. Wansuk Senanan: Fisheries
Asst. Prof. Dr. Suchai Worachananant: Tourism
Mr. Chanachai Lertsuchatavanich: Shipping and ports
Assoc. Prof. Dr. Soparatana Jarusombat: Blue economy development
Assoc. Prof. Dr. Suvaluck Satumanatpan: Governance
Prof. Dr. Padermsak Jarayabhand: Opportunities for blue economy investment and business

The drafting of the remaining sections of the report was the responsibility of the TEI Staff.

3. Consolidation and analysis of data

The TEI, as technical assistant, coordinated with DMCR, national agencies and institutions, universities, local governments, and other projects and programmes to gather, review, and analyse all available information.

4. Preparation of the draft NSOC Report

Using the information gathered from the TWG members and other information sources, a draft NSOC Report was prepared by lead authors in accordance with the outline and template provided by PEMSEA. Three TWG meetings were convened to consider the draft report. PEMSEA also reviewed all drafts and provided comments and suggestions.

The NSOC Report contains the following:

Part 1

- Background: Location and boundaries; brief description of the seas and coastal areas; demographic features; socioeconomic conditions

Part 2

- Ocean economy: outputs (revenues) and gross value added of the ocean economy, and its contribution to GDP and employment; and
- Key ocean economy sectors, including revenues from fisheries and aquaculture, marine tourism; ports and shipping; offshore oil and gas; employment in ocean economy; threats and major issues; government response; and best practices.

Part 3

- Assessment of enabling conditions that would support blue economy development; and
- Blue economy initiatives: examples of innovative and sustainable practices in ocean and coastal management, habitat conservation, pollution reduction, climate change response, etc. to achieve the SDG 14 targets, SDS-SEA targets, and ensure sustainable ocean economy and ocean health.

Part 4

- Ocean health: state of the marine environment; state of the coastal and marine ecosystems, resources and biodiversity; and threats and pressures from human activities, natural hazards and climate change;

Part 5

- Policies and governance: description of key policies, laws, international agreements adopted that would address the pressures and threats to ocean health and ocean economy;
- Institutional arrangements and supporting mechanisms (budget and financing, capacity development, knowledge management, stakeholder participation, etc.) for the implementation of these policies, laws and international agreements; and
- Actions and initiatives addressing sustainable development (e.g., conservation and marine protected areas; marine pollution reduction; integrated coastal management; etc.)

5. Stakeholder Consultation Workshop

The Stakeholders Consultation on the Second Draft of the National State of the Oceans and Coasts Report for Thailand (NSOC Report) was held on 28 September 2017. There were 70 participants who attended the consultation. The objectives were to review the second draft of the NSOC Report. It was presided by Mr. Dhana Ying Charoen, Director of the Marine and Costal Resources Conservation Department, DMCR, and chaired by Prof. Dr. Padermsak Jarayabhand, TWG Chairperson. Apart from the TWG members, there were a number of representatives from concerned government agencies, such as the Budget Bureau, Fish Marketing Organisation (FMO), Department of Industrial Work, the Office of the National Research Council of Thailand (NRCT), the Royal Thai Navy, and Water Transport Promotion-Marine Department.

There were also representatives from the International Union for Conservation of Nature (IUCN), Thailand Research Fund (TRF), Thailand Development and Research Institute (TDRI), UN Environment, and PEMSEA who attended the consultation, and provided comments and suggestions. In addition, there were experts and lecturers from universities, such as the Faculty of Marine Sciences, Kesetsert University, Chulalongkorn University, and King Mongkut's University of Technology Thonburi (KMUTT), who attended the sessions.

6. Participation in the Regional Blue Economy Forum

The NSOC Report of Thailand was presented at the Regional Blue Economy Forum co-organized by PEMSEA, Thailand Research Fund, and the Department of Marine and Coastal Resources, on 14-15 November 2017. The objective of the forum is to share progress on valuing the growing ocean economy, the crucial marine ecosystem services, and highlights of the blue economy initiatives, innovations, policies and mechanisms in the East Asian Seas Region. Outputs from the Blue Economy Forum were incorporated into the NSOC Report, as appropriate.

7. Finalize the NSOC Report for submission to MNRE

Based on the comments provided by PEMSEA and inputs provided by the TWG and other stakeholders, TEI finalized the report for review, approval, and adoption by MNRE before submitting to PEMSEA for publication. The NSOC Report was launched together with reports of other countries at the EAS Congress 2018.

Timeframe

Date	Activities
28 March 2017	Organized the Inception Workshop
April – June 2017	Consolidated and analyzed available data and information
28 April 2017	Organized consultation workshop to set up the outline of the report and lead authors of each sector
20 June 2017	Organized the 1st NSOC TWG Meeting to consider the 1st Draft of the NSOC report
30 June 2017	Submission of the 1st draft of NSOC Report to PEMSEA
July - Aug 2017	Refinement of the first draft based on the review of the National TWG, PRF, and the Regional TWG
2 August 2017	Organized the 2nd NSOC TWG Meeting to consider the 2nd Draft of NSOC report
31 August 2017	Submission of 2nd draft of the NSOC Report to PEMSEA
28 September 2017	Organized Stakeholders Consultation to seek views and comments from Stakeholders' review of the draft NSOC Report
Sept – Oct 2017	Refinement of the draft report based on stakeholders' inputs and review of PRF
17 October 2017	Submission of the 3rd draft of the NSOC Report to PEMSEA

Timeframe (cont.)

Date	Activities
11 November 2017	Organized the 1st Focus Group Consultation to consider the template document for Blue Economy Forum
14-15 November 2017	Participation in the Regional Blue Economy Forum, and presentation of the NSOC Report
19 December 2017	Organized the 3rd NSOC TWG meeting to consider comments on 3rd draft report
December 2017 – January 2018	Refinement of the NSOC Report based on inputs from the Blue Economy Forum
10 January 2018	Submission of revised 3rd draft of the NSOC Report to DMCR and PEMSEA
26 February 2018	Organized the 2nd Focus Group Consultation to consider revised data information based on PEMSEA comments
12 March 2018	Organized the 3rd Focus Group Consultation to consider revised data information of Unit 1,3-4, 7
2 April 2018	Organized the 4th Focus Group Consultation to consider revised data information of Unit 8,10
15 May 2018	Organized the 4th NSOC TWG Meeting to consider draft final report
31 May 2018	Submission of draft final version of NSOC Report
30 June 2018	Submission of the final version of NSOC Report
November 2018	Launching of SOC reports at the EAS Congress 2018

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