MARINE AND LAND-BASED POLLUTION ASSESSMENT IN THE ARAFURA AND TIMOR SEAS REGION

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EXECUTIVE SUMMARY

The Arafura and Timor Seas (ATS) Region is a shallow continental shelf marine ecosystem which is often highlighted as one of the world’s highest productive seas which sustain both small- and large-scales fisheries that provide livelihoods for millions of people in the region. The efforts of regional stakeholders to protect the delicate and vulnerable marine ecosystem culminated in the launch of the Arafura and Timor Seas Ecosystem Action (ATSEA) Program in 2006. Two of the significant outcomes of the ATSEA Program Phase I were Trans-boundary Diagnostic Analysis (TDA) and Strategic Action Programme (SAP) in 2012. Since 2019, the ATSEA Program Phase II expounded on the findings of the TDA to resolve various issues in the region through the implementation of the SAP. This report was developed as a part of the SAP implementation to identify pollution hotspots in the region.

Chapter 1 introduces overall characteristics of the ATS Region in order to understand the background information on the sources of pollution. As highly productive seas, the ATS Region is rich in natural resources such as fisheries and oil reserves as well as teeming marine ecosystem. This chapter explains geography and bathymetry, marine features, biodiversity, socio-economic status, primary environmental concerns of the ATS region.

Chapter 2 delves on the legal and institutional arrangements for environmental governance of the ATS Region to protect marine environment and ecosystem in the region. Regional organizations such as Coral Triangle Initiative (CTI), PEMSEA and COBSEA are working towards sustainable development in the littoral countries. ATS countries are also established their legal and institutional arrangements for the protection of coastal and marine environment. Important multilateral agreements such as IMO conventions are also introduced.

Chapter 3 expounds on the pollution sources as elucidated by the TDA (2012) as well as the DPSIR framework employed in this report. There are several pollution sources identified among the region including nutrients, spilt oil from oil rigs, derelic fishing gears, marine debris, pesticides, sedimentation, animal manures among others. Considering the region-wide impacts, this report identified oil spill from offshore oil rigs and marine debris including plastics and derelic fishing gears as the regional pollution concerns which will be focused in the following chapters.

Chapter 4 elaborates on the oil pollution hotspots in ATS Region through examining the current oil exploration status and trend as well as historic oil spill incident, i.e., Montara Wellhead Platform Incident of 2009. Since offshore oil platforms are operating throughout the entire Timor Sea, the sea itself become a hotspot. In particular, the areas formerly known as the Joint Petroleum Development Area (JPDA) and Ashmore and the Cartier Islands Adjacent Area (ACIAA) are identified as oil pollution hotspots. This study conducted an oil spill simulation using the General NOAA Operational Modelling Environment (GNOME) to examine the spread of oil sleeks in time of oil spill at the scale of the Montara Incident.

Chapter 5 identifies marine debris hotspots in ATS Region through the analysis of available literatures. Two important types of marine debris were selected in this report: i) shoreline debris and ii) seafloor debris such as derelic fishing gears. Since the entire ATS Region is a fishing hotspot, ALDFGs (abandoned, lost and discarded fishing gears) of trawl and gill nets from fishing
vessels are assumed to be major sources of seafloor debris. Due to lack of scientific monitoring data on shoreline debris, this study was unable to identify shoreline debris hotspots, although it is assumed that shore areas around the big cities will be hotspots. Through the analysis on fishing vessel density data of Global Fishing Watch, Aru Sea was identified as a seafloor debris hotspot in ATS Region as well as fisheries hotspot.

Chapter 6 summarizes the findings of this report. ATS Region is highly productive and rich in resources while at the same time under the threats of oil spill and marine debris including derelict fishing gears. The ATS countries have established legal and institutional arrangements for pollution in their respective countries and many international and regional organizations are active. However, the level of preparedness and response on oil spill shows significant gaps between countries. Regional collaborative platform is largely lacking. In this regard, this report recommended that the ATS countries (except Australia) should ratify the OPRC 90 in soonest time and establish a regional platform for oil spill preparedness and response, similar to the Gulf of Thailand model. A regional marine debris monitoring program will be helpful in assessing the marine debris situation and in raising awareness on the impacts of marine debris as well as behavioural changes towards circular society of the residents. Finally, ATS countries are recommended to work closely with regional organizations, such as PEMSEA, COBSEA, RC3S, OSRL and GISEA for national capacity building on marine debris and oil spill response.
**RINGKASAN EKSEKUTIF**


Bab 1 memperkenalkan karakteristik keseluruhan wilayah ATS untuk memberikan latar belakang informasi tentang sumber-sumber polusi. Sebagai ekosistem laut yang sangat produktif, wilayah ATS memiliki sumber daya alam yang merupakan kekayaan seperti perikanan, cadangan minyak, serta keanekaragaman hayati di dalam ekosistemnya. Bab ini menjelaskan kondisi geografis dan batimetri, karakteristik kelautan, keanekaragaman hayati, status sosial ekonomi, serta masalah lingkungan di wilayah ATS.

Bab 2 membahas lebih detail terkait pengaturan hukum dan tata kelola lingkungan di wilayah ATS yang bertujuan untuk melindungi lingkungan dan ekosistem laut di wilayah tersebut. Organisasi regional seperti Coral Triangle Initiative (CTI), PEMSEA, dan COBSEA bekerja sama mendukung terwujudnya pembangunan berkelanjutan di negara-negara pesisir. Negara-negara ATS juga telah menetapkan peraturan hukum dan kelembagaan untuk perlindungan lingkungan pesisir dan laut. Perjanjian multilateral yang penting, seperti konvensi IMO, juga dibahas dalam bab ini.


Bab 4 menguraikan titik-titik pencemaran minyak di wilayah ATS yang dihasilkan melalui pemeriksaan status dan pola eksplorasi minyak saat ini, serta kejadian kecelakaan tumpahan minyak di masa lampau, yaitu Insiden Anjungan Sumur Montara tahun 2009. Banyaknya anjungan minyak lepas pantai yang beroperasi di daerah Laut Timor menyebabkan kawasan ini masuk ke dalam status zona rawan. Secara khusus, kawasan yang sebelumnya dikenal sebagai Area Pengembangan Minyak Bersama (APMB) dan Ashmore and the Cartier Islands Adjacent Area (ACIIAA) diidentifikasi sebagai kawasan yang rawan terhadap pencemaran minyak. Kajian ini
melakukan simulasi tumpahan minyak dengan menggunakan General NOAA Operational Modelling Environment (GNOME) untuk mengkaji penyebaran aliran minyak pada saat terjadi tumpahan minyak pada skala insiden Montara.


SUMÁRIU EZEKUTIVU

Rejiaun Arafura no Tasi Timor (ATT) nu’udár ekosistema marina ho plataforma kontinentál ne’ebé la-kle’an ne’ebé dala barak konsidera hanesan tasi ho produtividade aasliu iha mundu ne’ebé sustenta peska ho esklasaun kiik no médiu hodi fornese maneira buka moris nian ba ema tokon ba tokon iha rejiaun ne’e. Esforsu hosí parte-interesada rejejonál nian hodi proteze ekosistema marina ne’ebé frjíl no vulnerável hetan kulminasaun iha lansamentu ba Programa Asaun Ekosistema Arafura no Tasi Timor (AEATT) nian iha tinan 2006. Rezultadu signifikante rua hosí Programa Faze Dahuluk AEATT nian maka Análize Diagnóstiku Trans-fronteirisa (ADT) no Programa Asaun Estratéjiku (PAE) iha tinan 2012. Dezde tinan 2019, Programa Faze Daruak AEATT ne’ebé deskreve kle’an bazea ba deskobrimentu iha ADT hodi resolve kestaun oioin iha rejiaun liuhosi implementasaun PAE. Relatóriu ida ne’e dezenolve hanesan parte ida iha implementasaun PAE hodi identifikasi fatin poluisaun sira iha rejiaun.

Kapítulu 1 introduz karaterístika jerál sira iha Rejiaun Arafura no Tasi Timor (ATT) hodi kumpriende klala’ok informasaun kona-ba fonte poluisaun sira. Hanesan tasi ho produtividade aas, rejiaun ATT riku iha rekursu naturál hanesan peska no rezerva mina nomós ekosistema marina ne’ebé wa’in-bo’ot. Kapítulu ida ne’e esplika jeografia no batimetria, karaterístika marina, biodiversidade, estatutu sósiu-ekonómiku, kestaun primáriu ambientál hosi rejiaun ATT.

Kapítulu 2 ezamina kl’ean kona-ba aranju jurídiku no institusionál ba governasaun ambientál iha Rejiaun ATT atu proteze ambiénte no ekosistema marina iha rejiaun. Organizaun rejonál sira hanesan Inisiativu Triângulu Ahu-Ruin (Coral Triangle Initiative, sigla Tetun – ITAR), PEMSEA no COBSEA hala’o serbusu ba dezenvolvimentu sustentável iha paíz litorál sira. Paíz ATT sira mós establese ona sira nia aranju jurídiku no institucionál ba protesaun ambiénte kosteira no marina nian. Iha ne’e introdúz mós akordu multilaterál importante sira hanesan konvensaun IMO.

Kapítulu 3 deskreve kle’an kona-ba fonte poluisaun hanesan esplika hosí ADT (2012) nomós enkuadramentu DPSIR ne’ebé hakerek iha relatóriu ida ne’e. Iha mós fonte poluisaun balun ne’ebé identifikasi entre rejiaun, inklui nutriénte sira, mina nakfakar hosí ekipamentu mina, ekipamentu peska naksoe, residu marina, pestisida, sedimentasaun, adubu animál no seluseluk tan. Konsidera impaktu wa’in rejiaun nian, relatóriu ida ne’e’edifikasi mina nakfakar hosí mina fatin iha tasi-claran no residu marina inklui plástiku sira no ekipamentu peska naksoe sira hanesan kestaun poluisaun rejonál nian ne’ebé sei foka iha kapítulu sira tuirmai.

Kapítulu 4 elabora kona-ba fatin poluisaun mina iha Rejiaun ATT liuhosi ezamina estatutu explorasaun mina ezistente no tendensia sira nomós insidente históriku mina nakfakar, h.e., Insidente Plataforma Mina-Matan Montara tinan 2009. Dezde plataforma mina tasi-claran hala’o operaun iha área Tasi Timor tomak, tasi ne’e rasik maka sai fatin. Partikularmente, área sira ne’ebé uluk konesidu hanesan Área Konjunta ba Dezenvolvimentu Petróleu (AKDP) no Ashmore no Área-Besik Illa Cartier (ABIC) identifikasi hanesan fatin poluisaun mina nian. Estudu ida ne’e hala’o simulasaun ba mina nakfakar uza General NOAA Operational Modelling Environment (GNOME) atu ezamina nakbalar hosí mina nia nafurin-mahar bainhiru mina nakfakar iha eskala Insidente Montara nian.

Kapítulu 5 identifikasi fatin residu marina iha Rejiaun ATT liuhosi análize ba literatura sira ne’e iha. Tipu importante rua residu marina nian maka hetan selesaun iha relatóriu ida ne’e: i) residu
kosteira no ii) resídu tasi-kidun hanesan ekipamentu peska naksoe. Dezde Rejiaun ATT tomak nu’udár fatin peska nian, ALEPM (abandonadu, lakon no ekipamentu peska naksoe) hosí rede-besi no rede-tali ró peska nian maka konsidera hanesan fonte bootliu ba resídu tasi-kidun. Tanba falta data monitoriamentu sientifiku kona-ba resídu kosteira, estudu ida ne’e la konsege identifika fatin resídu kosteira nian, maske konsidera área kosteira ne’ebé haleu sidade boot sira maka sei saí fatin resídu kosteira nian. Liuhosi análíze ba data densidade ró peska hosi Hamatan Peska Globál (Global Fishing Watch), identifika Tasi Aru hanesan fatin resídu tasi-kidun nian iha Rejiaun ATT nomós hanesan fatin peska nian.

Kapítulu 6 halo sumáriu ba deskobrimentu nian iha relatóriu ida ne’e. Rejiaun ATT nu’udár fatin ho produtividade aas no riku iha rekursu no iha tempu hanesan sai rísku ba mina nakfakar no resídu marina nian inklui ekipamentu peska naksoe. Paíz ATT sira estabelese ona aranju jurídiku no institusiónál ba poluisaun iha sira nia paíz respetivu no organizasaun internasionál no rejionál maka ativu. Maske nune’e, nível prontidaun no resposta ba mina nakfakar nian hatudu suut signifikante entre paíz sira. Plataforma kolaborativu rejionál nian maka falta tebes. Ba biban ne’e, relatóriu ida ne’e rekomenda atu paíz ATT sira (haketak Australia) tenke ratifika OPRC 90 iha tempu badak nia laran no estabelese plataforma rejionál ida ba prontidaun no resposta mina nakfakar nian, hanesan ho modelu Abízmu Tailândia nian. Programa monitoriamentu rejionál ba resídui marina sei tulun tebes atu avalia situasaun resídui marina no atu hasa’e konsiénsia kona-ba impaktu resídui marina nomós mudansa hahalok hasoru sosiedade sirkulár nia rezidente sira.
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CHAPTER 1. INTRODUCTION

1.1 ARAFURA AND TIMOR SEAS REGION

The Arafura and Timor Seas (ATS) Region comprises of contiguous, semi-enclosed seas bordered by the four littoral nations: Indonesia and Timor-Leste to the North, Papua New Guinea to the East and Australia to the South (Figure 1). This region is particularly important in connecting the waters from Pacific Ocean with Indian Ocean through the thermohaline circulation of global ocean currents, commonly known as “The Great Ocean Conveyor Belt (Broecker, 1991).” The ocean currents in ATS Region flow from the east to the west and provides corridor for migration to numerous marine megafaunas including endangered marine mammals.

The bathymetry of the ATS Region and adjacent seas show the shallow features of the seas (Figure 2). With the incoming sediments from lands around the seas and upwelling at the seas create phytoplankton blooms in the ATS Region during the southeast monsoon season (June – November), notably in Arafura Sea (Kämpf, J., 2018). The majestic phytoplankton blooms in the north-western Arafura Sea (around Aru Sea) during the southeast monsoon are created by the undercurrents that drive nutrient-rich Banda Sea slope water into the area. While undercurrents develop in most of the Arafura Sea, the eventual upwelling of nutrient-rich water is restricted to its north-western region between the Aru Islands and the west coast of the Yos Sudarso Peninsula.

Figure 1. Arafura and Timor Seas
(Source: Author created map using shapefile from IW:LEARN)

1 http://geonode.iwlearn.org/layers/geonode:selected_seas
Timor Sea

Timor Sea is lying southeast of the island of Timor, Indonesia, and northwest of Australia and influenced alternately by the southeast trade winds and the monsoon belt. About 480 km wide, it covers about 610,000 km² and opens west into the Indian Ocean and east into the Arafura Sea. The Joseph Bonaparte Gulf is located in the Australian territory of the Timor Sea. A maximum depth of more than 3,300 m is reached in the Timor Trough in the north, but more than half of the sea has a depth of less than 200 m. Throughout the year, the sea experiences a southwesterly surface current, the Timor Current, averaging 0.8–1.6 km per hour. The Timor Sea is the site of important oil fields.

Arafura Sea

The Arafura Sea is bordered by the Torres Strait to the east, the Gulf of Carpentaria to the south, the Timor Sea to the west and the Banda and Ceram Seas to the northwest. It is 1,290 km long and 560 km wide. The depth of the sea is mainly 50–80 m with the depth increasing to the west. The sea lies over the Arafura Shelf, part of the Sahul Shelf. When sea levels were low during the last glacial maximum, the Arafura Shelf, the Gulf of Carpentaria and the Torres Strait formed a large flat land bridge connecting Australia and New Guinea and easing migration of humans from Asia into Australia. Due to the shallow depth with nutrient-rich waters flowing into the Sea, Arafura Sea has become a major fishing ground.

ATSEA Program

The Large Marine Ecosystem (LME) program of UNDP put significant attention to the ATS Region due to its declining fisheries stocks and pollution issues. In 2006, The Arafura and Timor Seas
Ecosystem Action (ATSEA) Program was developed by the Arafura and Timor Seas Expert Forum (ATSEF) and supported by the Global Environment Facility (GEF). The program called ATSEA-1 was implemented from 2010 to 2016 through which TDA and SAP were development. Figure 3 shows the map of ATSEA Region which is slightly modified from ATS regional map by including Dili and Papua New Guinea. ATSEA-2 Project is under the implementation since 2019 with the mandate to implement some actions identified in the SAP including pollution assessment and hotspot identification in the ATS Region.

![Arafura and Timor Seas Ecosystem Action (ATSEA) Region](ATSEA-program.com)

Figure 3. Arafura and Timor Seas Ecosystem Action (ATSEA) Region
(Source: ATSEA-program.com)

### 1.2 ATS REGION AS A BIODIVERSITY HOTSPOT

Biodiversity Hotspots

According to the Critical Ecosystem Partnership Fund (CEPF), South East Asian countries comprise four (4) biodiversity hotspots, namely: Indo-Burma, Philippines, Wallacea, and Sundaland. As shown in Figure 4, these areas also contain highly biodiverse Large Marine Ecosystems including South China Sea, Sulu Sea, Sulawesi Sea, Java Sea, Indonesian Sea, Arafura and Timor Seas and the Gulf of Thailand.

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2 ATSEA-program.com
3 www.cepf.net
Wallacea Biodiversity Hotspot covers central Indonesia and part of Arafura and Timor Seas with a total land area of 33.8 million hectares. The region’s thousands of islands support highly diverse biological communities with many unique species - more than half of the mammals, 40 percent of the birds and 65 percent of the amphibians found in Wallacea do not occur outside the hotspot. Many of these species are endemic not only to the hotspot but also to single islands or mountains within it. Such species are highly vulnerable to habitat loss, hunting, collection and other pressures. As a result, Wallacea has 308 terrestrial and freshwater species classified by the IUCN as globally threatened and many more species for which data is inadequate to allow full assessment of their status.

Along with neighbouring New Guinea, the Wallacea Region has more marine species than anywhere else on the planet, and it forms the heart of the Coral Triangle. Of these marine species, 252 are classified as threatened with extinction by IUCN, many of them are corals, which are vulnerable to the combined effects of bleaching, sedimentation and pollution as well as destructive fishing practices.

In 2014, Selig et al. (2014) tried to prioritize the conservation efforts of coastal and marine ecosystem through using species distribution and human impacts on the areas. In their investigation, they consider species richness and species endemism to identify range sensitivity. They compiled vast available data for species richness and distribution with high resolution human impact data. In Figure 5, the species richness and range rarity are presented in A and B where it can be shown that the South East Asian seas including ATS Region marks the highest. This implies that this Region has the most endemic species which has limited mobility and under the threat of extinction unless conservation efforts are directed. Figure 5(D) shows also that human impacts are significant in the Asian countries. It is true that the Asia is one of the fastest growing regions in the world with the development at the ASEAN countries are very strong over the past decades. As the most developments are happening at coastal areas, the loss of habitats such as mangrove, seagrass and corals are significant.
ATS Region Rich in Marine Resources

The ATS Region is one of the world’s highest productive marine ecosystems producing more than 300 g C m$^{-2}$/year (Figure 6). The region’s high productivity sustains both small- and large-scale fisheries, including several high-value, shared trans-boundary fish stocks that provide livelihoods for millions of people in the region (Alongi et. al., 2011).

Figure 5. Spatial patterns for (A) species richness, (B) range rarity, (C) proportional rarity and (D) cumulative human impacts within EEZs and ABNJ
(Source: Selig et al., 2014)

Figure 6. Global net primary productivity map
(Source: Nellemann et al., 2008)
The neritic pelagic waters of the Arafura and Timor Seas, as in the neritic zone of other sea areas, are the waters which receive light and are generally occupied by an abundance of marine organisms. The high level of organisms associated with this zone is related to the presence of typical neritic or shallow water zones which are a feature of tropical ecosystems such as mangrove forests, seagrass beds and coral reefs. These three ecosystems are found in the intertidal zone, where the coral reef habitat is comprised of extensive sandy areas, fringing corals and coral rock, sand and muddy substrates which are found in many mangrove and seagrass ecosystems. An examination of the depth profile of the Arafura Sea reveals that this area is only representative of shallow-water marine ecosystems, whereas in the Timor Sea deep water ecosystems can be found as well as the typical tropical shallow water ecosystems.

The ATS Region is home to a vast array of natural wonders⁴:
- 160 species of coral
- 350 species of reef fish
- 25% of the world’s mangroves
- 45 mangrove tree species
- 15 species of seagrass beds
- Marine turtles, dugongs, sharks and rays
- Nesting colonies of shorebirds and seabirds

Figure 7 shows MPAs of the ATS Region (source: CTC/YKAN)⁵. As shown in this figure, there are numerous protected areas exist along the coastal areas of ATS. Along the MPAs, sea turtles, whale sharks, whales and dugongs are migrating to find food. ATS have been feeding grounds for numerous marine species due to ATS’s high productivity and rich marine biodiversity. In addition, the ATS Region is extremely rich in non-living natural resources, including oil and gas reserves.

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⁴ Atsea-program.com
⁵ Coral Triangle Center (CTC) / Yayasan Konservasi Alam Nusantara (YKAN)
1.3 SOCIAL AND ECONOMIC STATUS OF ATS REGION

There are approximately 4.1 million people living in the ATS Region, of which approximately 2.8 million people are in Indonesia, 1 million in Timor-Leste, 310,000 in Australia and 46,000 in Papua New Guinea (ATSEA, 2012). The level of development and social and economic status of people living in the ATS Region varies considerably between districts and countries as does the size of the local economies and growth rates of economies. Levels of economic development in northern Australia are much higher than those of the other three countries, with annual per capita GDPs twenty or more times higher than those in the highest earning districts of ATS Region of Indonesia or Papua New Guinea.

In Indonesia, Timor-Leste and Papua New Guinea, poverty is a significant issue and serious in some districts. There has actually been a trend to increasing rather than decreasing poverty levels over the last decade. Over 30 percent of Indonesians are considered ‘poor’ based on the national classification system (living on less than Rp. 126,000 per month or US 1.25$ per day). A look at the overarching human capital quality parameter based on health, education and income, the human development index (HDI), for each of the ATS countries demonstrates the difference in the development situations of the countries. With a HDI score of 0.937, Australia was ranked the second highest of the 169 nations with sufficient data for comparison (but this does not necessarily reflect the situation of the Indigenous population). Indonesia was ranked 108th, Timor-Leste was 120th and Papua New Guinea came 137th (UNDP, 2010).

### Table 1. General Facts of Arafura and Timor Seas (2009)

<table>
<thead>
<tr>
<th>Country</th>
<th>GDP/capita</th>
<th>Human Development Index (2014)</th>
<th>Human population (% ATS)</th>
<th>Population density (pop/km²)</th>
<th>Area of EEZ (km²) (% of ATS)</th>
<th>Number of fishers (% ATS)</th>
<th>Fisheries catch (t) (% ATS)</th>
<th>Fisheries value (million AUD) (% ATS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>727</td>
<td>0.684</td>
<td>2,845,028 (69.26%)</td>
<td>15.2</td>
<td>773,319 (30%)</td>
<td>247,277 (97.67%)</td>
<td>793,410 (97.97%)</td>
<td>689.6 (85.64%)</td>
</tr>
<tr>
<td>Timor-Leste</td>
<td>325</td>
<td>0.595</td>
<td>906,435 (22.07%)</td>
<td>67.6</td>
<td>54,335 (2%)</td>
<td>5,265 (2.08%)</td>
<td>3,066 (0.38%)</td>
<td>5.3 (0.66%)</td>
</tr>
<tr>
<td>Papua New Guinea</td>
<td>695</td>
<td>0.505</td>
<td>46,537 (1.13%)</td>
<td>1.5</td>
<td>30,364 (1%)</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Australia*</td>
<td>37,453</td>
<td>33,043 (97.55%)</td>
<td>310,000 (7.5%)</td>
<td>0.2</td>
<td>1,749,432 (67%)</td>
<td>625+ (0.25%)</td>
<td>13,340 (1.65%)</td>
<td>110.3 (13.7%)</td>
</tr>
<tr>
<td>Total</td>
<td>253,167</td>
<td>809,816</td>
<td>805.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*GDP for Queensland, Northern Territory and Western Australia. NA: not available
(Source: ATSEA, 2012)
1.4 PRIMARY ENVIRONMENTAL CONCERNS

According to the Ocean Health Index (OHI)\(^6\) assessment, ATS Region scores between 50-75 (Global score is 71) in clean waters goal of OHI. The result varies due to country-based assessment, not specifically for ATS Region. In OHI, marine pollution is assessed using four categories, i.e., nutrients, pathogens, chemicals and trash.

![Figure 8. OHI marine pollution assessment framework (above) and ATS Region assessment results (below)
(Source: OHI)](Image)

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\(^6\) www.oceanhealthindex.org
Much of the marine life in ATS is under threat from a combination of overfishing, loss of habitat and the impacts of climate change. This underlines the urgent need for collective regional action and transboundary management of economically important fish species, critical habitats and marine megafauna. Through a series of national and regional consultations during the first phase of the ATSEA Programme (ATSEA-1), it was identified the following five primary environmental concerns:

1. Unsustainable Fisheries
   A dramatic decline in coastal resources is being caused by illegal, unreported and unregulated (IUU) fishing. Combined with unsustainable practices and fisheries bycatch, this issue is draining the ATS Region of resources faster than they can be naturally replenished.

2. Habitat Degradation
   Industrial expansion is having a major impact on the ATS ecosystem while the clearing of mangroves for fuel wood is accelerating the destruction of vital coastal habitats.

3. Pollution
   From both land and sea, the ATS Region is being suffocated by pollution from human waste, sediments and oil spills. Coastal development in the region has led to increased sediment runoff into the ocean, along with land degradation and toxic waste from mining projects.

4. Loss of Biodiversity
   The combined impact of unsustainable harvesting, fisheries bycatch, habitat loss and climate change has led to a major decline – and in some cases loss – of biodiversity, including several key marine species.

5. Impacts of Climate Change
   The destruction currently unfolding in the ATS Region is the result of fossil fuel-based global energy consumption, unregulated land use and unsustainable forestry on a global scale.
2.1 REGIONAL ORGANIZATIONS IN THE ATS REGION

CTI-CFF

The Coral Triangle Initiative on Coral Reefs, Fisheries, and Food Security (CTI-CFF) is a multilateral partnership of six countries, namely: Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands and Timor-Leste (the ‘CT6’), working together to sustain marine and coastal resources by addressing crucial issues such as food security, climate change and marine biodiversity. Recognizing the critical need to safeguard the region’s marine and coastal resources, Indonesian President Yudhoyono inspired other leaders in the region to launch the CTI-CFF through the signing of the Leaders Declaration in 2009. It is the first multilateral cooperation which focuses on food security through sustainable management of marine natural resources taking into consideration climate change impacts.

![CTI-CFF Implementation area](source: CTI-CFF)

At the Leader’s Summit in 2009, these governments agreed to adopt a 10-year CTI-CFF Regional Plan of Action (CTI RPOA) to safeguard the region’s marine and coastal biological resources. The RPOA has five (5) goals: strengthening the management of seascapes; promoting an ecosystem approach to fisheries management; establishing and improving effective management of marine

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7 Coraltriangleinitiative.org
protected areas; improving coastal community resilience to climate change; and protecting threatened species.

Through the CTI-CFF, the Coral Triangle Member Parties have agreed to apply people-centred biodiversity conservation, sustainable development, poverty reduction and equitable benefit sharing. The CTI-CFF seeks to address both poverty reduction through economic development, food security, sustainable livelihoods for coastal communities and biodiversity conservation through the protection of species, habitats and ecosystems.

CTI-CFF Member States and Partners

<table>
<thead>
<tr>
<th>Member States</th>
<th>National Coordinating Committees (NCC)</th>
<th>National Coordinating Committees (NCC)</th>
<th>National Coordinating Committees (NCC)</th>
<th>National Coordinating Committees (NCC)</th>
<th>National Coordinating Committees (NCC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDONESIA</td>
<td>Ministry of Marine Affairs and Fisheries</td>
<td>Ministry of Environment and Water</td>
<td>Conservation and Environment Protection Authority</td>
<td>Department of Environment and Natural Resources</td>
<td>Ministry of Environment, Climate, Disaster Management and Meteorology</td>
</tr>
<tr>
<td>MALAYSIA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>PAPUA NEW GUINEA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHILIPPINES</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>SOLOMON ISLANDS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TIMOR-LESTE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 10. CTI-CFF member states and partners
(Source: CTI-CFF)

PEMSEA

Partnerships in Environmental Management for the Seas of East Asia (PEMSEA)\(^8\) was created with a mission to foster and sustain healthy and resilient coasts and oceans, communities and economies across the Seas of East Asia through integrated management solutions and partnerships. For over two decades, the organization has provided solutions for effective management of coasts and oceans across the countries of East Asian Seas. As the regional coordinating mechanism for the Sustainable Development Strategy for the Seas of East Asia (SDS-SEA), a marine strategy among 14 countries in the region, PEMSEA works with national and local governments, companies, research and science institutions, communities, international agencies, regional programs, investors and donors towards implementation of the SDS-SEA. Crucial networks such as learning centers also contribute their expertise and coastal management skills to attain the goals of SDS-SEA.

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\(^{8}\) Pemsea.org
PEMSEA aims to proactively build effective intergovernmental and intersectoral partnerships and expand the capacities of countries and other stakeholders with innovative, cross-cutting policies, tools and services for integrated coastal and ocean management. PEMSEA applies integrated coastal management (ICM) as the primary approach for generating and sustaining healthy oceans, people and economies. The major focus of the PEMSEA project includes:

- Formulation and adoption of integrated approaches to managing land and water uses, from river basins to coastal seas, among participating countries in response to the challenges of climate change, sea level rise, loss of biodiversity, depleting fisheries and marine resources, severe degradation of water quality, and increasing multiple-use conflicts in the coastal and marine areas;

- Development of human resources in areas of planning and sustainable management of coastal and marine areas through innovative capacity development programs such as promoting horizontal learning among stakeholders, south-south and north-south learning, on-the-job learning, as well as formal and informal training programs;

- Demonstration of ICM as a systematic and effective approach for managing land and water uses in coastal areas, and scaling up of ICM initiatives; and

- Development and adoption of a sustainable regional mechanism to augment national and regional commitment to protect and manage the coastal and marine environment of the Seas of East Asia.

In 2009, PEMSEA gained an international legal personality. Also, PEMSEA together with the SDS-SEA was recognized as the regional governance mechanism and framework for the sustainable management of the seas of East Asia. PEMSEA has implemented several UNDP/GEF supported projects. ATSEA-2 project is currently being implemented by PEMSEA with Regional Project Management Unit located in Bali, Indonesia.
COBSEA


The Regional Coordinating Unit for the Action Plan was established in 1993, functioning as a Secretariat for COBSEA. COBSEA brings together nine countries (Cambodia, People’s Republic of China, Indonesia, Republic of Korea, Malaysia, the Philippines, Thailand, Singapore and Vietnam) for the sustainable development and protection of the marine environment and coastal areas of the region. Efforts are focused on addressing marine pollution, strengthening marine and coastal planning and management, and strengthened regional governance for marine environmental management.

COBSEA is a regional intergovernmental policy forum and the decision-making body for the East Asian Seas Action Plan, with a mandate to coordinate coastal and marine initiatives in the region, facilitate policy development, and develop and implement related projects. Strong partnerships with national and regional institutions and an institutional structure that evolves with regional priorities are key to fulfilling this mandate.

The COBSEA Secretariat is hosted by Thailand in Bangkok and administered by UNEP. It acts as the Regional Coordinating Unit of COBSEA and provides overall technical coordination and supervision of the implementation of the Action Plan, including:

- co-ordinating the activities of government partners and other stakeholders in the region for a healthy marine environment,
- acting as a supervisory body for the implementation of COBSEA projects and activities, and
- facilitating knowledge sharing among participating countries and across regions, including with other Regional Seas programmes.

Regional Activity Centres (RACs) provide a means to support and supplement efforts by governments and other partners towards the implementation of the Action Plan. RACs are established by and operate under the overall authority of the Intergovernmental Meeting and the guidance of the COBSEA Secretariat.

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\(^9\) Cobsea.org
2.2 IMO CONVENTIONS

Global Initiative for Southeast Asia (GISEA)

The Global Initiative (GI) is a joint programme between the International Maritime Organization (IMO) and IPIECA, the global oil and gas industry association for advancing environmental and social performance. This cooperation stem from the International Convention for Oil Pollution Preparedness, Response and Co-operation (OPRC), and represents the sustainable commitment by Industry to address oil spill issues, in conjunction with governments, local ownership, and stewardship, through the regional models with programme delivery focused on joint workshops, seminars, and training and exercises.

Southeast Asia has long been identified as a priority region which could benefit from GI activities. A study was conducted in 2017 on the level of oil spill preparedness across the region, following which, an action plan was drafted a year later to implement GI for Southeast Asia. The Global Initiative for Southeast Asia (GISEA) Project was launched in March 2013 in Jakarta, Indonesia.

GISEA, in collaboration with competent national authorities in charge of oil spill response, and in partnership with the IMO, technical partners, and local oil and gas industry, seeks to strengthen the following six elements of oil spill preparedness, and response capability across the region:

- Legislation
- Contingency planning
- Cooperation
- Resources
- Training
- Exercises

---

Figure 12. Inception of GISEA
(Source: GISEA)

Gisea.org
OPRC

In July 1989, a conference of leading industrial nations in Paris called upon IMO to develop further measures to prevent pollution from ships. Subsequently, the IMO Assembly in November endorsed the work began to draft a convention aimed at providing a global framework for international co-operation in combating major incidents or threats of marine pollution. In 1990, the Convention was adopted for ratification. Parties to the International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC) are required to establish measures for dealing with pollution incidents, either nationally or in co-operation with other countries.

In accordance with the OPRC, 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. Ships are required to report incidents of pollution to coastal authorities and the convention details the actions that are then to be taken. The Convention 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 the convention 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. The Convention provides for IMO to play an important co-ordinating role. A Protocol to the OPRC relating to hazardous and noxious substances (OPRC-HNS Protocol) was adopted in 2000 and entered into force in 2007.

MARPOL 73/78

The International Convention for the Prevention of Pollution from Ships (MARPOL), adopted in 1973, is the main convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. The Protocol of 1978 was adopted in response to a spate of tanker accidents in 1976-1977. As the 1973 MARPOL Convention had not yet entered into force, the 1978 MARPOL Protocol absorbed the parent Convention. The combined instrument entered into force on 2 October 1983. In 1997, a Protocol was adopted to amend the Convention and a new Annex VI was added which entered into force on 19 May 2005. MARPOL has been updated by amendments through the years.

The MARPOL Convention includes regulations aimed at preventing and minimizing pollution from ships - both accidental pollution and that from routine operations - and currently includes six technical Annexes. Special Areas with strict controls on operational discharges are included in most Annexes.

- Annex I Regulations for the Prevention of Pollution by Oil (entered into force 2 October 1983)
- Annex II Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk (entered into force 2 October 1983)
- Annex III Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form (entered into force 1 July 1992)
• Annex IV Prevention of Pollution by Sewage from Ships (entered into force 27 September 2003)
• Annex V Prevention of Pollution by Garbage from Ships (entered into force 31 December 1988)
• Annex VI Prevention of Air Pollution from Ships (entered into force 19 May 2005)

Table 2. MARPOL 73/78, OPRC and OPRC-HNS ratification status among ATS Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>MARPOL 73/78</th>
<th>OPRC</th>
<th>OPRC-HNS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Indonesia</td>
<td>✓ except III, IV and V</td>
<td>Not yet</td>
<td>Not yet</td>
</tr>
<tr>
<td>Papua New Guinea</td>
<td>✓ except IV</td>
<td>Not yet</td>
<td>Not yet</td>
</tr>
<tr>
<td>Timor-Leste</td>
<td>Not yet</td>
<td>Not yet</td>
<td>Not yet</td>
</tr>
</tbody>
</table>

(Source: IPIECA)

2.3 ATS COUNTRIES

Indonesia

According to Article 7 of Law 12 of 2011 on the Formulation of Laws and Regulations, the Indonesian legal framework sets forth the following hierarchy of laws, regulations, and decrees as shown in Figure 13. This also applies to the environmental laws and regulations. There are also presidential instructions (Instruksi Presiden or Inpres), ministerial decrees (Keputusan Menteri or Kepmen) and circulation letters (Surat Edaran). However, ministerial decrees and the decrees of non-departmental chiefs do not have the same binding power as regulations; rather they are binding in their respective sectors as an administrative decision. Under the law hierarchy, Indonesia established extensive laws and regulations covering major aspects of environmental protection and international environmental conventions. However, the laws and regulations are subject to amendment and frequent updates to cope with changing environment.

![Figure 13. Regulations hierarchy in Indonesia](Source: ADB, 2017)
As an important development on ocean policy of Indonesia, Indonesian President Joko Widodo signed Presidential Regulation no. 16 on the “Indonesian Ocean Policy” on February 20, 2017. The national policy was issued as the guideline for, and to coordinate, all maritime-related policies and programmes across different ministries and agencies. Prior to this, Indonesia was long criticized for lacking an integrated ocean policy and ocean-based strategies. Aside from domestic urgency, the narrative through which the new policy was introduced portrays a strategic document that projects Indonesia's interest and strategy in the region. Emphasizing these two dimensions of the policy (domestic and external), on the domestic front the policy document has a clear elaboration of the important aspects of ocean management, and functions appropriately in its aim to coordinate maritime-related policies. On the other hand, the external dimension of the ocean policy is still unclear, particularly in terms of how this document will interact with and affect regional geopolitics (Muhiat, S.F., 2017).

![Figure 14. Indonesian ocean policy](Source: Oegroseno, A.H., 2017)
The legal foundation of environmental management can be found in the National Constitution of Timor-Leste. In the Article 61, it is stated that:

- Everyone has the right to a humane, healthy and ecologically balanced environment and the duty to protect it and improve it for the benefit of the future generations.
- The State shall recognize the need to preserve and rationalize natural resources.
- The State should promote actions aimed at protecting the environment and safeguarding the sustainable development of the economy.

The National Constitution also stipulates articles on natural resources. In Section 139(3), it is stated that the exploitation of the natural resources shall preserve the ecological balance and prevent destruction of ecosystems. Protected Areas are stipulated by the Decree Law #5/2016 (covered 46 protected area) and Decree Law #3/2009 (Local Community Lider Activities).

The General Directorate of the Environment (GDE), under the Ministry of Economy Commerce, Industry and Environment and the Ministry of Agriculture and Fisheries (MAF) are the two government agencies with primary responsibilities for the environment. GDE has responsibility for environmental monitoring, control and protection. The Secretary of Environment and Natural Resources (SERN) is responsible for mineral and natural resources, including oil and gas, as well as related industries whereas the State Secretary of Energy Policy (SSEP) is responsible for implementing the development program that promotes the use of renewable and alternative energy sources throughout the country. The National Directorate for Water and Sanitation (NDWS) is the agency responsible for most of the water and sanitation sector activity and is under the Ministry of Infrastructure. This agency is responsible for the national management of water resources and formulates sector policy, manages distribution of water for human consumption, and monitors water quality through the National Laboratory.

Land management and forestry are under the current jurisdiction of the MAF. However, land, water and coastal zones provide many functions for many users, and therefore there are potential conflicts that require an integrated approach. Environmental concerns of Timor-Leste include:

- Land degradation: driven mainly by “slash and burn” agriculture
- Deforestation: major driver of deforestation is currently conversion of forest to agricultural land, mainly driven by the rural households’ efforts to increase their food security
- Water resources –pollution and scarcity: experienced short rainy seasons, non-existing sewage systems and inadequate systems for the collection and disposal of wastewater and solid waste
- Loss of biodiversity and ecosystem services: a combination of Australian and Asian flora and fauna and is known to have rare terrestrial, lake and marine ecosystems originating from unique geological and meteorological conditions
- Climate Change: rising sea levels will increase the risk of flooding in low-lying coastal villages and the higher risk of floods, forest fires and food shortages as a result of more extreme weather conditions

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11 UNESCAP (2017)
Papua New Guinea

The Department of Environment and Conservation (DEC) is a government agency responsible for managing overall environment of Papua New Guinea which was established in 1985. Its mission (approved by the National Executive Council on 22 August 1989) is to ensure natural and physical resources are managed to sustain environmental quality and human well-being (APEC EGS). The key legislations administered by the Department are:

- Environmental Planning Act 1978
- Environmental Contaminants Act 1978
- Conservation Areas Act 1978
- National Parks Act 1982
- International Trade (Fauna & Flora) Act 1979
- Fauna (Protection and Control) Act 1966
- Crocodile Trade (Protection) Act 1974
- Water Resources Act 1982

It also has an important role under the Forests Act 1992. Efforts are currently underway to amalgamate three legislations (Environment Planning Act, Environment Contaminants Act and Water Resource Act) to provide for an effective and efficient environmental regulation process. The system is intended to provide for a one-stop-shop environmental approval. The functions of the Department include:

- environmental impact assessment of major projects including forestry, mining and petroleum proposals;
- environment policy development;
- pollution control and the regulation of hazardous substances;
- management of water resources
- conservation of flora and fauna;
- establishment and management of national parks and protected areas;
- species management;
- biodiversity assessment;
- biodiversity data management;
- hydrological investigation, data collection and analysis;
- education and awareness, and;
- administration of Papua New Guinea’s international environmental convention agreements.

The National Parks Act 1982 provides for reserving Government land in various categories of conventional style parks and it allows for the leasing of, and accepting gifts of land for conservation purposes. The Conservation Areas Act 1978 has similar objectives to the National Parks Act, but importantly, its provisions apply to all types of land, not just government land. This

12 APEC Environmental Goods and Services Information Exchange. Egs.apec.org/more-articles/172-department of environment and conservation in Papua New Guinea
Act is very flexible in its definitions of conservation methods. Other legislation important to the enforcement of conservation are:

- the Crocodile (Trade and Protection) Act 1974, which regulates the crocodile industry;
- the Customs Regulations which provide for control over the export of fauna, alive or dead, and;
- the International Trade (Fauna and Flora) Act 1979, which provides Central measures on International Trade on Wild Fauna and Flora.

There is a strong determination to reverse the cycle of conservation effort decline of the past several years. Encouraged by the international conservation community and by indication of substantial support from other donor agencies, the DEC has recently revised its conservation program, and has embarked on a major new effort to expand conservation awareness.

Australia

Australia has a federal constitutional system. In the federal system, the central government (Australian government) works together with states and territory governments and local governments. The central government has various functions and roles in regulation: lead regulator, sole regulator, co-regulator and parallel regulator (Figure 15). The Department of the Environment and Energy is the responsibility center for the matters related to the environmental issues. In legislative perspective, the Environment Protection and Biodiversity Conservation (EPBC) Act of 2009 is Australia’s central piece of environmental legislation. The law aims to conserve and protect the environment, including threatened species, wetlands, world heritage sites and the Great Barrier Reef marine park. The law is used to determine what should be listed for protection, guide the recovery of wildlife threatened with extinction, identify major threats to the environment, manage wildlife trade and decide whether development such as mining, urban expansion or agriculture clearing should proceed.

![Figure 15. Australian government’s regulatory arrangements (Source: Department of the Environment and Energy, Australian Government, 2017)](image-url)
The eight matters of national environmental significance protected by the EPBC Act are:

- world heritage properties
- national heritage places
- wetlands of international importance (listed under the Ramsar Convention)
- migratory species protected under international agreements
- listed threatened species and ecological communities
- Commonwealth marine areas
- the Great Barrier Reef Marine Park, and
- nuclear actions (including uranium mines).

The States and Territories where ATS Region lies are Western Australia, Northern Territory and Queensland. These States and Territory have their own government organizations and agencies for managing their environment. For example, Northern Territory Government has its own department for the environment: the Department of Environment, Parks and Water Security which provides services on natural resources management, parks and wildlife, environmental regulatory reform, etc.

Among the Australian Government Agencies, the Australian Maritime Safety Authority (AMSA) is the responsibility center for MARPOL related pollution as well as oil spill preparedness and response. AMSA’s responsibilities include: search and rescue, port state control, ship registration, operation of the National Plan for Maritime Environmental Emergencies.
CHAPTER 3. POLLUTION ASSESSMENT OF ATS REGION

3.1 ATSEA TDA AND SAP

Marine and Land-based Pollution Assessment

In 2011, ATSEA completed the Transboundary Diagnostic Analysis (TDA) for Arafura and Timor Seas Region. As shown in Table 3, five environmental priority concerns were identified. The methodology for analysing the priority drivers recommended by UNDP for the Large Marine Ecosystem (LME) projects is the causal chain analysis (CCA). In line with this, the TDA study was conducted using the CCA for marine and land-based pollution assessment (Figure 16). The CCA covered the six major economic sectors, namely: agriculture/forestry, mining, energy/oil & gas, marine tourism, urban and industrial development and fishing/shipping.

The resulting direct drivers of pollution included: land clearing (increased sediment), chemical run-off (fertilizer and pesticides), damming of freshwater sources (increased sedimentation), mangrove conversion (aquaculture), seaweed farming, sand mining (run-off), chemical contaminants, oil spills, marine debris from fishing vessels, sewage run-off, and derelict fishing gears. Based on the findings of the TDA, the Strategic Action Programme (SAP) was developed in 2012. In order to respond to the drivers of pollution, SAP included two objectives, namely: 3.1 prevent and reduce inputs of pollutants and diffuse sources, 3.2 prevent and reduce pollution from marine sources (Table 4).

Table 3. Priority transboundary issues in the ATS

<table>
<thead>
<tr>
<th>Priority Environmental Concerns</th>
<th>Key Causal Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Unsustainable fisheries &amp; decline &amp; loss of living coastal &amp; marine resources</td>
<td>Illegal, unreported and unregulated fishing; overexploitation; unsustainable practices; fisheries by-catch</td>
</tr>
<tr>
<td>2. Modification, degradation &amp; loss of coastal &amp; marine habitats</td>
<td>Coastal development, bottom trawling, fuel wood (mangroves), dynamite fishing, pollution (sediments)</td>
</tr>
<tr>
<td>3. Marine &amp; land-based pollution (e. g. marine debris, sediments, oil spills)</td>
<td>Coastal development (nutrients, sediments), mining (sediments, toxicants), land degradation (sediments), oil spills, marine debris</td>
</tr>
<tr>
<td>4. Decline &amp; loss of biodiversity &amp; key marine species</td>
<td>Illegal harvesting, traditional indigenous harvest, fisheries by-catch (ghost nets, trawling, long-lines), habitat loss</td>
</tr>
<tr>
<td>5. Impacts of climate change including ocean warming and ocean acidification</td>
<td>Fossil fuel-based global energy consumption, land use, Land use change and forestry</td>
</tr>
</tbody>
</table>

(Source: ATSEA TDA 2012)
Figure 16. Causal chain analysis for marine and land-based pollution of ATSEA TDA
(Source: ATSEA TDA)
Table 4. Objective 3 of ATS SAP

**Objective 3.1: To prevent and reduce inputs of pollutants from coastal point land sources (wastewater, sewage and industrial) and diffuse sources (land-use)**

**Target 3.1: Reduction of the ecologically harmful impacts of nutrients in coastal waters from base year**

<table>
<thead>
<tr>
<th>Priority Actions</th>
<th>Key national activities</th>
<th>Supporting regional activities</th>
<th>Indicator(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhanced coordination of policies across sectors and different levels of government</td>
<td>Improvement (where required) of existing policies and legislation and filling of gaps, including through: - Gap analysis of regulations to control land-based sources of marine pollution - Harmonise standard procedures to control land-based pollution - Strengthening of intersectoral coordination mechanism - Improve coordination between different levels (district provincial, national)</td>
<td>Identify pollution hotspots and associated impacts as an input to ICM</td>
<td>Number of laws and policies strengthened</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Intersectoral coordination mechanisms in place in each country</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hotspots identified across the ATS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Training and exchanges completed</td>
</tr>
</tbody>
</table>

**Objective 3.2: To prevent and reduce pollution from marine sources (ports and shipping)**

**Target 3.2: Reduction in the incidence and impacts of marine-based pollution from base year**

<table>
<thead>
<tr>
<th>Priority Actions</th>
<th>Key national activities</th>
<th>Supporting regional activities</th>
<th>Indicator(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhance oil spill prevention and response arrangements</td>
<td>Development of early warning and response measures at national level, such as oil spills contingency plan</td>
<td>Development of regional oil spill response coordination arrangements, including communication protocols</td>
<td>Early warning systems in place at national level</td>
</tr>
<tr>
<td></td>
<td>Introduce good practices</td>
<td>Sharing of good practices, including evaluation of environmental risks and sensitivities, and environmental impact assessment and approval practices.</td>
<td>Coordinated oil spill response arrangements in place across the ATS region</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Number of good practices adopted</td>
</tr>
<tr>
<td>Reduce marine debris</td>
<td>Improve monitoring and strengthen awareness</td>
<td>Strengthen regional collaboration on marine debris (including DFG) to identify key sources and impacts, and develop and implement cost-effective solutions</td>
<td>Reduction of marine debris compared to baseline</td>
</tr>
<tr>
<td></td>
<td>Awareness raising at national and local levels of environmental impacts of marine debris, through means such as beach clean-up campaigns</td>
<td></td>
<td>Reduction in amount of derelict fishing gear (DFG) in the ATS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Implementation of actions to reduce marine debris, such as port reception facilities, gear locators etc.</td>
</tr>
</tbody>
</table>

(Source: ATSEA SAP 2012)

Objective 3.1 is for land-based pollution while objective 3.2 is for marine-based pollution. The SAP recommended key activities for pollution reduction as shown in Table 4. In this study, another analysis tool, DPSIR framework is utilized to come up with the priority pollution sources.
3.2 DPSIR FRAMEWORK ANALYSIS

Using DPSIR framework, the drivers identified in the TDA can be analysed for their impacts (Table 5). Among the environmental concerns of ATS Region, coastal development (nutrients, sediments), mining (sediments, toxicants), land degradation (sediments), oil spills, marine debris from fishing vessels are considered for analysis.

<table>
<thead>
<tr>
<th>Driver</th>
<th>Pressure</th>
<th>State</th>
<th>Impacts</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capture fisheries</td>
<td>Extensive seaweed culture</td>
<td>Derelict fishing gears</td>
<td>Ghost fishing by derelict fishing gears</td>
<td>Awareness building for fishers on marine ecosystem impacts of derelict fishing gears</td>
</tr>
<tr>
<td></td>
<td>Increased capture fisheries</td>
<td>Overfishing</td>
<td>Marine ecosystem degradation by pollutants</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Extensive use of fishing gears</td>
<td>IUU fishing</td>
<td>Reduced income of fishers</td>
<td>Aquaculture development for sustainable fisheries</td>
</tr>
<tr>
<td>Oil extraction at the platforms in the ATS</td>
<td>Off-shore oil extraction</td>
<td>Coastal areas including habitats and species under constant threats of oil spill</td>
<td>Coastal habitats degradation</td>
<td>Oil spill early warning system</td>
</tr>
<tr>
<td></td>
<td>High-vessel traffic for oil transport</td>
<td>Oil spillage from fishing boats</td>
<td>Reduced coastal economic activities (fisheries)</td>
<td>Oil spill contingency planning</td>
</tr>
<tr>
<td></td>
<td>Pipe connection for oil transport from the platform</td>
<td>Litters from fishing boats</td>
<td>Mass mortality of coastal species</td>
<td>ESI Mapping</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Response and preparedness</td>
</tr>
<tr>
<td>Coastal and mining development</td>
<td>Coastal area development for residential and commercial</td>
<td>Habitat destruction along the coastal areas</td>
<td>Loss of habitat for species to nurture and regenerate</td>
<td>Implementing ICM plan and zoning plan</td>
</tr>
<tr>
<td></td>
<td>Mining for minerals and gold</td>
<td>Siltation and chemical run-off</td>
<td>Excessive mud and chemicals polluting coastal areas</td>
<td>Enforcement of laws and regulations on mining operation</td>
</tr>
<tr>
<td>Agricultural development</td>
<td>Animal husbandry development</td>
<td>Untreated animal manures running off to coastal areas</td>
<td>Eutrophication of coastal waters</td>
<td>Improved treatment of animal manures at the site</td>
</tr>
<tr>
<td></td>
<td>Plantation on extensive areas for trade crops</td>
<td>Excessive use of chemicals for monocrop plantation</td>
<td>Chemical pollution at the coastal communities</td>
<td>Enforcement of laws and regulations on using chemicals</td>
</tr>
</tbody>
</table>

3.3 PRIORITY REGIONAL POLLUTION ISSUES

In Table 5, we may see that the most serious driving forces of issues at ATS Region are capture fisheries and oil extraction which are posing imminent threats to the marine environment. This is due to the intensive fishing activities as well as oil and gas extraction at the ATS Region. This analysis is congruent with a survey result on pollution sources from the coastal residents of Rote.
Ndao Regency, Indonesia (Figure 17). Most of the residents perceived oil spill from oil rigs and marine debris as serious concerns.

![Diagram](image)

**What is the most serious source of pollution?**

While there are numerous pollution concerns exist in ATS Region as shown in TDA (Table 4) and DPSIR Analysis (Table 5), only few issues draw region-wide attention such as oil spill and marine debris due to their far-reaching impacts to the Region. In this report, pollution sources are classified as regional concerns and localized concerns, as shown below:

- **Regional concerns:**
  - Oil spill
  - Marine debris (including plastics and derelict fishing gears)

- **Localized pollution concerns**
  - Nutrients (animal manures and sewerage)
  - Sedimentation from local mining activities
  - Toxic substances from agricultural practices

Although localized concerns such as nutrients may be severe at the very sources, solutions are rather simply obtained locally. On the other hand, regional concerns require concerted efforts of all the stakeholders at ATS Region for solutions. In this reason, this report will be focused on the status and response on the two regional concerns in details in separate chapters.
3.4 GAP ANALYSIS

Since oil spill response requires significant resources and techniques, it is imperative for countries in ATS Region to co-operate for joint response actions. As shown in Figure 18, Australian government’s division of responsibility for oil spill incident rely on AMSA and Oil companies. When the oil spill happens at the oil rig in Timor Sea, it is the responsibility of the oil company which is oftentimes not acting fast enough to contain the spread of spilt oil. The Montara oil spill incident is a typical example which need co-operation of countries.

![Figure 18. Division of responsibility for oil spill response](Source: National Marine Oil Spill Contingency Plan, AMSA)

Australia has established the National Marine Oil Spill Contingency Plan in 1973 which is managed by AMSA. The country is bilaterally entered joint response agreement with Timor-Leste and Papua New Guinea. Indonesia also has developed a National Oil Spill Contingency Plan in 2006 and launched in 2007. The lead agency for oil spill preparedness and response is the Directorate General of Sea Transportation (DGST). A national team for Oil Spill Response has been established comprising the Directorate General of Mining and Gas and other government ministries and agencies. Timor-Leste and Papua New Guinea have not set up any oil spill preparedness and response measures to date.

When it comes to oil spill preparedness and response, the OPRC 90 is the most important IMO convention. The convention requires ships and offshore units to have oil pollution emergency plans which must be co-ordinated with national systems for responding promptly and effectively to oil pollution incidents. Also, it provides a framework for co-operation with other countries in
time of oil spill and requires establishments of stockpiles of oils spill combating equipment, holding of oil spill exercises, development of detailed plans for dealing with pollution incidents. Therefore, the countries of ATS Region should ratify the OPRC 90 in due time in order to promote oil spill preparedness, response and co-operation. Only Australia has ratified the convention. This lack of ratification of the most important international treaty on oil spill hampers the region to effectively prepare for the worst-case scenario on oil spill.

As oil spill is identified as one of the most significant threats to the ATS Region, it is imperative to collaborate with countries of the region, global response companies as well as the oil and gas industries such as IPIECA.

Table 6. Gap in oil spill response in ATS Region

<table>
<thead>
<tr>
<th>Current state</th>
<th>Desired State</th>
<th>Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of oil spill response materials and capable personnel</td>
<td>Equipment for oil spill preparedness and response should be equipped</td>
<td>Australia is equipped with response material and capacity. Other countries should equip with response resources.</td>
</tr>
<tr>
<td>Cooperation arrangements are limited</td>
<td>Regional response cooperation mechanism setup</td>
<td>Regional cooperation mechanism is lacking. Also, joint exercise and training activities should be done regularly.</td>
</tr>
<tr>
<td>Ratification of OPRC Convention is limited</td>
<td>All the countries should ratify the OPRC Convention</td>
<td>Only Australia ratified OPRC and OPRC-HNS. Other countries should follow.</td>
</tr>
</tbody>
</table>
CHAPTER 4. OIL POLLUTION HOTSPOTS IN ATS REGION

4.1 OIL AND GAS DEVELOPMENT IN TIMOR SEA

Early Development Stage and JPDA

Oil and gas exploration started in 1960s in Timor Sea which led to successful discoveries in the Sunrise and Troubadour Fields in 1974 (ERCE, 2020). Subsequently, the Jabiru 1a well, drilled by the Australian company BHP, found significant oil deposits with extraction began in 1986. In 1989, Indonesian and Australian government signed the Timor Gap Treaty which established a Zone of Cooperation (ZOC). The treaty provided Indonesia-Australia joint exploration of the Timor Sea with revenues shared 50-50.

In 1991, Australia and Indonesia awarded Production Sharing Contracts (PSCs) to Philips Petroleum, Royal Dutch Shell, Woodside Australian Energy and other petroleum companies to explore and exploit resources in Timor Gap Zone of Cooperation. In 1994, exploitable oil was found in Elang-Kakutua and Laminaria followed by Bayu-Undan by Philips Petroleum. In 2000, Australia and United Nations Transitional Administration in East Timor (UNTAET) signed a MOU continuing Timor Gap Treaty terms but replacing Indonesia with Timor-Leste. The agreement specified a 50-50 division between Australia and Timor-Leste on oil and gas production from the ZOC, called the joint Petroleum Development Area (JPDA) (Figure 19). In 2001, the Timor Sea Treaty was signed granting Timor-Leste 90% of oil and gas revenues from the JDPA. The treaty established the Timor Sea Designated Authority (TSDA) which was responsible for the administration of all petroleum-related activities in JPDA.

Figure 19. Location of JPDA in Timor Sea in in 2001
(Source: Northern Territory Government, 2001)
In 2002, drilling of 16 wells at Bayu-Undan began. Maritime boundary between Australia and Timor-Leste also began in 2002. In 2003, Australia and Timor-Leste signed International Unitization Agreement for Greater Sunrise by which Australia agreed annual payment to Timor-Leste. In 2004, Bayu-Undan started to produce oil and gas. Subsequently, a 500 km-long natural gas pipeline connecting the Bayu-Undan processing facility to a liquefied natural gas plant in Wickham Point, Darwin was constructed (red dotted line in Figure 19).

In 2005, Timor-Leste established a Petroleum Fund law to establish Petroleum Fund with a balance of US$247 million. Timor-Leste started to receive bids for its offshore licensing round with five contracts awarded to Eni and one to Reliance for offshore exploration. Since then, various oil and gas fields were discovered and operated as summarized in Table 7.

### Table 7. Oil and Gas Exploration Sites in Timor Sea (as of 2006)

<table>
<thead>
<tr>
<th>Within the Joint Petroleum Development Area (JPDA)</th>
<th>On the border of the JPDA or contested with Australia</th>
<th>Areas in Timor-Leste’s undisputed territory contracted in 2006</th>
<th>Areas in the JPDA contracted in 2006</th>
<th>Elsewhere in the Timor Sea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bayu-Undan</td>
<td>Greater Sunrise</td>
<td>Exploration contracts were signed with Eni and Reliance</td>
<td>Exploration contracts were signed with Petronas, Oilex and others</td>
<td>Petrel-Tern (Australia)</td>
</tr>
<tr>
<td>Elang-Kakatua</td>
<td>Laminaria-Corallina</td>
<td></td>
<td></td>
<td>Jabiru (Australia)</td>
</tr>
<tr>
<td>Buffalo</td>
<td></td>
<td></td>
<td></td>
<td>Evans Shoal (Australia)</td>
</tr>
<tr>
<td>Jahal - Kuda Tasi</td>
<td></td>
<td></td>
<td></td>
<td>Abadi (Inpex, Indonesia)</td>
</tr>
</tbody>
</table>

(Source: laohamutuk.org)

### Maritime Boundary between Australia and Timor-Leste

In 2006, Australia and Timor-Leste signed the Treaty on Certain Maritime Arrangements in the Timor Sea (CMATS) which aimed to resolve the contest over the development of Greater Sunrise. With the CMATS, both countries agreed to split the upstream revenues at 50:50, and put a moratorium on permanent maritime boundaries until after 2050 (AMTI, 2018). By 2012, Timor-Leste was making legal and political moves to extricate itself from the CMATS agreement due to arising issues. In 2016, Timor-Leste initiated United Nations Compulsory Conciliation (UNCC) proceedings. In 2017, Australia agreed to dissolve CMATS which reinvigorated its obligations to delimit maritime boundaries. Finally, in 2018, the Australia–Timor-Leste Treaty Establishing Their Maritime Boundaries in the Timor Sea (the Maritime Boundary Treaty) was signed on 6 March 2018 at the United Nations headquarters in New York, USA in the presence of the United Nations Secretary-General.

The Department of Foreign Affairs and Trade (DFAT) of Australian Government (2018) commented that the Maritime Boundary Treaty is an historic agreement for Australia and Timor-Leste in that it settled a long-running dispute, delimited the maritime boundaries, and laid the foundation for a new chapter in the relationship between the two countries. The Treaty was brought into force by an exchange of notes between the countries’ Prime Ministers in Dili on 30 August 2019. Figure 20 shows the resulting map of maritime boundary after the Treaty ratified in 2019.
Under the Treaty, the JPDA was annulled and the oil and gas fields currently shared between Australia and Timor-Leste in the former JPDA was transferred to Timor-Leste’s exclusive jurisdiction. Also, the Treaty replaced earlier treaties: the 2002 Timor Sea Treaty and the 2003 International Unitisation Agreement for Greater Sunrise. Timor-Leste terminated the 2006 Treaty on CMATS.

Onshore and Other Oil Field Development in Timor-Leste

Timor-Leste is currently issued PSCs for onshore oil development. The Onshore Blocks A, B and C in the southwest of Timor-Leste covering an area of approximately 1,000 km\(^2\) are currently the only onshore areas licensed by the Timor-Leste Government as PSCs. Charlton et. al. (2018) said that considerable exploration potential exists for onshore exploration in Timor-Leste which attracted significant exploration interest since 19\(^{th}\) century. It is expected that onshore oil exploration in Timor-Leste would be accelerated in near future.

With the Bayu-Undan Oil Field which covers more than 90% of Timor-Leste’s government budget from petroleum revenues nearing closure, Timor-Leste may aggressively involve in the petroleum development at Buffalo and Greater Sunrise Oil Field. These activities may pose additional threats of oil spill to the Timor Sea.
4.2 MONTARA WELLHEAD PLATFORM INCIDENT

Overview of the Incident

On Friday 21 August 2009 the Montara wellhead mobile drilling unit, located within the Ashmore and Cartier Islands Adjacent Area (ACIAA) and approximately 250km offshore from the southeast coasts of Rote Ndao Regency, had an uncontrolled release of hydrocarbons from one of the platform wells which caused oil escaped to the water surface and gaseous hydrocarbons into the atmosphere. The operator PTTEP Australasia (PTTEP AA), a subsidiary of PTT Exploration and Production (PTTEP) which is in turn a subsidiary of PTT, the Thai state-owned oil and gas company, estimated that approximately 64 tonnes per day (about 400 barrels/day) of crude oil were released each day and an estimated 30,000 barrels of oil in total during the 74-day incident. An Australian Maritime Safety Authority (AMSA) report (2010) noted that for safety reasons the estimates of the operator could not be confirmed at any time during the incident, or was it possible to provide a more accurate assessment. The leak stopped on 3 November 2009 when PTTEP AA pumped approximately 3,400 barrels (540 m$^3$) of mud into a relief well to stop the leak.

Response

Immediate after the incident, AMSA initiated the National Oil Spill Contingency Plan. Response action included deploying aircrafts such as a Hercules C-130 aircraft from Singapore under the auspices of PTTEP AA/Australian Maritime Oil Spill Center (AMOSC), AMSA personnel and dispersants from AMSA and AMOSC stocks. Response operations continued until the well was capped on 3 December 2009 (105 days).

According to the Montara Commission of Inquiry (2010), oil and gas continued to flow unabated into the Timor Sea approximately 250 km off the northwest coast of Australia for a period of just 10 weeks. Patches of sheen or weathered oil could have affected at various times an area as large as 90,000 km$^2$. The commission concluded that PTTEP AA did not observe sensible oilfield practices at the Montara Oilfield and that major shortcomings in the company’s procedures were widespread and systemic, directly leading to the blowout.
Figure 22 shows the extent of the oil patches reported in the Montara Commission of Inquiry Report (2010). In the description of this figure, it reads “This image does not represent the extent of any oil slick observed at any time during the oil spill. It is a graphic representation of the area within which isolated patches of oil and/or sheen were observed by surveillance aircraft on 130 separate flights between 21 August 2009 and 28 November 2009. This image is combined with a graphic representation of a model depicting occurrences of visible surface oil emanating from the Montara Well Head over a 90-day period beginning the 21st of August 2009.”

AMSA commenced dispersant spraying operations on 23 August 2009 and continued until 1 November 2009. The Hercules C-130 sprayed a total of 12,000 litres of dispersant on 23 and 24 August 2009 whereas light aircraft contracted to AMSA sprayed 32,000 litres of dispersant from 25 August until 2 September 2009. Also, vessel spraying operation were carried out from 30 August to 1 November with 118,000 litres of dispersant sprayed. AMSA (2010) commented that the use of dispersant was highly effective in assisting the natural process of biodegradation and minimizing the risk of oil impacts on reefs or shorelines quoting the observations made by experienced personnel during the response.
On March 2018, AMSA announced ‘correcting the record – Montara’ stating that the Authority has become aware of documents that indicate oil from the Montara wellhead spill was sighted closer to the Indonesian coast than previously stated and reported publicly. The announcement explained that AMSA inadvertently overlooked the written report of air observer from 22 September 2009 which reported oil sighting approximately 65 kilometers (35 nautical miles) from the Indonesian coast.

Compensation

As the incident was happened due to a failure to maintain a safe workplace and a failure to observe good oilfield practice in accordance with the relevant provisions of the Offshore Petroleum and Greenhouse Gas Storage Act 2006, PTTEP AA was pleaded guilty in August 2012 in the Darwin Magistrates Court to four charges arising out of the Montara incident (PTTEP AA, 2017). Subsequently, the company was fined a total of $510,000 concluding all Australian Government legal matters in relation to the Montara incident.

However, the compensation was not granted to Indonesian fishers on the damages caused by the Montara oil spill. Indonesian fishers in Rote Ndao Regency experienced drastic decline in seaweed production and fish catch as shown in Figure 24. The PTTEP AA claimed that the oil slick were not reached to Indonesian waters affecting the environment.

![Figure 23. Hercules C-130 (left) and an aircraft (right) spraying dispersant](image)

(Source: AMSA, 2010)

![Figure 24. Changes in seaweed production in Rote Ndao Regency (left) and fishery landings in Oeba, Kupang Regency (right)](image)

(Source: Spies et. al., 2017)
In this reason, Indonesian seaweed farmers filed a class action law suit against PTTEP AA for a $200M compensation for their losses as shown in the articles of news reports in Figure 25. The timeline of class lawsuit cases is shown in Box 1. The long legal struggle of seaweed farmers finally paid off when the Australian Federal Court ordered PTTEP AA to pay lead plaintiff Mr. Daniel Sanda a compensation of 252 million rupiah. Although the legal battle in the court might be continued in the following years, this win over the oil company can be a relief to Indonesian seaweed farmers.

**Figure 25. Media publishing Montara incident law suit by Indonesian fishers**
(Source: SBS and The Jakarta Post)
Box 1. Montara Class Lawsuit Case Timeline
(Source: Offshore Technology, 2019 and Business & Human Rights Resource Centre)

**August 2010**
Indonesian government submitted a claim to PTTEP AA for seeking $2.4B in compensation for damages that has severely hit the livelihoods of fishing communities along its southeast coast. It is unclear how Jakarta arrived at the $2.4B figure but local officials have cited the severe impact on the marine habitat and the long-term damage to the fishing communities (31 Aug 2010 Financial Times).

**October 2010**
Around 7,000 Indonesian fishermen reported that their livelihoods had been impacted by the leak including cases of bankruptcy with the number of red snappers in Indonesian waters being drastically reduced as a consequence of the spill.

**August 2016**
Indonesian seaweed farmers launched a class action lawsuit in Australia against PTTEP AA over loss of income caused by 2009 oil spill. More than 13,000 Indonesian seaweed farmers launched a class action in the Federal Court in Sydney against the company responsible for the worst oil spill in the history of Australia’s offshore petroleum industry. Maurice Blackburn Lawyers is seeking hundreds of millions of dollars in compensation for the loss of income. It says the farmers suffered when their seaweed plots died after the 2009 Montara oil spill in the Timor Sea.

**June 2019**
A class action trial against PTTEP began, with over 15,000 seaweed farmers whose livelihoods were affected by the spill seeking more than AUD200m ($137m) in compensation. The class action lawsuit was first filed in the Federal Court of Australia on 3 August 2016, with hearings held on 20 October 2016 and 1 August 2017. Judgement was given in favor of lead plaintiff Mr. Daniel Sanda on 15 November 2017, allowing his case against PTTEP to continue.

**March 2021**
Class action win for Indonesian farmers after 2009 Montara oil spill. The Federal Court found the 2009 Montara oil spill travelled 240 km into Indonesian waters and destroyed the seaweed crops and livelihood of Rote Ndao farmers. Justice Yates ordered PTTEP to pay Mr. Sanda damages for his losses from 2009 to 2014, which amounted to 252 million rupiah, or $22,600 Australian dollars. Consequently, more than 15,000 Indonesian seaweed farmers will be compensated for loss of livelihood caused by one of Australia’s largest oil spills after a protracted class action battle against the company that ran the rig off the coast of Western Australia. Final court ruling would take few more years.
4.3 OIL SPILL HOTSPOTS IN ATS REGION

Oil Development Projection in Timor Sea

With the newly agreed Maritime Boundary Treaty in 2019, the area formerly known as JPDA is now become an exclusive jurisdiction of Timor-Leste (see Figure 20). This solved several hurdles for developing the Greater Sunrise and Buffalo projects through defining the border and formalizing the governance structure and tax-sharing arrangement between the two countries (Offshore Energy, 2019). Since oil and gas fields so far shared between Australia and Timor-Leste in the JPDA were transferred to Timor-Leste’s exclusive jurisdiction, the Buffalo field also transferred from Australia to Timor-Leste. The Greater Sunrise will be jointly developed by the two countries, and share revenue.

In 2019, Timor-Leste signed five new and revised Production Sharing Contracts (PSCs) with offshore petroleum operators affected by the treaty to ensure that they will have certainty and security for affected offshore operations in the Timor Sea. The Greater Sunrise fields, comprised of the Sunrise and Troubadour gas and condensate fields, are located some 150 km southeast of Timor-Leste and 450 km northwest of Darwin, Northern Territory. The offshore gas fields hold gross contingent resources of 5.13 trillion ft$^3$ of gas and 225.9 million barrels of condensate. Woodside is the operator of the project.

The Buffalo field is operated by Carnarvon Petroleum. In January 2021, the company agreed in principle to fundamental terms of a PSC with the Timor-Leste government agency ANPM regarding its Buffalo offshore project.

Figure 26. Current PSC license areas of Timor-Leste
(Source: Charlton et. al., 2018)
Oil Spill Hotspots

It is expected that the nearing closure of the Bayu-Undan Oil Field will hasten the development of the oil and gas in Timor Sea including the Greater Sunrise and Buffalo Oil Fields. Together with the Ashmore and Cartier Islands Adjacent Area (ACIAA), the area formally known as JPDA will be oil spill hotspots in ATS Region (see Figure 20 for JPDA). For the practical purposes, it is necessary to identify the entire Timor Sea as the oil spill hotspot of the ATS Region. Therefore, it is recommended that the Regional Oil Spill Contingency Plan as well as Regional ESI map and Risk Assessment be developed in order to prepare the impending risk of oil spill from the offshore oil rigs in Timor Sea.

4.4 OIL SPILL DISPERSION MODELLING IN ATS REGION

Rationale

There are several oil rigs currently under operation or preparing for operation in Timor Sea. As oil reserves are continuously explored and tapped for future operation, ATS Region is under high risk of oil pollution. Recent incident of the Montara wellhead platform case explained the situation well. When oil is spilt from oil rigs or vessels, the fate of oil in aquatic environment follows the natural processes that may act to reduce the severity of an oil spill or accelerate the decomposition of spilt oil. These natural processes include weathering, evaporation, oxidation, biodegradation, and emulsification (US EPA)\(^{13}\).

Weathering is a series of chemical and physical changes that cause spilled oil to break down and become heavier than water. Winds, waves, and currents may result in natural dispersion, breaking a slick into droplets which are then distributed throughout the water. Evaporation occurs when the lighter substances within the oil mixture become vaporous and leave the surface of the water. This process leaves behind the heavier components of the oil, which may undergo further weathering or may sink to the ocean floor. Oxidation occurs when oil contacts the water and oxygen combine with the oil to produce water-soluble compounds. This process affects oil slicks mostly around their edges. Biodegradation occurs when micro-organisms such as bacteria feed on oil. A wide range of micro-organisms is required for a significant reduction of the oil. Emulsification is a process that forms emulsions consisting of a mixture of small droplets of oil and water.

Modelling procedure

There are several oil spill dispersion modelling tools available in the public domain. The most common and free software available is NOAA’s GNOME. The GNOME (General NOAA Operational Modelling Environment) Suite is a set of modelling tools for predicting the fate and transport of pollutants, such as oil, spilled in water. These modelling tools are used for NOAA’s spill response support and are also publicly available for use by the broader academic, response, and oil spill planning communities.

\(^{13}\) Archive.epa.gov/emergencies/the fate of spilled oil
GNOME is a publicly available oil spill trajectory model that simulates oil movement due to winds, currents, tides, and spreading. GNOME is used during spill response to calculate a ‘best guess’ of a spill’s trajectory and the associated uncertainty in that trajectory. NOAA recommended to use GNOME to:

- Predict how winds, currents, and other processes might move and spread oil spilled on the water.
- Learn how predicted oil trajectories are affected by inexactness (uncertainty) in current and wind observations and forecasts.
- See how spilled oil is predicted to change chemically and physically (weather) during the time that it remains on the water surface.

 GNOME use the Location Files for the regions of interest. These files contain pre-packaged tide and current data, and make it easier to work with GNOME. The Location Files also contain references (both print publications and Internet sites) to help users find detailed information for the location the users are simulating. Since NOAA does not provide a pre-constructed Location file for the Arafura and Timor Seas, GNOME is operated at Diagnostic Mode and inputs of geographic coordinates and physical oceanographic data were input manually.

Modelling using GNOME requires data imported from the web. The most important data required for operating GNOME are global ocean current models, winds and base map. NOAA provides these data through GOODS (GNOME Online Oceanographic Data Server). GOODS is an online tool that helps GNOME users access base maps and publicly available ocean currents and winds from various models and data sources. Required data can be downloaded in a format that can be uploaded directly into GNOME (e.g., map files in BNA format; current and wind files in netCDF).

Map Area

At GOODS, there is a map generator called Base Maps. Using the Global Custom Map Generator, the base map for GNOME can be generated as shown in Figure 27. Select the coordinates and press ‘Get Map’ button, then the map is generated in a BNA format.

![Figure 27. Base map generated for ATS Region using Global Custom Map Generator of NOAA](image)
Current data for the ATS Region can be obtained using Hybrid Coordinate Ocean Model (HYCOM) at GOODS. In order to obtain current data for the specific time and location, user will need to visit Global HYCOM website\(^{14}\). The HYCOM nowcast/forecast system is a demonstration product of the HYCOM Consortium run in real time at the Naval Oceanographic Office. There are lots of data available at Hycom.org and the user must select the data carefully. For this simulation at ATS Region, GOFS 3.0: HYCOM + NCODA Global 1/12° Analysis (data range: 2008-09-19 to 2018-11-20) has been utilized.

Data Setting for Modelling

The size and extent of spilt oil used in this simulation imitated the Montara spill incident. This is to consider historic incident that might happen again in the future. Considering the development potential due to the Maritime Boundary Treaty signed in 2019, the spill site was selected at Buffalo Oil Rig, off coasts of Timor Island. Thus, the simulation has been conducted using the following criteria:

- Spill site: Buffalo Oil Rig
- Spill amount: 300 barrel/day
- Current data: HYCOM + NCODA Global 1/12° Analysis (data year 2018)
- Spill date: 90 days starting from: 1) 01 January 2018; 2) 01 April 2018; 3) 01 August 2018, and 4) 01 Oct 2018

The oil spill was modelled for 90 days and see how the oil spread affect the coastal areas of ATS Region.

4.5 MODELLING RESULTS

Spill on 01 January - 31 March 2018

The first simulation was conducted during 01 January 2018 to 31 March 2018. For the 90 days of spill, most of the spilt oil dispersed within the Timor Sea as shown in Figures 28 to 30. In this simulation, it is clearly shown that the southern coasts of Timor Island as well as southern coasts of Rote Island are affected by oil slicks. The Buffalo oil rig is indicated in red dot in the figures.

\(^{14}\) Hycom.org
Figure 28. Buffalo oil rig spill simulation starting 01 January 2018 (30 days after the spill)

Figure 29. Buffalo oil rig spill simulation starting 01 January 2018 (60 days after the spill)

Figure 30. Buffalo oil rig spill simulation starting 01 January 2018 (90 days after the spill)
Spill on 01 April – 30 June 2018

The second simulation was conducted during 01 April 2018 to 30 June 2018 (90 days). In this simulation, it is clearly seen that the oil slicks were dispersed far distance to the westwards into the Indian Ocean. However, the start of the incident, the oil slicks were already affecting the southern coasts of Timor Island and Rote Island as shown in Figures 31 to 33.

Figure 31. Buffalo oil rig spill simulation starting 01 April 2018 (30 days after the spill)

Figure 32. Buffalo oil rig spill simulation starting 01 April 2018 (60 days after the spill)
Figure 33. Buffalo oil rig spill simulation starting 01 April 2018 (90 days after the spill)

Spill on 01 August – 31 October 2018

The third simulation was conducted during 01 August 2018 to 31 October 2018 (90 days). The spilt oil slicks were spread along the Timor Sea and affecting the southern coasts of Timor Island and Rote Island. Rote Island is affected after few days of spill. Figures 34 to 36 show oil slick movement into Timor Sea.

Figure 34. Buffalo oil rig spill simulation starting 01 August 2018 (30 days after the spill)
Spill on 01 October – 10 November 2018

The fourth simulation was conducted during 01 October 2018 to 10 November 2018 (40 days). During the 40 days, spilt oil was spread widely to the Timor Sea area and mostly affecting the southern coasts of Rote Island. It is clear that during the fourth quarter of the year, Rote Island is the most vulnerable to oil spill from Buffalo oil rig. Figure 37 and 38 show heavy oil sleeks deposit to Rote Island.
Implications

The simulations of oil spill at Buffalo oil rig clearly showed that Timor Island and Rote Island are heavily affected by the oil slicks. With the similar amount and duration of oil spill as the Montara spill case, the spilt oil at Buffalo oil rig travelled to the coastal areas of the two Islands immediately.

The results of the simulations call for an immediate action for oil spill preparedness and response in Rote and Timor Islands. Since the Buffalo and the Greater Sunrise oil fields are exclusive jurisdiction of Timor-Leste, the country will need to enhance oil spill preparedness and response system. Although the responsibility for oil spill cases fall to the operators of the oil rigs, the devastating consequences of spilt oil will be borne by the coastal residents and fishers as clearly shown in Montara Case. Compensation for oil spill case usually takes considerably long time, even a decade, preparedness and proper response system and early warning system are imperative to the coastal residents of Timor Sea, in particular, Rote and Timor Islands.
5.1 AN EMERGING GLOBAL ISSUE

Marine Debris or Marine Litter

Marine debris is one of the emerging global issues in recent years due to its impacts to the marine ecosystem and human health. According to UNEP (2009), the terms “debris” and “litter” are variously used throughout the literature in that some cases they are used to differentiate between marine sourced material (debris) and locally sourced material (litter). In this report, the terms are used interchangeably. UNEP also defined the definition of marine litter as any manufactured or solid waste entering the marine environment irrespective of the source. Marine litter can be categorised into several classes of material including: plastics (e.g., moulded, soft, foam, nets, ropes, buoys, monofilament line and other fisheries related equipment etc.), metal (e.g., drink cans, bottle caps, pull tabs), glass (e.g., buoys, light globes, fluorescent globes, bottles, etc), processed timber (including particle board) and so on. Among the litters, plastics cover more than 80% of the total litter created and gaining attention of the global community due to its impacts to marine ecosystem through the form of microplastics.

GESAMP (2019) uses the term ‘plastic litter’ to cover wide variety of materials, ranging in size from ocean-going boat hulls many metres in length to particles a few nano-metres in diameter. ‘Plastic’ covers a very wide range of compositions and properties. For the past few decades, the global community has produced excessive number of plastics and consumed extravagantly in our daily lives. Majority of the plastics has ended their life at ocean waters (Figure 39).
According to Geyer et. al. (2017), about 70% of plastics were discarded in various forms such as landfill, incineration, marine litter during 1950 to 2015. Only 6% of total plastics manufactured were recycled. Plastic litters discarded to ocean waters in the form of marine litter created environmental, economic, health and aesthetic problems. Poor practices of solid waste management and lack of infrastructure and awareness of the public at large about the consequences of their actions exacerbates the marine litter situation.

This is the very reason that the global community responded with counteractions against marine litter. The EU identified marine litter as one of 11 indicators of good environmental status in 2008 through Marine Strategy Framework Directive (Box 2). The G7 Summit adopted in June 2015 an Action Plan, covering land- and sea-based sources of marine litter, awareness raising and outreach, as well as removal actions and the G20 countries adopted their Action Plan in 2017. The 4th UN Environment Assembly in 2019 adopted resolutions aiming to tackle ocean pollution from plastics and microplastics and single use plastic products. The International Maritime Organization (IMO) adopted an action plan to contribute to the global solution for preventing marine plastic litter entering the oceans through ship-based activities.

**Box 2. EU classification of marine litter sources**
(Source: eu.europa.eu)

Main sources of marine litter are:

Land-based:

- land-fills and littering of beaches and coastal areas (tourism)
- rivers and floodwaters
- industrial emissions
- discharge from storm water drains
- untreated municipal sewerage

Sea-based:

- fishing and aquaculture
- illegal or accidental dumping at sea from shipping (e.g., transport, tourism)
- offshore mining and extraction

Classification of marine litter

- Beach litter
- Floating litter
- Seafloor litter
- Litter in biota
- Microlitter

[Box 2 Figure 1. Types of marine litter of EU]
Two Important Types of Marine Debris in ATS Region

As shown in Box 2, EU defines 5 types of marine litter, namely: beach litter, floating litter, seafloor litter, litter in biota and microlitter. Among these types, the most mentioned litters are beach litter and seafloor litter. Shoreline litters are easy to be witnessed all over the coastal areas. However, deposited benthic litters are most of the times difficult to observe due to its benthic nature. However, it is interesting to see that deposited litters last longer time than our expectation. Lebreton et. al. (2019) showed that much of the plastics in the shorelines are from the past 15 years while significantly large amount is older suggesting that plastics can persist for several decades without breaking down (Figure 40). Also, it was claimed that about 90% of the litter collected from seafloor trawls is made up of plastics (Derraik, 2002 and Galgani et al., 2015).

Galgani et al. (2015) claimed that human activities such as fishing, urban development and tourism contribute to the distribution pattern of debris on the seabed where debris from the fishing activities are prevalent in fishing areas. It was further mentioned that 72% of debris is made of plastic, mainly pots, nets, octopus jars, and fishing lines. Investigations using submersibles at depths beyond the continental shelf and canyons have revealed substantial quantities of debris in remote areas.

Since ATS Region is an intensive fishing area (Figure 41), this report focuses on the two types of marine debris:

i. Shoreline debris; and
ii. Seafloor debris. Most benthic debris is in the form of abandoned, lost and discarded fishing gear (ALDFG), also called derelict fishing gear.
5.2 SHORELINE DEBRIS HOTSPOT IN ATS REGION

Indonesia

It was reported that considerable volumes of marine debris are stemming from the countries of fast-growing economies with large populations (Jambeck et. al., 2015). Although Indonesia is imputed to be one of the leading global contributors of marine debris, the degree of marine debris pollution differs seas by seas. Since Indonesia is the world’s largest archipelagic nation with 17,504 islands and coastlines longer than 54,716 km, it is very difficult to identify marine debris occurrence in every corner of the country. In particular, the status of marine litter occurrence of East Nusa Tenggara Province where ATS Region is located is extremely difficult to identify.

Since the Presidential Regulation No. 16 of 2017 on Indonesian Sea Policy identifies the oceans as a strategic priority and central to Indonesia’s development goals, many research efforts on marine litter in Indonesia have been conducted. From 1986 to 2018, 32 research papers were published among which 26 papers were published since 2014 (Purba et. al., 2019). In 2018, there was a research conducted in East Nusa Tenggara Province, including Kupang and Rote Ndao Regency. Purba et. al. (2018) reported that average marine debris abundance to be $4.447 \pm 1.131$ kg/m$^2$ and $215.417 \pm 35.609$ item/m$^2$ (total transect line was 1.2 km) using the ICC monitoring methodology. It was also reported that Tiang Bendera showed the highest abundance in number of items (item/m$^2$) among 6 sites with 7.99 item/m$^2$ (Figure 43). The report claimed that Tiang Bendera showed lower number than Northeast Coast Brazil (910 items/m$^2$) but higher than Southern beaches of Australia (3.16 item/m$^2$).
Purba et al. (2018) concluded that most of the marine debris are coming from local activities such as fishing and aquaculture, residential and tourism. Therefore, it is important to raise awareness on marine litter and good practices on solid waste disposal at local residents in order to minimize or prevent the occurrence of marine debris.

Australia's State of Environment Report (2016) stated that marine debris has been identified as a key threatening process for threatened and endangered vertebrate fauna. Around the three-quarters of debris items found on Australian beaches are plastic polymers. The report also stressed that although marine debris can be found in all areas of the marine environment in the Australian EEZ, northern Australia is especially vulnerable because of the proximity of intensive fishing operations (including international operations) to the north of Australia. Regional
difficulties in surveillance and enforcement, and ocean circulation and wind patterns were to be blamed for the accumulation of floating debris in northern Australia.

Australia’s marine litter research is led by the Commonwealth Scientific and Industrial Research Organization (CSIRO).\(^{15}\) CSIRO operates Marine Debris Research Program through which comprehensive menus for scientific survey of marine litter including survey methodology, marine debris items list, coastal transect datasheet have been developed. Through the research, CSIRO suggested that approximately three-quarters of the rubbish along the Australian coast is plastic and that most of debris is from Australian sources (not from overseas) with debris concentrated near urban centres. CSIRO also suggested that in coastal and offshore waters, most floating debris is plastic and that the density of plastic ranges from a few thousand pieces of plastic per square kilometre to more than 40,000 pieces of plastic per square kilometre. This conclusion agrees with Indonesian study that debris is more highly concentrated around major cities suggesting local sources as marine debris origin.

Through the Australia State of Environment Report (2016), Australian government projected a deteriorating trend of marine debris. The report expected that losses of debris into the marine environment will continue in the future. Therefore, the assessment grade was high impact with deteriorating trend (Table 8).

Table 8. Marine debris assessment in Australia

<table>
<thead>
<tr>
<th>Component</th>
<th>Summary</th>
<th>Assessment grade</th>
<th>Confidence</th>
<th>Comparability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marine debris</td>
<td>Increasing losses of debris into the marine environment are expected to continue, with a corresponding increase in impacts on marine fauna, and associated socio-economic, environmental, navigation and hazard impacts</td>
<td>Very high impact</td>
<td>Low impact</td>
<td>Very low impact</td>
</tr>
</tbody>
</table>

(Note: Downward arrow in Assessment grade means trend is deteriorating)
(Source: Australia State of Environment 2016)

**Timor-Leste**

Marine debris is relatively new issue in Timor-Leste. Few studies have been conducted in recent years and limited data available. In 2021, Timor-Leste joined a global project for responding to marine debris entitled IMO/FAO/Norad GloLitter Partnership Project as one of the 20 partnering countries. This project aims to enable citizens of Timor-Leste building awareness on marine debris.

Surveys on shoreline or seafloor debris are very limited. One marine debris survey study conducted by Lopes (2017) at the two beaches of Timor-Leste was one of frontier projects. Lopes stated that the Timorese public has minimal knowledge on marine debris due to the lack of education as well as governmental and institutional influences and supports. The survey was

\[^{15}\] http://www.research.csiro.au/marinedebris
conducted over the six weeks for the two beaches with local environmental groups and students. The results of the survey by Lopes (2017) shown in Table 9 revealed that Dolok Oan recorded much larger quantity of marine debris collected than Kusu. Since Dolok Oan is closer to Dili, capital of Timor-Leste, Lopes explained that local contribution on marine debris is obvious. In addition, fishing nets and ropes at the beaches clearly indicates the influence of fishing activities at the adjacent waters. This finding supports the literature claim that industrial fishing activities are quite high in ATS Region (Edyvane and Penny. 2017).

Table 9. Marine debris survey results at the two beaches of Timor-Leste (2017)

<table>
<thead>
<tr>
<th>Study site</th>
<th>Total mass (kg)</th>
<th>Items</th>
<th>Larger debris</th>
<th>Average age of debris</th>
<th>Number of volunteers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kusu (Com village)</td>
<td>~300 (661 lbs)</td>
<td>Plastic, rubber, clothes and glass</td>
<td>Fishing nets and ropes (1 m)</td>
<td>Mostly old, deposited in sand, buried, brittle and fragmented</td>
<td>20</td>
</tr>
<tr>
<td>Dolok Oan (near Dili)</td>
<td>~2,721 (6,000 lbs)</td>
<td>Plastic, rubber, clothes and glass</td>
<td>Fishing nets (2 m), ropes, wood and long metals</td>
<td>Mostly fresh, new, less fragmented and durable</td>
<td>&gt; 130</td>
</tr>
</tbody>
</table>

(Source: Lopes, J.D.R., 2017)

Another marine litter survey recently conducted by Spiller and Fonseca (2021) showed that density of solid waste at the 14 sites of southern coasts was 0.11 items (average)/m² (see Table 10). This result is much lower than the finding of marine litter survey conducted by Da Cruz (2015) on northern coast which showed 0.6 items (average)/m². Some of the claims for this disparity in litter density between northern and southern coasts were the difference in survey methods and the population density between northern coasts where Dili is closer and southern coasts where population is sparse.

Table 10. Numbers of solid waste items collected during Aug to Oct 2020 survey

<table>
<thead>
<tr>
<th>Municipality</th>
<th>Hotspots</th>
<th>Transect length (m)</th>
<th>Transect width (m)</th>
<th>Transect Area (m²)</th>
<th>Total Items</th>
<th>Items per m² (average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viqueque</td>
<td>2</td>
<td>60</td>
<td>10</td>
<td>600</td>
<td>75</td>
<td>0.125</td>
</tr>
<tr>
<td>Manatuto</td>
<td>1</td>
<td>100</td>
<td>10</td>
<td>1,000</td>
<td>150</td>
<td>0.15</td>
</tr>
<tr>
<td>Manufahi</td>
<td>7</td>
<td>250</td>
<td>10</td>
<td>2,500</td>
<td>71</td>
<td>0.0284</td>
</tr>
<tr>
<td>Covalima</td>
<td>4</td>
<td>150</td>
<td>10</td>
<td>1,500</td>
<td>330</td>
<td>0.22</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td>-</td>
<td>-</td>
<td>5,600</td>
<td>626</td>
<td>0.11</td>
</tr>
</tbody>
</table>

(Source: Spiller and Fonseca, 2021)
As Australia expected, occurrence of marine debris might be increasing in Timor-Leste due to several factors such as increase in population and tourists, intensified fishing activities and improper disposal of solid wastes, etc. In order to elucidate the trend of marine debris occurrence, long-term systematic survey on marine debris in Timor-Leste is necessary.

**International Coastal Clean-up Activities**

The Ocean Conservancy (OC) conducts annual International Coastal Clean-up (ICC) campaign during the third week of September around the world. The ICC events produce not only data but also build awareness of public on marine litter. According to 2020 ICC Report, Indonesia produced much larger quantity of debris compared to Australia (Table 11). This means that Indonesian coasts are receiving higher number of debris than Australia. As many literatures proved, significant portions of marine debris are originated from largely localized sources. Therefore, Indonesia will need to address marine litter issue more aggressively in near future.

Table 11. Summary results of 2019 International Coastal Cleanup activities in the ATS countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Australia</th>
<th>Indonesia</th>
</tr>
</thead>
<tbody>
<tr>
<td>People</td>
<td>1,606</td>
<td>11,246</td>
</tr>
<tr>
<td>Pounds</td>
<td>7,425</td>
<td>17,920</td>
</tr>
<tr>
<td>Kilograms</td>
<td>3,375</td>
<td>8,146</td>
</tr>
<tr>
<td>Miles</td>
<td>83.6</td>
<td>76.3</td>
</tr>
<tr>
<td>Kilometers</td>
<td>134.5</td>
<td>122.7</td>
</tr>
<tr>
<td>Total items collected</td>
<td>12,997</td>
<td>309,000</td>
</tr>
<tr>
<td>Food wrappers</td>
<td>2,188</td>
<td>29,197</td>
</tr>
<tr>
<td>Cigarette butts</td>
<td>3,451</td>
<td>115,445</td>
</tr>
<tr>
<td>Plastic beverage bottles</td>
<td>282</td>
<td>9,081</td>
</tr>
<tr>
<td>Plastic bottle caps</td>
<td>148</td>
<td>16,495</td>
</tr>
<tr>
<td>Straws, stirrers</td>
<td>539</td>
<td>20,687</td>
</tr>
<tr>
<td>Plastic cups, plates</td>
<td>87</td>
<td>3,662</td>
</tr>
<tr>
<td>Plastic grocery bags</td>
<td>405</td>
<td>7,999</td>
</tr>
<tr>
<td>Plastic take-out/away containers</td>
<td>124</td>
<td>9,132</td>
</tr>
<tr>
<td>Other plastic bags</td>
<td>72</td>
<td>9,158</td>
</tr>
<tr>
<td>Plastic lids</td>
<td>185</td>
<td>4,529</td>
</tr>
</tbody>
</table>

(Note: Papua New Guinea and Timor-Leste have not participated in ICC event)
(Source: International Coastal Clean-up: 2020 Report, Ocean Conservancy)
Implications

From the marine debris studies of ATS Region, it can be said with confidence that marine debris is an emerging issue with a certain degree deteriorating trend in ATS Region. In 2018, World Bank conducted a rapid assessment of Indonesia marine debris hotspot. The study selected fifteen coastal cities considering urbanization trend, proximity to the coast, population size and presence of container ports and/or tourism activities. Unfortunately, coastal cities in Eastern Indonesia where ATS Region is located were not selected given that the bulk of municipal waste leakage is borne from urban centers in Western and Central Indonesia.

In ATS Region, the location and contribution of marine debris hotspots are hardly identified due to the lack of conclusive data and information. It may be safely assumed that marine debris hotspots are located within or around the large cities and towns in ATS Region as marine debris is originated mostly from localized sources. Therefore, the countries of ATS Region will need to initiate a collaborative network of marine litter monitoring and awareness building. A project like IMO/FAO/Norad GloLitter Partnership Project should be developed and implemented in ATS Region in order to understand better about marine debris in the region as well as raise awareness of the residents.

Box 3. National Marine Litter Monitoring Program of RO Korea
(Source: Marine Environment Information System)

RO Korea has developed and implemented a Comprehensive National Marine Litter Management Plan in 2005. One of the programs supported by the Plan is the National Marine Litter Monitoring Program initiated in 2008. The program aims to: i) understand the occurrence of marine litter around the country in a scientific way, ii) build awareness of citizens around the coastal area; and iii) enhance collaboration with other countries. Monitoring activities are divided into two phases: Phase I (2008-2017) and Phase II (2018-to date). In Phase II, the monitoring methodologies were updated from the Phase I.

The main features of the National Monitoring Program (Phase I) include:

- Monitoring sites selected in accordance with the selection criteria recommended by UNEP Guidelines
- 40 monitoring sites around the country
- 25 NGOs survey the site bi-monthly
- Scientific methods for collecting the debris
- Measures number, volume and weight of debris collected
- Domestic and foreign debris separately identified

Meis.go.kr/mli/monitoringInfo

Box 3 Figure 1. Monitoring sites of the National Marine Litter Monitoring Program of RO Korea
Through the monitoring results from Phase I Monitoring Program, it can be said with strong confidence that marine litter in RO Korea is in decreasing trend over the past 10 years as shown in the figures below. The implications of the monitoring program of RO Korea are quite significant in that: i) the occurrence trend of marine litter is elucidated scientifically; and ii) RO Korea’s waste management policy is effectively functioning.

5.3 SEAFLOOR DEBRIS HOTSPOT IN ATS REGION

Status of Seafloor Debris

Numerous literatures consistently confirm that most of the marine debris are made of synthetic plastics and about 10 M tons of plastics are estimated to enter into oceans every year. Since fishing is one of the most important economic activities in ATS Region with many populations being highly dependent on fish as a source of protein, employment and income (Edyvane and Penny, 2017), extensive use of fishing gears is inevitable. In this reason, derelict fishing gears, also called as abandoned, lost and discarded fishing gear (ALDFG), comprise majority of the deposited or benthic debris. A recent survey on marine debris at southern coasts of Timor-Leste revealed that more than 17% of shoreline debris collected was fishing gears (Spiller and Fonseca, 2021). Australia State of Environment report (2016) imputed the extensive human pressure to the seabed in Australia to demersal trawling for fishes, prawns and scallops by commercial fishing.
vessels. The report also indicated that trawl gear has substantial direct impacts on seabed habitats which comprise delicate long-lived structure-forming biota such as coral reef.

An Australian NGO, Ghost Nets Australia (GNA),\(^{17}\) claims that ALDFGs are devastating the endangered marine life in Australia, in particular, in the Gulf of Carpentaria. In their research, it was found that less than 10% of the nets were from Australian fisheries and others are from various countries. It was further noted that proportion of unidentified nets for the period of 2010-2012 has increased slightly from the period of 2004-2009, indicating that newer nets entering the waters were not be identified with their current net identification system. GNA revealed that the most frequent type of net is from trawl fisheries (62.2%) followed by gill nets (14.4%).

Gilman et al. (2017) identified gear-specific relative risk from ALDFG. As shown in Figure 44, the most frequently found net types, bottom trawl and drift gillnet, scored high in this analysis. They explained that the higher the relative risk score, the larger the amount of global adverse effects from ALDFG is estimated to be causing.

\[
\text{Figure 44. Gear-specific relative risk from abandoned, lost and discarded fishing gear (ALDFG)} \\
\begin{center}
\begin{tabular}{l}
\hline
\text{gear type} & \text{relative risk score} \\
\hline
\text{bottom trawl} & 1.0 \\
\text{drift gillnet} & 0.8 \\
\text{gillnet} & 0.6 \\
\text{tow net} & 0.4 \\
\text{longline} & 0.2 \\
\text{dragnet} & 0.1 \\
\text{hook} & 0.0 \\
\hline
\end{tabular}
\end{center}
\]

The relative risk score was calculated using: i) rate of production of ALDFG, ii) fishing effort (accounts for gear-specific weight of total catch and geospatial area of fishing grounds), and iii) adverse ecological and socioeconomic impacts of ALDFG which consider ghost fishing, dispersal and transfer of toxins and microplastic into marine food webs, dispersal of invasive alien species.

\(^{17}\) Ghostnets.com.au
and microalgae that cause harmful algal blooms, habitat degradation, obstruction and safety risks to navigation and in-use fishing gear, and reduced socioeconomic, aesthetic and use values of coastal and nearshore habitats.

**Fishing Intensity in ATS Region**

Intensive fishing activities not only cause to deplete the fisheries resources but also create huge amount of fishing gears deposited to the fishing ground through ALDFGs. These derelict fishing gears pose significant threats to the marine ecosystem due to ghost fishing and degrading fisheries habitat. A study by Edyvane and Perry (2017) on impact of marine debris through long-term monitoring revealed that foreign fishing debris (nets, rope and gear) is the major source of marine debris (63%) on Australia’s northern shores (Figure 45).

![Figure 45. Trends in fisheries catch in the Australian EEZ of the ATS](Source: Edyvane and Penny, 2017)
They claimed that Industrial foreign and Indonesian-flagged fisheries – particularly, illegal, unreported and unregulated (IUU) trawling activity – and small-scale Indonesian IUU fisheries (primarily targeting shark) in the Arafura Sea are likely the major sources of these nets. Derelict nets comprised mostly trawl nets (71%) and gillnets/drift nets (12%) with 95% of all identified net sourced from the nations of Taiwan, Indonesia, Thailand and Korea. Data on catch by sector in Eastern Indonesia and type of fishing vessel clearly show that fishing intensity increases during 1990-2010 as shown in (d) to (f) of Figure 45. Naturally, derelict fishing gears also increased during these periods.

**Fishing Hotspots in ATS Region**

Global Fishing Watch (GFW)\(^{18}\) is an organization promoting ocean sustainability through heightened transparency utilizing high-tech technology to track and visualize global fishing activity in near real-time. Indonesia has become the first nation to share its vessel tracking data with GFW since 2017. For this reason, Indonesian vessels can be traced through GFW tracking system. As shown in Box 3, GFW utilized three tracking methods, namely: i) Automatic Identification System (AIS), ii) light detection by satellite, and iii) Indonesian Vessel Monitoring System (VMS).

**Box 4. Global Fishing Watch method of identifying fishing vessel**

(Source: globalfishingwatch.org)

Fishing Intensity can be identified through data obtained from fishing vessels at open seas. Global Fishing Watch (GFW) utilized the following data sets to track fishing vessels at sea.

**Fishing effort**

GFW uses data on a vessel’s identity, type, location, speed, direction and more that is broadcast using the Automatic Identification System (AIS) and collected via satellites and terrestrial receivers.

**Night Light Vessel Detections**

Satellites detect the lights that the vessels emit at night. This includes all vessels that emit a lot of light at night, including non-fishing vessels. However, the majority of lights detected at sea at night come from commercial fishing vessels. The satellite makes a single over-pass across the entire planet every night, detecting lights not obscured by clouds and designed to give at least one observation globally every day.

**Indonesian VMS Fishing Activity**

GFW uses the Vessel Monitoring System (VMS) data containing a vessel identity, gear type, location, speed, direction and more provided by the Indonesian Government’s Ministry of Maritime Affairs and Fisheries. The VMS data are collected via satellites and terrestrial receivers.

\(^{18}\)globalfishingwatch.org
Using the GFW vessel tracking map, fishing hotspots can be identified. The data analysed were vessel activities from 1990 to 2020. Figure 46 shows fishing vessel density in ATS Region during April 2018 while Figure 47 shows fishing vessel density in December 2019. It is clearly shown that Aru Sea within Arafura Sea is a fishing hotspot. This is consistent with the fact that Arafura Sea is traditionally one of the most important fishing grounds for penaeid shrimp in Indonesia and shrimp trawl fishing started commercially in 1966 (Af-idati and Lee, 2009). Shrimp trawl fishing heavily depleted shrimp stock until the trawl ban in 1980 through Presidential Decree No. 39 and Marine Affairs and Fisheries Ministerial Decree No. 71/2016. Still Arafura Sea is a productive commercial fishing ground due to its high primary productivity.

Figure 46. Fishing vessel tracking at ATS Region (April 2018)
(Source: Global Fishing Watch)

Figure 47. Fishing vessel tracking at ATS Region (December 2019)
(Source: Global Fishing Watch)
In this reason, large number of foreign fishing vessels illegally fished around Arafura Sea. A report of GFW revealed that foreign fishing vessels have declined significantly during 2012 to 2019. As shown in Figure 48, foreign fishing vessels were accumulated in Aru Sea (WPP 718) during 2012-2014. However, foreign fishing vessels disappeared since 2015 within Aru Sea. GFW report explained that this is a result of Indonesia’s efforts to combat IUU fishing activity since 2014. It should be noted that Indonesian fishing vessels are still heavily fishing in the Aru Sea.

In this study, we assumed a congruent relationship between fishing intensity and ALDFG density. Various facts support this hypothesis such as: high density of foreign fishing gears in Australian seas. Edyvane and Penny (2017) showed that over 70% of the fishing vessels in the ATS Region use trawl nets. Therefore, it can be assumed that significant amount of derelict fishing gears from trawl fishing boats would be deposited in ATS Region.
Implication

ATS Region is a highly productive sea with rich marine flora and fauna. This is the very reason the global fishing vessels, not only Indonesian, rush to ATS Region to fish. In particular, Arafura Sea is famous for penaeid shrimps which are traditionally being caught by bottom trawl fishing. In this reason, trawl nets and gillnets are the most highly used fishing gears in ATS Region. Although the use of bottom trawl was banned long time ago, still IUU fishing is not eradicated.

As shown in GFW data on vessel tracking, Aru Sea is identified as the most heavily fished sea among ATS Region. As assumed in this report, high fishing density implies high ALDFG density. Therefore, it was determined that Aru Sea is the ALDFG hotspot among ATS Region (Figure 49).

Figure 49. ALDFG hotspot in ATS Region (Aru Sea)
CHAPTER 6. CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

ATS Region is highly productive and rich in resources

ATS Region is a semi-enclosed shallow trophic marine ecosystem with nutrients discharged from surrounding islands. Therefore, primary production is one of the highest seas around world with teeming marine flora and fauna. In this reason, ATS Region has become a fisheries hotspot from littoral countries. Data revealed that foreign vessels illegally fished in ATS Region although the trend is declining due to strong enforcement for IUU fishing in ATS Region.

ATS Region also contain significant oil reserves. In particular, the areas once called JPDA and adjacent area in Timor-Leste territory withhold a total reserve of 403 million tons of carbon in 2005 estimates (Nicolau and Scheiner, 2005). The oil fields are continuously developed to date and the trend will be hastened because some of the oil fields are almost depleted.

ATS Region is under the threats of oil spill and marine debris

Since ATS Region is rich in resources both minerals and fisheries, it was identified that the most serious issues in the region are oil spill and marine debris including derelict fishing gears. Oil spill is an omni-present threat due to numerous oil rigs actively operating in the formerly known JPDA and other adjacent areas in Timor Sea. Whereas oil well development brings the economic benefits to the ATS countries, the consequences of oil spill incidents would be devastating. Habitats and species as well as economic development can be jeopardized by oil spill. As shown in Montara incident in 2009, the coastal residents of Indonesia are still suffering from the aftermaths of the oil spill.

Marine debris is gaining attention in recent years due to its adverse impacts to marine ecosystem. In some studies, Indonesia is identified as one of the top marine debris producing countries. However, ATS Region as a sparsely populated area is more concerned on sea-based debris such as derelict fishing gears and litters from vessels. Fishing intensity is severely high in ATS Region so that most of the commercially valuable fish resources are highly exploited. The fishing gears usually employed are trawl and gillnet which are considered as relatively high risk than other gears. As the consequence of the intensive fishing efforts, derelict fishing gears are deposited at the bottom of the seas. In this reason, marine habitats are degraded only to exacerbate the dwindling trend of fisheries resources.

Lack of a regional collaborative platform for oil spill response

IPIECA and IMO established Global Initiative for South East Asia (GISEA) for oil spill preparedness and response in 2013 in Jakarta, Indonesia. However, only Indonesia is the member of GISEA since it covers the ASEAN member countries. Among the oil producing countries in ATS Region, only Australia has ratified the OPRC 90. This is an indication that the level of preparedness and response in other countries are not significant enough to cope with impending risks of oil spill.
With the Maritime Boundary Treaty between Australia and Timor-Leste settled, Timor-Leste will become growingly active in the development oil reserves at the Buffalo and Greater Sunrise Oil Fields. At the same time, the responsibilities for preparing and responding to oil spill would equally grow. The simulation of oil spill at Buffalo oil field suggested that the coastal areas of Timor Island and Rote Island are the direct recipients of spilt oil. The areas will need to be prepared for oil spill.

6.2 RECOMMENDATIONS

Ratify the OPRC 1990

ATS countries shall ratify the OPRC 90 in the soonest time. The ratification of the Convention entails enactment of domestic laws and regulations on oil spill response, establishment of systematic mechanisms for oil spill response, and international co-operation modality in time of oil spill. Investing in oil spill response assets such as booms, skimmer, absorbents, dispersants and other relevant equipment should be done prior to develop oil reserves.

Although mobilizing equipment and response assets for oil spill and environmental remediation is very costly, it is imperative to equip the response assets in the oil spill hotspot. Sharing response resources with neighbouring countries may be established in time for transboundary oil spill cases.

Develop a Regional Platform for Oil Spill Response

Oil spill usually happens in a great scale beyond a country’s capacity. This is the reason why an international response cooperative such as Oil Spill Response Limited (OSRL) exists to serve whenever oil spill may occur by providing preparedness, response and intervention services. At the same rate, ATS countries should be prepared for oil spill in their respective countries to immediately deploy response assets and resources to Tier 1 or Tier 2 level oil spill incidents.

ATS countries should be prepared for Tier 2 or tier 3 oil spill incidents due to the presence of oil rigs in Timor Sea. In order to establish a successful regional mechanism for cooperation, the ATS countries will need to develop a Regional Oil Spill Contingency Plan (ROSCP) which will stipulate the collaboration and co-operation modalities in time of oil spill incidents between countries. The
ROSCP will be jointly implemented by the competent authority of each country. A joint secretariat for ROSCP might be set up at a country in ATS Region. A good example can be found in Gulf of Thailand Regional Oil Spill Preparedness and Response arrangement (Figure 50).

**Establish a Regional Monitoring Programme on Marine Debris**

Marine plastic debris is a global issue due to its adverse impacts to marine ecosystem. Among the marine debris, plastics are of great concern and take numerous forms such as bottles, packages, sheets and fishing gears, among others. Many scientists proved that plastics in the oceans survive fairly longer time than previously thought. The disintegrated by-products of plastics, which is called microplastics, are causing more serious problems due to transmission to food chain in marine ecosystem.

In the case of shoreline marine debris, it is necessary to monitor the occurrence at the coastal areas. At the present time, ATS Region has dearth of marine debris monitoring data meaningful enough to conclude any impacts or significance. Scientific protocol should be developed with the trained monitoring personnel conducting the site surveys. Regular and repeated monitoring of marine debris would produce meaningful recommendation at ATS Region as shown in RO Korea’s case (see Box 3).

The deposited marine debris, usually in the forms of derelict fishing gears, is a serious threat to marine ecosystem due to ghost fishing, entrapment of marine mammals, destruction of benthic habitats, among others. Since ATS Region is a fisheries hotspot, it is assumed that the region is highly polluted with derelict fishing gears. In particular, Aru Sea is suspected to be the derelict fishing gears. Regular monitoring of benthic debris would produce meaningful conclusions.

Whether it is shoreline or benthic debris, it is imperative to regularly monitor the occurrence of marine debris in a fairly long time. Since ATS Region does not possess marine debris data and information due to lack of scientific monitoring program, it is difficult to conclude any direction for marine debris. Therefore, it is recommended that ATS Region commence the Regional Marine Debris Monitoring Program. Under the program, survey guidelines, monitoring techniques, data deposit center, survey NGOs, funding modalities among others should be developed prior to the launching of the program.

**Build National Capacity to Respond to Oil Spill and Marine Debris**

As shown in this report, oil spill and marine debris are two priority issues in ATS Region. While regional platform for collaboration is necessary, building national capacity to respond to the impending threats are an urgent task and of utmost importance. Except for Australia, ATS countries are grossly lacking the national capacity to effectively respond to these threats.

There are several regional organizations for national capacity building for oil spill and marine litter active in the ATS Region. Organizations such as PEMSEA, COBSEA and the Regional Capacity Center for Clean Seas (RC3S) are resourceful for marine litter response, whereas OSRL and GISEA will be helpful for oil spill preparedness and response. The ATS countries are recommended to work closely with these regional organizations.
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