



National State of Oceans and Coasts 2018:  
**Blue Economy Growth**  
**TIMOR-LESTE**



Empowered lives.  
Resilient nations.







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Resilient nations.



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**Blue Economy Growth**  
**TIMOR-LESTE**

## **National State of Oceans and Coasts 2018: Blue Economy Growth of Timor-Leste**

December 2019

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# Acronyms and Abbreviations

ADB	– Asian Development Bank	GVA	– gross value added
APEC	– Asia-Pacific Economic Cooperation	ha	– hectare
APORTIL	– Port Authority of Timor-Leste	HDI	– human development index
ATS	– Arafura and Timor Seas	ICM	– integrated coastal management
ATSEA	– Arafura and Timor Seas Ecosystem Action Programme	IFAD	– International Fund for Agricultural Development
ATSEF	– Arafura and Timor Seas Expert Forum	INGOs	– International Non-governmental Organizations
AUSAID	– Australian Agency for International Development	IUCN	– International Union for Conservation of Nature
BOE	– Barrel of Oil Equivalent	IUU	– illegal, unreported and unregulated
CCA	– climate change adaptation	kg	– kilogram
Cd	– cadmium	km	– kilometers
C	– celsius	km <sup>2</sup>	– square kilometers
CI	– Conservation International	L	– liter
CO <sub>2</sub>	– carbon dioxide	LIT	– Line Intercept Transect
CR	– critically endangered	LMMA	– Locally Managed Marine Area
CREP	– Coral Reef Ecosystem Program (NOAA)	m	– meters
CTI	– Coral Triangle Initiative	m <sup>2</sup>	– square meters
CTSP	– Coral Triangle Support Partnership	m <sup>3</sup>	– cubic meters
Cu	– copper	mm	– millimeters
DG	– Director-General	MAF	– Ministry of Agriculture and Fisheries
DGR	– Directorate General for Revenue	MCIE	– Ministry of Commerce, Industry and Environment
DO	– dissolved oxygen	MECAE	– Ministro do Estado Coordenador Assuntos Economico
EAFM	– ecosystem approach to fisheries management	mg	– milligram
EAS	– East Asian Seas	mm	– millimeters
EbA	– ecosystem-based adaptation	MoF	– Ministry of Finance
EEZ	– Exclusive Economic Zone	MPAs	– Marine Protected Areas
EIA	– environmental impact assessment	NAPA	– National Adaptation Plan of Action
EN	– endangered	NBSAP	– National Biodiversity Strategy and Action Plan
ENSO	– El-Nino Southern Oscillation	NDFA	– National Directorate of Fisheries and Aquaculture
EU	– European Union	NFC	– National Facilitating Committee
FADs	– fish aggregating devices	NGOs	– Non-governmental Organizations
FAO	– Food and Agriculture Organization	NOAA	– National Oceanic and Atmospheric Administration
Fe	– iron	NOP	– National Oceans Policy
FIP	– fisheries improvement project	NSOC	– National State of Oceans and Coasts
FRC	– fiscal reform committee		
GDP	– gross domestic product		
GEF	– Global Environment Facility		
GNI	– gross national income		

NKSNMP	– Nino Konis Santana National Marine Park	SOC	– State of the Coasts
OECD	– Organisation for Economic Cooperation and Development	TDA	– Taxes and Duties Act
OHI	– Ocean Health Index	TL	– Timor-Leste
PACCSAP	– Pacific Australian Climate Change Science Adaptation Programme	TSS	– total suspended solids
Pb	– lead	UN	– United Nations
PCCSP	– Pacific Climate Change Science Programme	UNCCD	– United Nations Convention to Combat Desertification
PEMSEA	– Partnerships in Environmental Management for the Seas of East Asia	UNDP	– United Nations Development Programme
PES	– payment for ecosystem services	UNFCCC	– United Nations Framework Convention on Climate Change
PNLC	– PEMSEA Network of Learning Centers	UNITAL	– Univercidade Oriental Timor-Leste
ppm	– parts per million	UNTAET	– United Nations Transitional Administration in East Timor
PPP	– public-private partnership	UNTL	– Universidade Nacional Timor Lorosa'e (National University of East Timor)
RDTL	– Republica Democratica de Timor-Leste	USAID	– United States Agency for International Development
rri	– reef resource inventory	US\$	– United States Dollar
SDGs	– Sustainable Development Goals	VAT	– value-added tax
SDP	– Strategic Development Plan	VU	– vulnerable
SDS-SEA	– Sustainable Development Strategy for the Seas of East Asia	WB	– World Bank
SE	– southeast	WEF	– World Economic Forum
SE	– standard error	WHO	– World Health Organization
SEMA	– Secretario Estado do Meio Ambiente	WWF	– World Wildlife Fund
SIDS	– Small Islands Development State		

# FOREWORD

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More than 70 percent of the earth's surface is covered by oceans, which provide food, oil and gas, and alternative water and energy sources, serve as highways for sea-borne international trade, offer recreational areas, determine weather patterns and temperatures, and absorb greenhouse gases. Oceans and coasts can play a major role in improving livelihoods, and achieving sustainable, climate-resilient and inclusive development and economic growth. However, the oceans are under stress – from pollution, habitat destruction, overfishing, rising temperatures and ocean acidification among others. These challenges have serious ramifications on the sustainability of the planet, and health and well-being of people.

Thus, the Ministry of Agriculture and Fisheries (MAF) recognizes the need for a National Oceans Policy to protect coastal and marine ecosystems of Timor-Leste, while, at the same time, viewing the oceans as a source of economic growth. The country has adopted the **blue economy** paradigm as defined in the *Changwon Declaration 2012*. Blue economy encompasses a sustainable ocean-based economy while promoting innovative and 'greener' technologies and practices, and ensuring the protection of the marine environment, and the sustainable use and conservation of related ecosystems, biodiversity, genetic resources and other resources in the seabed.

MAF also understands the importance of a monitoring and reporting system to show the current status of the ocean economy and the coastal and marine environment and ecosystems, the benefits they generate, and the pressures and threats they are facing, and contribute to enhancing our ocean governance mechanisms. We are therefore pleased to have a **National State of Oceans and Coasts 2018: Blue Economy Growth** report. This is a collaborative effort among different government agencies, academe, nongovernment organizations, and development partners. The preparation of this report entailed stakeholder consultations, and their inputs and suggestions are reflected in this report.

The country's initiative to develop this National State of Oceans and Coasts (NSOC) Report reinforces its commitment to regional and global partnerships on sustainable oceans and blue economy development. This NSOC Report aims to contribute to the over-all assessment and monitoring, not only of the implementation of the *Sustainable Development Strategy for the Seas of East Asia (SDS-SEA)*, but also the *Strategic Development Plan 2011-2030*, related targets of the *2030 Agenda for Sustainable Development*, other international agreements, and national policies. It supports the government to design and create an enabling environment that promotes the development and emergence of sustainable ocean-related economic sectors as well as addressing

poverty reduction, pollution, habitat loss, disaster and climate resiliency, and other challenges that our country is facing.

The NSOC report identifies the opportunities that the blue economy can bring. This report shows that the ocean economy is around 87 percent of our country's GDP, but mostly from oil and gas. We can also benefit more from other ocean-related sectors, such as tourism, fisheries and aquaculture (including seaweeds), seafood processing, shipping and ports, ocean energy, etc., but ensuring that these are sustainable.

The baseline information is provided in this NSOC report, and we should work on improving the monitoring of the marine environment, and developing the ocean economy accounting and resource valuation system. I am expecting that this report will be shared to all stakeholders, private sector and local communities in Timor-Leste to increase their understanding of the value and vulnerability of the oceans, potential sources of income and jobs, and the impacts of unsustainable practices. I encourage everyone who worked on this report to continue updating this report to show the progress in securing the ocean and marine resources, and moving toward blue economy development.

My sincere thanks to all parties engaged in the NSOC report development, especially Ms. Lince Dessy and colleagues from UNITAL during the drafting process, Mr. Mario Cabral and his team for their coordination with various stakeholders, Ms Ingrid Narcise and Mr. Adrian Ross for their support and encouragement, and Ms. Mária Corazon Ebarvia for her inputs, advice and guidance. PEMSEA and GEF/UNDP provided funds to facilitate the preparation and publication of the NSOC report.

Thank you!



**Ir. ACÁCIO GUTERRES, M.Si**  
Director-General of Fisheries

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- Coral Triangle Initiative (CTI)
- Gabinete das Fronteiras Maritimas
- Grupo Kadiuk Timor

- Haburas Foundation
- Instituto do Petroleo e Geologia (IPG), MPNR
- La'ó Hamutuk Timor-Leste NGO (Timor-Leste Institute for Development Monitoring and Analysis)
- Ministry of Agriculture and Fisheries (MAF)
- Ministry of Commerce, Industry and Environment (MCIE)
- Ministry of Coordination of Economic Affairs (MCEA)
- Ministry of Defence
- Ministry of Finance (MOF)
- Ministry of Interior
- Ministry of Petroleum and Natural Resources (MPNR), NAPM
- Ministry of Public Works, Transport and Communication (MOPTC)
- Ministry of Social and Solidarity (MSS)
- Ministry of State and Administration (MSA)
- Ministry of Tourism, Arts and Culture (MOTAC)
- Municipalities of Dili, Liquiça and Manatuto
- National Directorate of Statistics, MOF
- Partnerships in Environmental Management for the Seas of East Asia (PEMSEA)
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- Universidade Oriental de Timor Lorosa'e (UNITAL)
- WorldFish

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# EXECUTIVE SUMMARY

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## Background

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

The theme of the first National State of Oceans and Coasts (NSOC) report is blue economy. The definition of blue economy is given in the **Changwon Declaration 2012**,<sup>a</sup> which was adopted by the ministers of the East Asian Seas (EAS) Region. The Blue Economy is the sustainable use of ocean resources for economic growth, improved livelihoods and jobs, enhanced disaster and climate resiliency, while preserving the ocean health.

This NSOC report aims to:

- Compile data and information collected from different concerned agencies and organizations to serve as baseline information related to the country's ocean economy, coastal and marine resources and environment, socioeconomic condition, governance structure, and blue economy initiatives;
- Contribute to the blue economy assessment, and monitoring of the implementation of the *Sustainable Development Strategy for the Seas of East Asia* (SDS-SEA), UN Sustainable Development Goals (SDGs), other international agreements, and related national laws and policies; and
- Aid policy-making, planning and management of the coastal and marine areas of the country, and monitoring of the country's progress.

The NSOC Report uses available data from agencies, reports and studies. It is limited by lack of disaggregated data for the ocean economy, and current data on the marine environment and ecosystems, and initiatives related to blue economy development. Nevertheless, the information presented in this report provides an overview of the valuable and vulnerable oceans, and shows potential areas and opportunities for more sustainable growth path.

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<sup>a</sup> "We understand the Blue Economy to be a practical ocean-based economic model using green infrastructure and technologies, innovative financing mechanisms, and proactive institutional arrangements for meeting the twin goals of protecting our oceans and coasts and enhancing its potential contribution to sustainable development, including improving human well-being, and reducing environmental risks and ecological scarcities." (Changwon Declaration 2012).



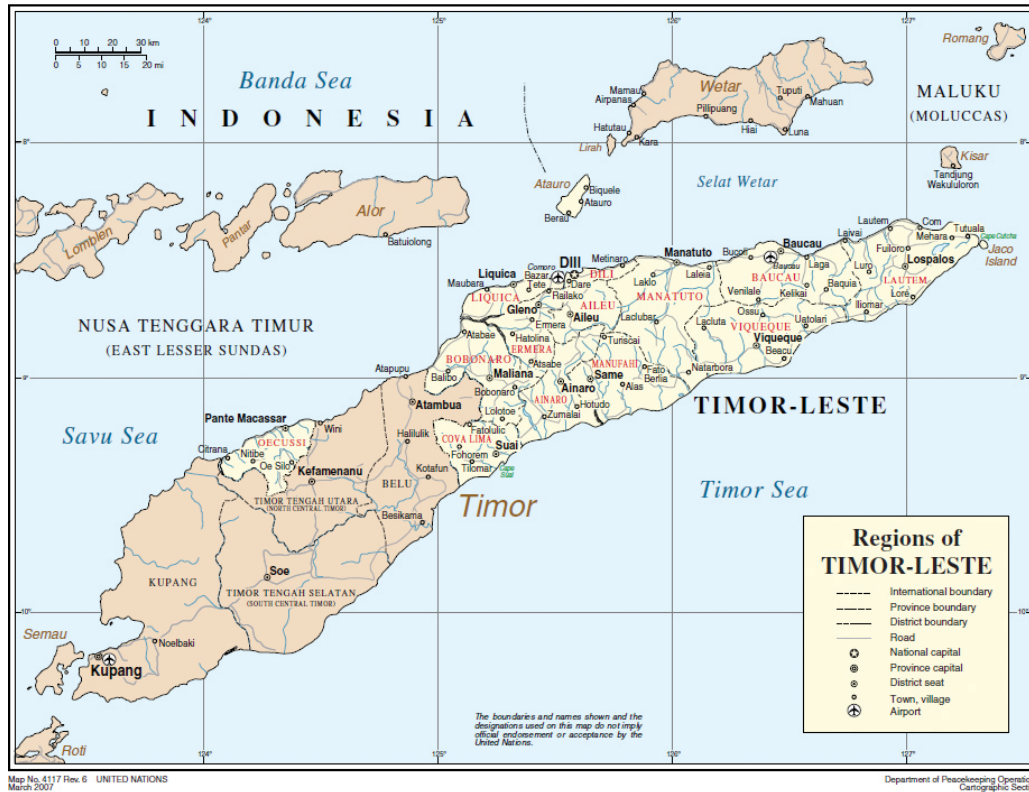
## The Seas and People of Timor-Leste

Timor-Leste is a country located on the island of Timor, which is part of the Lesser Sunda Islands. It is bounded by Nusa Tenggara Timur, a province of Indonesia, in the west; Wetar Strait in the north; Timor Sea in the south; and, Arafura Sea in the east. (Figure 1).

The land area is approximately 14,919 square kilometers (km<sup>2</sup>) (World Bank, 2018). The country is divided into 12 municipalities and one special administrative region, of which 11 are coastal. The country also includes two outlying islands, Atauro Island (144 km<sup>2</sup>) and uninhabited Jaco Island (8 km<sup>2</sup>). Most of the country's land area is located on the eastern part of the island of Timor. The **Special Administrative Region (SAR) of Oecusse-Ambeno** is located on the north coast of the western part of Timor Island. It is separated from the rest of Timor-Leste by the Indonesian territory, which surrounds the small enclave in all directions, except to the north, where it borders the Savu Sea. Oecussi-Ambeno was the first place on which the Portuguese established themselves at their arrival. This is the reason why it is considered the cradle of Timor-Leste.

Timor-Leste's coastline is 782.88 km (MAF, 2018). The shelf area is 25,648 km<sup>2</sup>, and the marine area, including the exclusive economic zone (EEZ), is approximately 72,000 km<sup>2</sup> (N DFA, 2012).

Figure 1: Map of Timor-Leste.<sup>b</sup>



<sup>b</sup> Source: United Nations Integrated Mission in Timor-Leste (<https://unmit.unmissions.org/timor-leste-map-region>).

**Population.** In 2015, total population was 1,196,302 (World Bank, 2019). Population growth rate in 2014-2015 was 2.39%. The population in 2017 was 1,243,261, and increased to 1,267,972 in 2018, of which 50.54% are male and 49.46% are female (World Bank, 2019). In 2018, the urban population was 387,720 (30.58% of total population) while rural population was 880,252 (69.42%). The population density in 2018 was 85.27 people per km<sup>2</sup> of land area. The most densely populated municipalities are Dili, Ermera, and Liquica, which have more than 100 people per km<sup>2</sup>. Dili surpasses all other municipalities with a population density of 689 people per km<sup>2</sup> in 2015.

**Economy.**<sup>c</sup> The real gross domestic product (GDP) declined from US\$4.16 billion in 2013 to US\$3.08 billion in 2014 (in constant 2010 US\$) due to lower oil prices. The economy rebounded, with GDP increasing by 20.6% from 2014 to 2015. The GDP in 2015 was US\$3.72 billion (in constant 2010 US\$). The economy declined in 2015-2017, but grew by 2.81% in 2017-2018. GDP (in constant 2010 US\$) increased from US\$3.403 billion in 2017 to US\$3.499 billion in 2018.

**Coastal livelihood.** Source of coastal livelihoods are derived from fisheries, salt distillation, tourism, and ecosystem provisioning services, such as bamboo, mangrove, honey and fish.

**Poverty.** Poverty incidence (at national poverty lines) declined from 50.4% in 2007 to 41.8% of total population in 2014.<sup>d</sup>

**Human development.**<sup>e</sup> Timor-Leste's human development index (HDI) value for 2018 is 0.626, which puts the country in the medium human development category, positioning it at 131 of the 189 countries and territories. GNI per capita in 2018 is US\$7,527 (2011 PPP \$). Life expectancy at birth is 69.3 years. Expected years of schooling are 12.4 years while mean years of schooling are 4.5 years only. Timor-Leste's GNI per capita increased by about 138.4% between 1990 and 2015. The HDI is a summary measure for assessing long-term progress in three basic dimensions of human development: a long and healthy life, access to knowledge and a decent standard of living. The mean years of schooling among young men and women need to be raised. With more and better education, young people entering the labor force would be more prepared for manufacturing, services, and knowledge-based industries that provide higher wages.

**Access to water,<sup>c</sup> sanitation,<sup>c</sup> and solid waste management.** There is an increase in the percentage of the population with access to basic water services. In 2002, only 50.62% of the population had access to least basic water services, but this increased to 74.53% of the population in 2015. By 2017, 98.32% of the urban population, and 69.69% of the rural population had access to basic water services. Urban population also had increased access to basic sanitation facilities, from 61.73% in 2002 to 75.93% in 2017. Similarly, access to basic sanitation facilities by rural population had improved from 28.99% in 2002 to 43.82% in 2017. Only Dili has a wastewater management system. Total area that is covered by solid waste management in Dili is 161 hectares (ha).

<sup>c</sup> <https://data.worldbank.org/country/timor-leste>

<sup>d</sup> [www.undg.org/archive\\_docs/5382-Timor-Leste\\_MDG\\_Report](http://www.undg.org/archive_docs/5382-Timor-Leste_MDG_Report)

<sup>e</sup> United Nations Development Programme (UNDP). 2018. *Human Development Indices and Indicators: 2018 Statistical Update*.

**Table 1:** Timor-Leste: Geographic and Socioeconomic Indicators.

Indicator	As of 2017
<b>Land area</b> (square kilometres or km <sup>2</sup> )	14,919 km <sup>2</sup>
<b>Coastline</b>	782.88 km
<b>Sea area</b> (EEZ waters up to 200 nautical miles)	72,000 km <sup>2</sup>
<b>Population</b>	1,243,261
<b>Coastal population*</b>	85% (2015 census)
<b>Gross domestic product</b> (GDP, in constant 2010 US\$ prices)	US\$3.4 billion
<b>Human development index (HDI)</b>	0.605 — medium human development category – positioning the country at 133 of the 188 countries and territories
<b>Gross national income (GNI) per capita</b> (at 2011 PPP prices)	US\$7,434
<b>Life expectancy at birth</b>	69.0 years
<b>Mean years of schooling</b>	4.5 years
<b>Access to safely managed water supply**</b>	Access to <i>basic</i> water services: 69.69% for rural population and 98.32% for urban population
<b>Access to safely managed sanitation**</b>	Access to <i>basic</i> sanitation services: 43.82% of rural population, and 75.93% of urban population.
<b>Ocean health index (OHI)</b>	59. Timor ranks #187 among 221 EEZs.
<b>Percentage of coastline with ICM</b>	30.49%
<b>Marine protected area</b> (percentage of territorial waters)	1.37%

\* Population of 11 coastal municipalities.

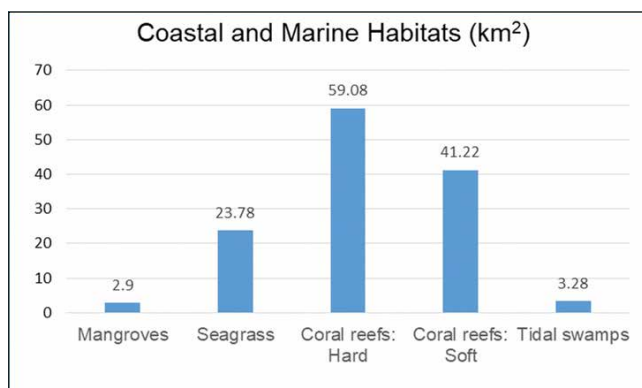
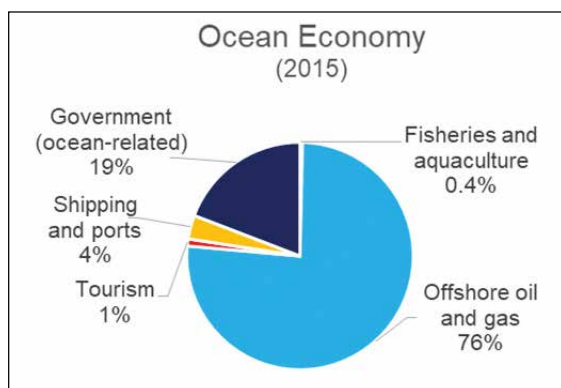
\*\* No available data on access to safely managed water services and safely managed sanitation services.

Sources: MAF, 2018; World Bank, 2018 (<https://data.worldbank.org/country/timor-leste>); UNDP, 2018 ([http://hdr.undp.org/sites/all/themes/hdr\\_theme/country-notes/TLS.pdf](http://hdr.undp.org/sites/all/themes/hdr_theme/country-notes/TLS.pdf)); <http://www.oceanhealthindex.org/region-scores/scores/east-timor>.

## Timor-Leste's Ocean Economy

The entire ocean economy is measured as the sum of: (a) the economic activities with dependence on the ocean and coastal and marine resources, and (b) natural assets, goods and services of marine ecosystems (OECD 2016).

The key ocean economic activities are: (a) offshore oil and gas; (b) port and shipping; (c) coastal and marine tourism; and (d) fisheries and aquaculture.



The ocean economy contributes 87% of the country's GDP (**Table 2**). The total number of people that have been employed in the ocean economy is around 16,077 persons. Indirect jobs employ 26,500 persons in two oil and gas projects (Tasi mane Suai and Beaço-Viqueque).

**Table 2:** GDP by Production, 2015 (Gross value added, US\$, in constant prices).

Item	GVA	GVA of Ocean-related Economic Activities
<b>Agriculture, hunting, forestry, fishing (ISIC A-B)</b>	122,383,113.76	
Fisheries and aquaculture		<b>7,094,571.89</b>
<b>Mining, Manufacturing Utilities (ISIC C-E)</b>	1,564,450,688.71	
Offshore oil and gas		<b>1,495,727,182.16</b>
<b>Manufacturing (ISIC D)</b>	6,200,036.47	
<b>Costruction (ISIC F)</b>	152,057,309.68	
<b>Wholesale, retail trade, restaurants and hotels</b>	116,300,477.11	
Tourism		<b>19,600,000.00</b>
<b>Transport, storage and communication (ISIC I)</b>	66,713,283.19	
Shipping and ports		<b>66,713,283.19</b>
<b>Other activities (ISIC J-P)</b>	245,173,596.89	
Government		<b>377,513,410.15</b>
<b>TOTAL</b>	<b>2,273,279,405.81</b>	<b>1,966,648,447.38</b>
		<b>87%</b>

## Valuation of Ecosystem Services

In addition to the ocean economic activities, the ocean provides goods and services, which are not captured in the GDP accounts. Using existing studies, the value of the coastal and marine ecosystem services is estimated to be around **US\$5.25 billion**.

## Fisheries and Aquaculture

### Contribution to income and livelihood

- Gross value added (GVA) of fish and other fishing products in 2015 was US\$7,094,571.89 (in constant prices).
- Around 90% of fisheries is artisanal. Given the bathymetry and small size of boats, only near-shore fishing can be done, and only small, low-valued types of fish can be caught.

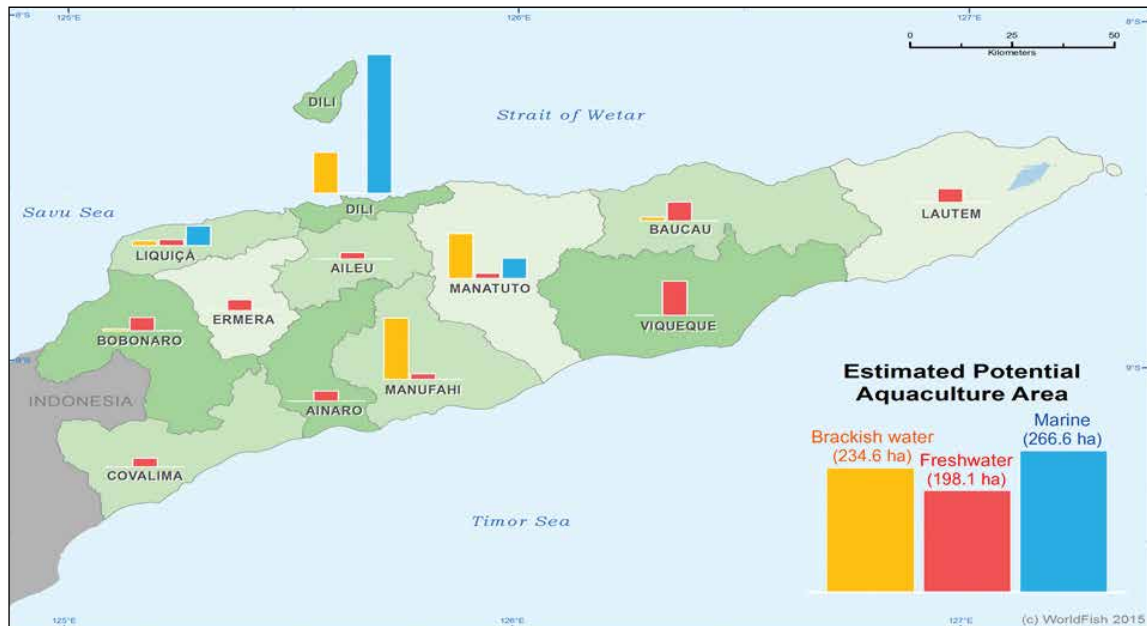
**Investment opportunities.** Aquaculture is a promising industry in Timor-Leste. It is still underdeveloped, however, potential areas for various types of aquaculture have been identified (**Figure 2**). Aquaculture and mariculture in Timor-Leste have been made a priority in the programs of organizations,



*Mud crab culture and mangrove rehabilitation in Beacou.*

such as Catholic Relief Services (CRS), WorldFish, United States Agency for International Development (USAID), among others. Livelihood diversification in coastal communities is also promoted. Seaweed culture is playing an increasing role due to the successful project of the National Directorate for Fisheries and Aquaculture (NDFSA). Other seafood products are also being tested through a US Government-funded project. The ATSEA project also includes mangrove rehabilitation and mud crab farming.

**Figure 2:** Potential Aquaculture Area in Timor-Leste.



Source: Team Identification of Aquaculture Potential of MAF in 2015.

## Coastal and Marine Tourism

### Contribution to income and livelihood

- Gross value added (GVA) of the tourism sector in 2015 was **US\$19.6 million**, where it contributed 1% to the GDP.
- According to a 2014 Asia Foundation's Survey of Travellers to Timor-Leste, the tourism sector ranks closely behind oil and coffee as the third largest sector.<sup>f</sup> Direct benefit was estimated to be US\$7.84 million (calculated based on research of Asia Foundation, 2014 and Timor-Leste National Tourism Policy, 2015). Majority of the respondents identified activities, such as beach leisure (36%), hiking (10%) and snorkelling (8%).
- In 2015, Timor-Leste's tourism sector directly employed approximately 4,300 people, with jobs in the accommodation, restaurant, and other tourism related services. Employment in tourism industry is expected to reach or exceed 15,000 by 2020.



<sup>f</sup> The Asia Foundation. 2014. Survey of Travellers to Timor-Leste. <https://asiafoundation.org/resources/pdfs/VisitorSurvey2014English.pdf>

**Investment opportunities.** Ecotourism; community-based tourism with sustainable accommodation and local sourcing of food; diving and boat operation; cruise tourism.

## Ports and Shipping

There is one major port in Timor-Leste, which is located in Dili. All goods, cargo, and construction materials are loaded in this Port. Improving and expanding the passenger terminal in Dili Port is being undertaken with support from Japan (JICA). There is an on-going construction for the Tibar port, considering the increasing number of container and cargo ships. Com-Lautem has a small fish port.

### Contribution to income and jobs

- The gross value added (GVA) of ports and shipping sector in 2015 was around **US\$66.7 million** (in constant prices), contributing 3% of the country's GDP.
- Employment in the port of Timor-Leste is around 50 people. This figure, however, varies depending on the amount of cargos that arrive each week.

**Investment opportunities.** Development of passenger and container ports is a major investment opportunity. The potential of cruise tourism is also being assessed, considering the initial influx of tourists from Australia. There are 4-5 cruise ships from Australia per year.

## Offshore Oil and Gas

Gas and oil industry (offshore) is the sector that has the highest economic contribution in Timor-Leste, accounting for 66% of GDP. Since the restoration of independence, three offshore fields have been developed, namely: Elang Kakatua, Bayu Undan, and Kitan in the Joint Petroleum Development Area (JPDA). Revenues received in the form of royalties, profit and taxes from petroleum have been supporting the development of the country with its annual budget contribution. Approximately US\$87.42 million were collected from petroleum tax revenue in 2016.

### Potential value (to be explored and developed in the next 50 years)

- Timor-Leste's total Petroleum Initial-In-Place (PIIP) is in the range of 12-17 Billion Barrel Oil Equivalent (BOE);
- TIMOR GAP estimates the recoverable resources will be around 6.3 Billion BOE (as a comparison, Bayu Undan reserve is ~ 1 Billion BOE); and
- The monetary value of these resources at an average of US\$59 per barrel in the next 50 years is US\$372 Billion.

**Investment opportunities.** To capture the full value, however, Timor-Leste should move from an upstream, extractive-oriented industry to more of a transformational industry by way of developing

services, and establishing the Suai Supply Base, refineries/petrochemicals, and LNG plant. This will ensure that around 27% of the US\$100 billion is captured in Timor-Leste’s economy with additional multiplier effects through job creation, trade, commerce, small- and medium-enterprise (SME) development, and overall GDP growth in the next 20 years or more. The government can take around US\$16 billion from downstream services, including TIMOR GAP dividends.

## Transitioning to Blue Economy

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

**Table 3** shows the developments in ocean economic activities, and new trends in blue economy.

**Table 3:** Ocean economy and developments in blue economy.

Ocean economy	Blue Economy Initiatives	Investment Opportunities
<p><b>Fisheries and aquaculture</b></p> <ul style="list-style-type: none"> <li>GVA of fisheries in 2015 was <b>US\$7 million</b> (in constant prices).</li> <li>Around 90% of fisheries is artisanal.</li> <li><b>Pressures:</b> extreme bathymetry; limited skills, techniques and gears; destruction of reef habitat, and declining fish stocks (due to El Niño); illegal fishing (foreign)</li> </ul>	<p><b>Sustainable fisheries and aquaculture</b></p> <ul style="list-style-type: none"> <li>Community-based fisheries</li> <li>Integrated farming system</li> <li>Livelihood diversification: seaweed farming; grouper</li> <li>Mangrove planting and mud crab culture</li> <li>10 municipalities provide support to youth for aquaculture of Tilapia sp.</li> </ul>	<p><b>Aquaculture</b></p> <ul style="list-style-type: none"> <li>Aquaculture is a promising industry in Timor-Leste. Potential areas for various types of aquaculture have been identified (e.g., grouper and seaweed culture; aquasilviculture).</li> </ul>
<p><b>Coastal and marine tourism</b></p> <ul style="list-style-type: none"> <li>GVA of coastal and marine tourism sector in 2015 was US\$19.6 million.</li> <li><b>Pressures:</b> High cost of traveling; limited accommodation and freshwater availability; potential of crocodile attacks; habitat degradation; increased solid waste and wastewater generation</li> </ul>	<p><b>Sustainable tourism</b></p> <ul style="list-style-type: none"> <li>Dugong and seagrass conservation as a model of ecotourism</li> <li>Community-based ecotourism, with sustainable accommodation and local sourcing of food</li> </ul>	<ul style="list-style-type: none"> <li>The tourism sector ranks closely behind oil and coffee as the third largest sector.</li> <li>Major ecotourism sites identified, including MPA and national parks</li> <li>Community-based ecotourism</li> <li>Diving and boat operation</li> <li>Cruise tourism</li> </ul>

Table 3: Ocean economy and developments in blue economy. (cont.)

Ocean economy	Blue Economy Initiatives	Investment Opportunities
<b>Ports and shipping</b> <ul style="list-style-type: none"> <li>GVA of transportation sector in 2015 was <b>US\$66.7 million</b>.</li> <li><b>Pressures:</b> habitat degradation due to port construction and dredging; oil spills from operations and accidents; pollution from ships and ports</li> </ul>	<b>Sustainable ports</b> <ul style="list-style-type: none"> <li>Construction of Tibar Port: through public-private partnership; use of new technologies to improve port performance and services, and energy-use efficiency</li> </ul>	<ul style="list-style-type: none"> <li>Expansion of passenger terminal in Dili Port; and terminal for cruise ships</li> <li>Transforming Dili Port and new Tibar Port into 'green port'</li> </ul>
<b>Offshore oil and gas</b> <ul style="list-style-type: none"> <li>GVA of oil and gas in 2015 was US\$1.5 billion, accounting for 66% of GDP.</li> <li><b>Pressures:</b> oil spills; depletion of oil and gas reserves</li> </ul>	<b>Offshore oil and gas</b> <ul style="list-style-type: none"> <li>Monitoring of water quality and sediments at the offshore oil and gas platforms and surrounding areas</li> </ul>	<ul style="list-style-type: none"> <li>Establishment of downstream industries, e.g., Suai Supply Base, refineries, petrochemicals, and LNG plant to ensure additional income and multiplier effects through job creation, trade, small- and medium-enterprise (SME) development</li> </ul>
<b>Water</b> <ul style="list-style-type: none"> <li>Marine environment</li> </ul>	<b>Pollution reduction/waste management</b> <ul style="list-style-type: none"> <li>Solid waste management: recycling system in schools; collection system and landfill in Dili</li> <li>Wastewater management: wastewater treatment facility (waste stabilization ponds) in Dilli</li> <li>Used oil management: tanks for used oil and daily collection system</li> </ul>	<ul style="list-style-type: none"> <li><b>Solid waste management</b> Expansion of solid waste management system; Improvement of sanitary landfill; recycling facility; disposal and treatment of oily waste, e-waste and hospital waste</li> <li><b>Sanitation and wastewater management</b> Expansion of wastewater management system</li> </ul>
<b>Coastal and marine ecosystems</b> <ul style="list-style-type: none"> <li>Estimated value: US\$5.25 billion</li> </ul>	<b>Habitat restoration and management</b> <ul style="list-style-type: none"> <li>MPAs; marine national parks, locally managed MPAs</li> <li>Mangrove restoration</li> <li>Seagrass and dugong conservation</li> <li>Coral reef protection</li> </ul>	<ul style="list-style-type: none"> <li>MPA and ecotourism</li> <li>Mangroves and sustainable aquaculture (aquasilviculture: mudcrabs and shrimp culture in mangrove areas)</li> </ul>

## State of Ocean Health Underpinning the Blue Economy

### Marine Water Quality

Primary productivity/Phytoplankton. A total of 81 genera and 224 species of phytoplankton were identified. The Biodiversity Index of plankton is 3.51 at Dili Municipality (Atauro Vila), 3.83 at Manatuto Municipality, and 2.89 at Liquica Municipality.<sup>9</sup> A biodiversity index greater than 3 indicates good water quality. The results of the monitoring of physio-chemical parameters are shown in **Table 4**.

<sup>9</sup> SOC Report of Dili; SOC Report of Manatuto; SOC Report of Liquiça (2016).



**Table 4:** Physico-chemical Parameters.

Parameters	Monitoring Results
Sea Surface Temperature	<ul style="list-style-type: none"> <li>• Average of 28.75°C, ranging from 27°C to 29°C</li> </ul>
Salinity	<ul style="list-style-type: none"> <li>• Salinity at the surface, and at depth of 25 m is between 33 parts per million (ppm) and 34 ppm.</li> <li>• Higher salinity is observed near the coast, while the offshore is slightly lower.</li> <li>• Salinity at 50 m, 75 m, and 100 m is homogeneous.</li> </ul>
pH	<ul style="list-style-type: none"> <li>• 8.12</li> </ul>
Dissolved oxygen (DO)	<ul style="list-style-type: none"> <li>• High near the coast and at the surface, but goes down with increasing depth</li> </ul>
Nutrients	<ul style="list-style-type: none"> <li>• Nitrate, silicate and phosphate concentrations were very low to undetectable near the surface.</li> <li>• Nitrite concentrations were mostly high at levels of 50 m to 75 m depth.</li> <li>• Phosphate concentrations tended to increase from sea surface to deep water.</li> </ul>
Heavy metals in sea water	<ul style="list-style-type: none"> <li>• The heavy metal concentration of all samples collected from 19 stations were lower than detection limit</li> </ul>

**Upwelling of nutrient-rich water.** Water-column casts at all of the sampling stations revealed some evidence of upwelling of cold, nutrient-rich water into the reefs of the Sahul Banks, and more significantly, extensive upwelling along the entire edge of the southern Timorese shelf. This cold water may account for low benthic oxygen consumption. However, high levels of chlorophyll suggest enhanced primary production due to these upwelling intrusions.

The seabed along the southern coast of Timor-Leste is dominated by extensive deposits of mud, probably derived from enhanced erosion of land within southern river catchments. Rates of anaerobic respiration were very high, suggesting intense recycling of organic matter derived from both enhanced land runoff and phytoplankton production.

**Indication of possible ocean acidification.** The waters surrounding Timor-Leste support high fish diversity as well as areas of localized high coral cover. Yet, the seawater carbonate chemistry observed in the shallow water reef environments of Timor-Leste suggests an area of concern and warrants continued long-term monitoring to assess whether low reef accretion rates are indeed an early indication of the effects of ocean acidification reducing reef growth and survival in the region.<sup>h</sup>

<sup>h</sup> Pacific Islands Fisheries Science Center, National Oceanic and Atmospheric Administration (PIFSC-NOAA). 2017. Interdisciplinary baseline ecosystem assessment surveys to inform ecosystem-based management planning in Timor-Leste: Final Report. NOAA Pacific Islands Fisheries Science Center, PIFSC Special Publication, SP-17-02, 234p.

## Biodiversity and Habitats

At Timor-Leste's eastern tip, Wetar Strait and Timor Sea converge, supporting diverse marine life. This eastern tip is also home to the country's first declared national nature reserve, the Nino Konis Santana National Park. The near-shore zone is characterized by a narrow reef flat (often <60m wide but up to almost 1 km in length) and is dominated by seagrass in shallower water. The north coast of Timor has very few coral reefs, seagrass, and mangrove habitats.

**Fish stocks and biomass.** Timor-Leste has abundant fish stocks, yet almost all fishing done is for subsistence or semi-subsistence. The Geographic Region and Trophic Group for Timor-Leste estimated that the total reef fish biomass averaged at 41.1 g/m<sup>2</sup> [standard error (SE): 3.1], which is slightly higher than other populated areas in the Pacific. Planktivores make up the majority of the overall fish biomass (50.3%), followed by primary consumers (22.3%), secondary consumers (18.8%), and piscivores (8.6%).

**Benthic habitats.** The dataset developed by PIFSC-NOAA (2017) for the shallow coastal seafloor (0 m–20 m) around Timor-Leste classified eight habitat types: (i) hard substrate, (ii) soft substrate, (iii) seagrass, (iv) mangrove, (v) macroalgae, (vi) intertidal, (vii) emergent rocks, and (viii) lagoon. The area of each habitat is shown in **Table 5** while the condition and pressures are described in **Table 6**.

**Table 5:** Shallow-water Habitats in Timor-Leste.

Region	Derived Bathymetry (km <sup>2</sup> )	Benthic Habitat (km <sup>2</sup> )	Hard Substrate (km <sup>2</sup> )	Soft Substrate (km <sup>2</sup> )	Seagrass (km <sup>2</sup> )	Mangrove (km <sup>2</sup> )	Macroalgae (km <sup>2</sup> )	Intertidal (km <sup>2</sup> )	Emergent Rocks (km <sup>2</sup> )	Lagoon (km <sup>2</sup> )	Unknown (km <sup>2</sup> )
Atauro Island	15.1	13.1	7.1	3.6	2.4	0.1	–	–	–	–	7.7
Oecusse	19.3	12.6	3.8	6.8	2.0	0.1	–	–	–	–	16.8
North Shore	85.6	76.9	35.1	16.3	10.5	2.7	6.2	3.3	0.5	2.3	249.1
South Shore	–	32.7	14.3	15.3	3.0	0.1	–	–	–	–	120.0
Total	120.0	135.3	60.3	41.9	17.9	2.9	6.2	3.3	0.5	2.3	393.6

km<sup>2</sup> = square kilometers

Note: 'Derived Bathymetry' and 'Benthic Habitat' are the areas mapped by region (km<sup>2</sup>). 'Unknown' is the area that could not be classified and is therefore excluded from the 'Benthic Habitat' area. The columns in light green show the benthic habitat characterized for each region (km<sup>2</sup>) that are included in the 'Benthic Habitat' area.

**Table 6:** Status and Condition of the Coastal and Marine Habitats.

Habitat	Area (km <sup>2</sup> )	Valuation (US\$ million)	Status and Condition
Mangroves	2.9 (decreasing)	116.96	<ul style="list-style-type: none"> <li>• <b>Area:</b> The total mangrove area has been reduced from 9,000 ha in 1940 to 1,802 ha in 2008, equating to an 80% loss, and to only 290 ha in 2015.</li> <li>• <b>Species composition:</b> There are six species out of the 19 species known to be true mangrove species in Timor-Leste. Many of these mangroves have been extinct due to massive pressure from coastal communities.</li> <li>• In Atauro Vila, there is a small mangrove habitat. The trees are few, widely-separated, and do not form a solid canopy.</li> </ul> <p><b>Causes of degradation:</b></p> <ul style="list-style-type: none"> <li>• Mangroves are harvested for timber and fuelwood.</li> <li>• Conversion of mangroves into brackish water shrimp and/or fish ponds</li> <li>• Salt is also being extracted from mangrove fringes.</li> </ul>
Seagrass	23.78 (increasing)	959.05	<ul style="list-style-type: none"> <li>• The narrow reef flats on the northern coast are dominated by seagrass beds in shallow waters (more than 2,200 hectares).</li> <li>• Species composition: About seven genera are known to exist around Timor-Leste: <i>Halodule</i>, <i>Halophila</i>, <i>Enhalus</i>, <i>Cymodocea</i>, <i>Syringodium</i>, <i>Thalassia</i>, and <i>Thalassodendron</i>.</li> <li>• In Atauro Vila, there is an extensive seagrass cover that is in good condition throughout the length of the aquatic natural reserve. About four species were found.</li> </ul>
Coral reefs	Hard: 59.08  Soft: 41.22	Hard: 2,382.71  Soft: 1,662.41	<ul style="list-style-type: none"> <li>• The coral reefs are in good condition with 51% living in hard and soft coral cover.</li> <li>• Hard (scleractinian) coral cover ranged from 0.0 to 42.3% across sites, with an average of 15.6%. <ul style="list-style-type: none"> <li>- Lautem and Atauro exhibited the highest mean coral cover at 20.3% and 20.5%, respectively.</li> <li>- Baucau and Liquica had the lowest cover at 10.4% and 10.7%, respectively.</li> </ul> </li> <li>• Fringing coral reefs form an almost continuous strip along the coastal waters, west of Timor-Leste.</li> <li>• Species composition: 23 species belonging to seven families</li> <li>• The coral reef fish community is species-rich, but overfished.</li> </ul>
Tidal swamps	3.28	132.28	<ul style="list-style-type: none"> <li>• No recent data</li> </ul>

## Ocean Health Index (OHI)

The overall ocean health index<sup>i</sup> (OHI) score of Timor-Leste is 59, compared to the overall global OHI score of 71 (<http://www.oceanhealthindex.org/region-scores/scores/east-timor>). Timor-Leste is ranked 187 out of 221 exclusive economic zones (EEZs). This indicates that more needs to be done to protect ocean health and ensure delivery of future benefits from the oceans.

## Major Risks and Threats

**Deforestation and coastal erosion.** Coastal erosion largely occurs in the northern coast of Timor-Leste. Forests have been previously cleared in the past.



**Habitat and biodiversity loss.** Many households also heavily rely on coastal resources for survival. People are cutting mangroves for house construction, building canoes, fuelwood for heating and cooking, as well as for cash.

**Water pollution and lack of sanitation and wastewater management facilities.** Sanitation facilities, and wastewater management systems are essential to reduce pollution loading into rivers and coasts, and protect the health of the oceans and the people. In terms of incidence of waterborne diseases, diarrhea is one of the top three diseases in children below five years old.

**Marine debris.** The inadequate solid waste collection, transport and disposal system has resulted in garbage washed to coastal and marine areas. Marine debris has been increasing and getting worse.

**Electronic waste.** There are imports of electronic equipment, such as computers, TVs, radios, etc. Since 1999 and the UN transitional administration, there has been a significant amount of e-waste, but there are no means of recycling or proper disposal facilities.

**Illegal, unreported, and unregulated (IUU) fishing.** IUU fishing activities have negative impacts on trans-boundary fish stocks in the large marine ecosystem in Arafura-Timor Sea and Indonesian Seas. Transboundary IUU fishing practices are widespread in these LMEs and surrounding areas.

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<sup>i</sup> The Ocean Health Index (OHI) establishes reference points for achieving widely accepted socio-ecological goals and scores for 220 countries and territories, Antarctica and 15 High Seas regions. Evaluated globally and by country, these goals represent the wide range of benefits that a healthy ocean can provide. Each country's overall score is the average of its respective goal scores. A goal is given a score of 100 if its maximum sustainable benefits are gained in ways that do not compromise the ocean's ability to deliver those benefits in the future. Lower scores indicate that more benefits could be gained or that current methods are harming the delivery of future benefits.

It has been estimated that illegal fishing amounts to around US\$36,000 (estimated) per year. Most of the pelagic fish have been captured in the Arafura region and traded outside the region. The live reef fish have also been exploited illegally and traded, this is also another transboundary issue. Inter-sectoral governance/coordination for fish management is lacking. This Arafura-Timor Sea area is also highly dominated by coastal communities with poverty and food insecurity being the major pressures.

## Ocean Governance: Gearing Up for the Challenges

### National Oceans Policy

Timor-Leste developed the National Oceans Policy (NOP) in relation to the blue economy development, where it would enhance the direction of future ocean use and management, as well as assist agencies that oversee national ocean priorities. The adoption of the NOP is needed to protect and improve the ecological health and economic value of the ocean and coastal areas. Detailed implementation planning will be developed to guide Timor-Leste toward achieving its vision of:

*“A healthy ocean that sustains the livelihoods and prosperity of the people of Timor-Leste in a fair and equitable manner.”*

The NOP recognizes the background of international and national laws and regional policy obligations adopted by Timor-Leste. There are six objectives for the NOP:

1. **Working together:** an integrated participatory ocean governance system, which facilitates collaboration across jurisdictions, allows for the exchange of knowledge, ideas and skills, and recognizes and considers local customary law, national law, and international and regional commitments;
2. **National security and sovereignty over our oceans:** including maintenance and protection of the rights of Timorese people, to equitably use and manage their marine natural resources;
3. **Our future:** a diverse blue economy based on the sea;
4. **Strengthening our natural defense:** protecting, restoring, and maintaining of coastal and ocean resources and ecosystem services to enhance disaster- and climate-resiliency;
5. **Investing in our people:** developing the capacity of Timorese to engage in ocean-based development and protection through research and education; and
6. **Climate change vulnerability, adaptation, and mitigation.**

As of 2018, the NOP is yet to be approved by the Council of Ministers.

### Major National Laws and Policies

At the national level, the **Strategic Development Plan for 2011-2030** (RDTL, 2011), calls for a comprehensive action to attain the vision of the country but the challenge is to implement them on the ground, with the active participation of the stakeholders. There is a need for an overall plan or

strategy, both at the national and municipality level, to integrate the efforts of the government so that timely and appropriate actions can be provided. Some of the key laws that have been passed:

- Environmental Basic Law
- Environmental Licensing: EIA, Pollution control
- Fisheries Law
- Forestry Law

Other laws and policies that are for consideration and adoption by the government are:

- Biodiversity Law (to be passed)
- National Oceans Policy (to be presented)
- 5 Maritime laws (related to the IMO Conventions to be adopted)

The WorldFish Center is assisting Timor-Leste in devising a national aquaculture strategy and action plan for the development of sustainable aquaculture. The Coral Triangle Initiative (CTI) is the first program to introduce the concept of payment of ecosystem services (PES) in Timor-Leste as a means of generating incentives for the efficient management of the country's marine and coastal resources.

The Ministry of Tourism is implementing the **National Tourism Policy 2011-2030**, considering the Timor-Leste Strategic Development Plan 2011–2030, traditional law (*Tara bandu*), and laws/ decrees related to other sectors (e.g., environment, agriculture and fisheries, land and property, etc.). The Tourism Policy is a pledge by the Government of Timor-Leste to develop a unified and holistic tourism sector that places emphasis on sustainability, community, quality, and business competitiveness. The objective of the policy is to build a tourism sector-enabling environment that will be inclusive, viable, and beneficial for all Timorese people. Ecotourism is also being promoted as alternative source of income and livelihood.

There are still no maritime policy and laws yet to support and regulate the ports and shipping industry. However, even if the International Convention for the Safety of Life at Sea (SOLAS) has not yet been adopted, and despite the lack of regulations, the Department of National Directorate of Maritime Transport and the port administration staff are following the SOLAS standards, and there are vessel traffic management system and Oil Spill Contingency Plan in place.

There are also policies and plans related to disaster risk management and climate change response.

- National Disaster Risk Management Plan (2005) and the National Disaster Risk Management Policy (2008) to deal with natural and man-made hazards. An inter-Ministerial Commission for Disaster Response/Management has also been established.
- The Small Scale Rural Infrastructure – a project under the National Adaptation Program of Action (NAPA) – is being implemented by the Ministry of State Administration in cooperation with UNDP/Global Environmental Facility (GEF). Under the UNFCCC, GoTL/MCIA has formulated nine NAPA priorities: (1) food security and agriculture, (2) water resource management, (3)

human health, (4) natural disasters, (5) forests, biodiversity and coastal ecosystem resilience, (6) livestock production, (7) physical infrastructure, (8) oil and gas infrastructure, and (9) capacity building.

## Governance Structure and Mechanisms Supporting Blue Economy Development

The main agencies responsible for environment and natural resources management in the country are the Ministry of Agriculture and Fisheries (MAF), Ministry of Commerce, Industry and Environment (MCIE), and Ministry of Petroleum and Mineral Resources. Under the MAF, there is a National Directorate of Fisheries and Aquaculture (NDFA), National Directorate of Agriculture and Horticulture (NDAH), and National Directorate of Forestry (NDF). Under MCIE, there is a National Directorate for Environment. Various other agencies also share responsibilities for environmental protection and natural resources management, especially those with functions and activities in coastal and marine areas. Previously, an Inter-Ministerial Working Group for Environment and Natural Resources Management served as a coordinating body. This inter-ministerial working group needs to be re-established given the changes in the government structure, and considering that the ocean economy provides a significant share of the country's economy and natural capital.

An integrated coordination and management mechanism for the implementation of three regional/sub-regional projects on coastal and marine management (e.g., CTI, ATSEF, and SDS-SEA) was also established within MAF in order to facilitate the national implementation of the said projects, through *Ministerial Order No. 8/24/GM/X/10* signed on October 2010.

**Integrated coastal management (ICM)** is being implemented in three municipalities in the northern coast: Dili, Manatuto, and Liquiça. Thus, 30.49% of the coastline is under an ICM program. However, the ICM program needs to be introduced and extended to other parts of the country, particularly in the southern coast. Capacity development and knowledge sharing are needed so that all coastal communities will better understand the concept, and for ICM to be implemented in an acceptable and sustainable manner. ICM could facilitate the blue economy development.

## Initiatives to Protect Ocean Health and Support Blue Economy Development

**Solid waste management.** Solid waste is being collected around Dili and transported to Tibar landfill by a private company as management contractors of Dili Administrative. The Tibar landfill site is located in the western part of Dili, about 13 km, and is managed by the Ministry of Infrastructure. Constructed under the Indonesian rule, it is the only site that is used as final disposal of solid waste. The Tibar landfill also accepts hospital waste (medical waste) that is categorized as nonhazardous waste. The Directorate of Water and Sanitation operates two compactor machines, and maintains the operator house, access road, warehouse for the compactor machines, and other materials.

**Wastewater treatment system.** Wastewater management is executed by the Directorate of Water Supply and Sanitation (Ministry of Public Works) and the Directorate of Environment (Ministry of Economy and Development). Dili has a wastewater treatment facility located in Tasitolu. The waste stabilization pond system uses low-cost technology, consisting of three treatment ponds: facultative pond; and two maturation ponds.



*Wastewater treatment pond  
(Source: Carlos Ximenes, 2016)*

**Adaptive government program for used oil management.**

Through the Secretariat of State of Environment, a facility for storage of used oil was established at Tibar Village. There are five tanks with the capacity of 100,000 liters each, and one collection truck that collects used oil across the country every day. There is a plan for future recycling process for these used oil stored in those tanks.



*(Source: Carlos Ximenes, 2016)*

There are also activities and investments being made to further conserve the ecosystem and biodiversity, as well as ensure blue economy development. These include:

**Marine protected areas (MPAs).** In August 2007, the Nino Konis Santana National Marine Park was established, covering an area of 123,600 ha. About 55,600 ha of it is part the 'Coral Triangle'. About five new marine protected areas (MPAs) are located in the National Park of Nino Konis Santana in Lautem municipality. There are four communities created as MPAs in Timor-Leste with the support of USAID's Coral Triangle Support Partnership (CTSP): Com, Lore, Tutuala, and Atauro communities. In addition, there are other seven MPAs in Timor-Leste: Atauro Vila with a cover area of 50.51 ha in Dili municipality, Batugade with 1100 ha in Bobonaro municipality, Lore 1 (487 ha), Hilapuna (303 ha), Perebenu (231 ha), Jone (409 ha), and Com (228 ha). The total area of MPAs in Timor-Leste is 1.37% of territorial waters (World Bank, 2018).

**Locally Managed Marine Area (LMMA).** A previous project in Manatuto established a LMMA to protect marine and coastal resources, and sustain fishers' income and other livelihoods. Some of the coastal communities have already taken part in the LMMA processes. The management of the LMMA is now part of the ICM program of the municipality.

**Other protected areas.** Found in Liquiça, Mount Fatumasin and the surrounding forests, with an area of 4,000 has, is one of the 15 'protected wild areas of the country'. Mt. Guguleur, which is found in the western part of Liquica, is also being evaluated to be included in the list of protected areas. Historical heritage sites are also located along the coast of the district, such as the ruins of the Dutch fort and the Epelu Jail during the Portuguese colonization. In addition, there are old buildings like the residence of the district and sub-district officers, as well as the Portuguese government administration office, chapel, hospital, and church. The total terrestrial protected areas are around 13.06% of total land area of the country.



**Mangrove and coral reef restoration.** The government is working together with stakeholders and investing in mangrove, seagrass and coral reef conservation. Local and international NGOs and donor organizations have been supporting mangrove rehabilitation and protection efforts in collaboration with various agencies and coastal communities in Liquica, Manatuto, Dili and other areas. The United Nations Development Programme (UNDP) has been implementing a project on enhancing coastal resilience that includes mangrove planting in seven municipalities, including the three ICM sites.

**Seagrass and dugong protection.** Under the GEF Dugong and Seagrass Conservation Project, national-level partners will be trained in seagrass and dugong research techniques, as well as priority sites for dugong and seagrass conservation efforts will be identified. A “tool box” will also be designed to illustrate the importance of dugong and seagrass habitats, their benefits to local people, options for their protection, and communicate related laws and regulations. A model for marine conservation ecotourism will be developed to incentivize local engagement in dugong and seagrass conservation. Moreover, the *National Biodiversity Strategy and Action Plan (NBSAP)* points out the endangered status of dugongs, which are protected under the Marine Protected Species Act. The NBSAP describes the importance of seagrass ecosystems not only as the primary habitat for dugongs and many fish and shellfish species, but also as a protective barrier for coral reefs against sedimentation.

**Sustainable fisheries.** The government adopted laws and decrees to manage and regulate fisheries and aquaculture. However, these laws need to be reinforced and adapted to the socio-economic conditions of the Timorese people. People are still heavily reliant on natural resources for survival, and they still lack awareness on how to exploit these resources in a responsible way. The government has also drafted strategy for development of fisheries in Timor-Leste. This will be presented to the Parliament. Another strategy is for aquaculture.

## Conclusion and Way Forward

The need to diversify the economy, and move beyond the oil sector offers opportunities for the country to look at alternative paths for economic growth. Blue economy and harnessing the oceans in a sustainable way presents potential investment areas for Timor-Leste, such as:

- Sustainable fisheries and mariculture (ongoing and pipeline)
- Marine and coastal ecotourism (initiated in some areas)
- Fish/seafood processing, food security and livelihood projects (initiated in some areas)
- Port development (port expansion is ongoing, but need to ensure that it is green and sustainable, and impacts on coastal habitats are minimized)
- Marine bioprospecting
- Downstream industries of the oil/petroleum sector

Such investments for short- and long-term development will require supporting policy instruments, clear regulations, strong collaboration among ministries; financing arrangements (from government and development partners); and indicators for monitoring and evaluation (M&E).

A technical working group is recommended to be established to assess the needs, and work on finding solution options to ensure that ocean health is protected for blue economy development. The key actions needed are:

- Adopt the National Oceans Policy, and prepare its Implementation Plan that includes initiatives on blue economy development, ocean health protection, and climate resiliency
- Formulate strategies and action plan for blue economy
- Strengthen coordination among line ministries and local governments with active involvement of decision-makers
- Develop capacity-building activities for the ministries involved in implementing projects related to blue economy development
- Increase ICM sites in other municipalities, and incorporate blue economy initiatives in the ICM and Coastal Strategy Implementation Plans
- Implement marine spatial planning to reduce multiple resource-use conflicts and for responsible use of Timor-Leste's near-shore habitats and resources
- Continue the monitoring and assessment of mangroves, seagrass, coral reef communities, seawater chemistry, and reef processes
- Evaluate the effectiveness of actions being undertaken for developing and sustainably managing coastal fisheries and aquaculture
- Develop projects on water supply, sanitation, wastewater and solid waste management to protect freshwater and marine waters, fisheries, and ecosystems from pollution as well as ensure the health and wellbeing of the people.
- Involve the communities and key stakeholders, increase their awareness, and develop their skills so they can be partners in economic development, and co-managers and stewards of the environment.
- Involve the statistics agency for the development of ocean accounts for the country. The ocean accounts will show the contribution of the ocean economy to the national economy as well as ensure that the ecosystem services, biodiversity values, and environmental damage are accounted for and integrated into national and local planning, development processes, and poverty reduction strategies (This is also in line with SDG 17).

There is a need to operationalize and strengthen an inter-ministerial mechanism to ensure a coordinated and integrated approach for blue economy development. Blue economy offers opportunities for emerging industries, economic growth, innovations, livelihood, and poverty reduction while enhancing food security, climate resiliency, and conservation of coastal and marine resources. It is important for the government and communities to recognize that blue economy is not just the role of the fisheries, environment, and coastal management sectors. Everyone would benefit from sustainable and inclusive blue economy development. Timor-Leste relies heavily on the resources from the oceans. However, everyone will also be affected by the oceans -- by human activities affecting the health of oceans, and by the impacts of sea level rise, ocean acidification, rising sea water temperature, increasing frequency and intensity of extreme weather events, and loss of habitats, fisheries and biodiversity. Thus, blue economy should be incorporated and highlighted into the economic and development planning and strategies of the country. Moreover, the blue economy initiatives can be linked to key targets of the UN Sustainable Development Goals.

**Table 7:** State of Ocean Economy and Health, Issues and Challenges, and Response.

Indicator	Status / Trend	Major Issues and Challenges	Response	
	INCREASING (↑) / DECREASING (↓) / NO CHANGE (-)	Top 3 issues	(a) key policies/ laws; (b) national action plan	Best practice or blue economy initiative
<b>State of ocean economy</b>				
<b>Ocean economy</b>	↑			
<b>Fisheries and aquaculture</b>	Fisheries: ↑ Aquaculture: ↑	<ol style="list-style-type: none"> <li>1. Lack of adequate fishing boats and gears (90% of boats are small.);</li> <li>2. Lack of capacity - knowledge and skills - and funds for sustainable fisheries and aquaculture</li> <li>3. Low demand for fish; high price of fish</li> <li>4. Lack of fish landing centers or fish ports, and storage facilities</li> </ol>	<ol style="list-style-type: none"> <li>1. Law No. 12/2004 "Fishing-Related Offences"</li> <li>2. Decree-Law No. 6/2004 of 21 April 2004: General Bases of the Legal Regime for the Management and Regulation of Fisheries and Aquaculture</li> <li>3. Decree-Law No. 4/2005 of 20 July 2005: Amending Decree-Law No. 6/2004 Of 21 April 2004</li> <li>4. Government Decree No. 5/2004: General Regulation on Fishing</li> <li>5. Decree- Law No. 21/2008, of the 25 June 2008: Implementation of Satellite System for Monitoring Fishing Vessels</li> <li>6. Policy and strategy for development of fisheries in Timor-Leste (draft)</li> <li>7. Aquaculture: Strategy for aquaculture</li> </ol>	<ul style="list-style-type: none"> <li>• Integrated farming system</li> <li>• 10 municipality support to youth for aquaculture of Tilapia sp.</li> </ul>

**Table 7:** State of Ocean Economy and Health, Issues and Challenges, and Response. (cont.)

Indicator	Status / Trend	Major Issues and Challenges	Response	
	INCREASING (↑) / DECREASING (↓) / NO CHANGE (–)	Top 3 issues	(a) key policies/ laws; (b) national action plan	Best practice or blue economy initiative
<b>State of ocean economy</b>				
<b>Tourism</b>	↑	<ol style="list-style-type: none"> <li>High cost of traveling (both air access and land costs) compared to neighbor destinations;</li> <li>Limited freshwater availability;</li> <li>Potential risk of crocodile attacks.</li> </ol>	<ol style="list-style-type: none"> <li>National Tourism Policy, 2011-2030</li> <li>Traditional law (<i>Tara bandu</i>) to support sustainable ecotourism and community-based tourism initiatives</li> </ol>	Ecotourism and MPAs; ecotourism and seagrass and dugong conservation; community-based tourism
<b>Ports and shipping</b> <ul style="list-style-type: none"> <li>Passenger volume</li> <li>Cargo and container throughput volume</li> <li>GVA</li> </ul>	↑		<ul style="list-style-type: none"> <li>Decree-Law No. 3 /2003 of 10 March: On the Establishment of the Port Authority (APORTIL) and on the Approval of the Bylaws Thereof</li> <li>No. 7/2002: Maritime Borders and the Territory of RDTL</li> </ul>	A new port in Tibar bay is under construction, with standard facility and services; including application of green building features, international rules and private sector participation.
<b>Offshore oil and gas</b> <ul style="list-style-type: none"> <li>Output; GVA</li> </ul>	↓			Regular monitoring of water quality and sediments (in the Joint Petroleum Development Area)
<b>Employment in ocean economy</b>	↑			
<b>State of ocean health</b>				
<b>Fish stocks</b>	↑	IUU fishing; intrusion of foreign fishing vessels		
<b>Catch per unit effort</b>	NA			
<b>Mangroves</b> <ul style="list-style-type: none"> <li>area; cover</li> <li>condition</li> </ul>	↓	Cutting trees	Regulation No. 2000/19: Protected Places	Mangroves rehabilitation
<b>Coral reefs</b> <ul style="list-style-type: none"> <li>area; cover</li> <li>condition</li> </ul>	↑		Regulation No. 2000/19: Protected Places	MPAs; LMMA

**Table 7:** State of Ocean Economy and Health, Issues and Challenges, and Response. (cont.)

Indicator	Status / Trend	Major Issues and Challenges	Response	
	INCREASING (↑) / DECREASING (↓) / NO CHANGE (–)	Top 3 issues	(a) key policies/ laws; (b) national action plan	Best practice or blue economy initiative
<b>Seagrass beds</b> • area; cover • condition	↑			MPAs
<b>Beach</b>	↑		Regulation No. 2000/19: Protected Places	
<b>Tidal swamps, mudflats</b>	–			
<b>Extinction of known threatened species</b>	↑			Public awareness
<b>Marine water quality</b>	DO: Good TSS: Fair Heavy metals: Good N, P: Inadequate data	Lack of wastewater treatment facilities		
<b>Marine protected areas (% of territorial waters)</b>	1.37% ↑	Effective management	Regulation No. 2000/19: Protected Places	Seven MPAs in Timor- Leste: (a) Atauro Vila, with an area of 50.51 ha in Dili municipality; (b) Batugade, with an area of 1,100 has in Bobonaro municipality; (c) Lore, with an area of 1,487 ha; (d) Hilapuna, 303 ha; (e) Perebenu, 231 ha; (f) Jone, 409 ha; and (g) Com, 228 ha. Five new MPAs were established in the Nino Konis Santana National Park in Lautem Municipality. One LMMA was established in Manatuto. Total area of MPAs is 1.37% of territorial waters.
<b>Mainstreaming of valuation of ecosystem services; natural capital accounting</b>	none	Need capacity development and data management system to support resource valuation and ocean economy- environment accounting		

**Table 7:** State of Ocean Economy and Health, Issues and Challenges, and Response. (cont.)

Indicator	Status / Trend	Major Issues and Challenges	Response	
	INCREASING (↑) / DECREASING (↓) / NO CHANGE (-)	Top 3 issues	(a) key policies/ laws; (b) national action plan	Best practice or blue economy initiative
<b>Pressures and threats</b>				
Population growth in the coastal areas	↑			
IUU fishing	No data	Remains one of the most damaging problems in Arafura and Timor Seas – strong political will is required		Coordination with Indonesia, ASEAN, CTI-CFF, etc. on monitoring IUU fishing
Coastal erosion and sedimentation	↑	Lack of Oil Spill Contingency Plan		Forest/mangroves rehabilitation
Untreated wastewater discharge	↑			
Solid waste generation	↑			
Plastic waste generation and marine debris	↑			Recycle plastic bottle, and reused (e.g., flower, chair, and border of garden)
Oil spills	–		Regulation No. 2000/19: Protected Places	
Greenhouse gas emissions	–			
Population with access to sanitation and wastewater management systems	↑ sanitation	<ol style="list-style-type: none"> <li>1. Need to increase access to safely managed sanitation services</li> <li>2. Only Dili has access to wastewater management system, and the facility has to be improved and expanded. Additional wastewater management systems are needed to serve other municipalities.</li> <li>3. Wastewater management systems are also needed in tourism and commercial establishments and industries.</li> </ol>		Majority uses toilet

**Table 7:** State of Ocean Economy and Health, Issues and Challenges, and Response. (cont.)

Indicator	Status / Trend	Major Issues and Challenges	Response	
	INCREASING (↑) / DECREASING (↓) / NO CHANGE (–)	Top 3 issues	(a) key policies/ laws; (b) national action plan	Best practice or blue economy initiative
<b>Population covered by solid waste management services</b>	–	<ol style="list-style-type: none"> <li>1. Increased public awareness on waste segregation, waste reduction, reuse and recycling, proper collection and disposal is needed.</li> <li>2. Only Dili is served by the solid waste management system and landfill, and the facility has to be improved and expanded.</li> <li>3. Additional solid waste management systems (regular garbage collection; recycling or materials recovery facilities; sanitary landfills) are needed to serve other municipalities.</li> </ol>		There are vehicles collecting solid waste everyday in urban area, and then transported to the Tibar for treatment by Shun Hsin Company.
<b>Tourist establishments with habitat, solid waste and wastewater management</b>	–			An example in Atauro is treatment of sludge (toilet waste), and then used as soil conditioner for plants.
<b>Ports and ships with environmental management systems</b>	–	Adoption of key IMO Conventions and corresponding national laws is needed.	<ul style="list-style-type: none"> <li>• Decree-Law 26/2012 - Framework Environmental Law;</li> <li>• Decree-Law 5/2011 - Environmental Licensing System; and</li> <li>• UNTAET Regulation No. 2000/19 - Protected Areas.</li> </ul>	



*Photo by M. Ebarvia*



# 1 Introduction

## 1.1 Context of the National State of Oceans and Coasts (SOC) Report

The Government of Timor-Leste has been participating and contributing to the implementation of programs and activities in the GEF/UNDP regional projects that support the implementation of the Sustainable Development Strategy for the Seas of East Asia (SDS-SEA), since 2005.

Together with 11 PEMSEA Partner Countries, the Government of Timor-Leste signed the Da Nang Compact, thereby adopting the SDS-SEA 2015 and four post-2015 Strategic Targets. These serve as indicators of country progress in implementing the SDS-SEA 2015 for the next 5 years. Target 2 of the four strategic targets stated that by 2018, a regional State of Oceans and Coasts reporting system will be established to monitor progress, impacts and benefits, and to continually improve planning and management of SDS-SEA implementation. Furthermore, prior to the EAS Congress 2015, 10 East Asian Seas countries affirmed to develop the blue economy and assess the ocean economy, ecosystem services, and investment opportunities for sustainable blue economy development.

Timor-Leste developed the National Oceans Policy (NOP) in relation to the blue economy development, where it would enhance the direction of future ocean use and management, as well as assist external bodies that oversee national ocean priorities. Detailed implementation planning will be developed to guide Timor-Leste toward achieving its vision of:

*“A healthy ocean that sustains the livelihoods and prosperity of the people of Timor-Leste in a fair and equitable manner.”*

The NOP recognizes the background of international and national laws and regional policy obligations adopted by Timor-Leste.

There are six objectives for the NOP:

1. **Working together:** an integrated participatory ocean governance system, which facilitates collaboration across jurisdictions, allows for the exchange of knowledge, ideas and skills, and recognizes and considers local customary law, national law, and international and regional commitments;
2. **National security and sovereignty over our oceans:** including maintenance and protection of the rights of Timorese people, to equitably use and manage their marine natural resources;

3. **Our future:** a diverse blue economy based on the sea;
4. **Strengthening our natural defense:** protecting, restoring, and maintaining of coastal and ocean resources and ecosystem services;
5. **Investing in our people:** developing the capacity of Timorese to engage in ocean-based development and protection through research and education; and
6. **Climate change vulnerability, adaptation, and mitigation.**

## 1.2 Objectives of the National SOC Report

The theme of the first National State of Oceans and Coasts (NSOC) report is blue economy. The definition of blue economy is given in the **Changwon Declaration 2012**,<sup>1</sup> which was adopted by the ministers of the East Asian Seas (EAS) Region. The **Blue Economy** is the sustainable use of ocean resources for economic growth, improved livelihoods and jobs, while preserving the health of marine and coastal ecosystems (World Bank, 2017). This is also in line with the Agenda 2030 and the Sustainable Development Goals (SDGs), especially SDG 14 – Life Below Water – for conservation and sustainable use of the oceans, seas and marine resources for sustainable development.

Marine and coastal resources have substantial contribution for Timor-Leste's economy, food security, and protein intake for most of the people, particularly in the coastal communities.

The SOC report aims to:

- Compile data and information collected from different concerned agencies to serve as baseline information related to the country's coastal and marine resources and environment, ocean economy, people, governance structure, and blue economy initiatives;
- Contribute to the blue economy assessment and monitoring of the implementation of the National Oceans Policy, Sustainable Development Strategy for the Seas of East Asia (SDS-SEA), SDGs, other international agreements, and national laws and policies; and
- Aid policy-making, planning and management of the coastal and marine areas of the country, and monitoring of the country's progress.

## 1.3 Rationale

One of the most important but little noticed change over the past decades is how our perspective on the world's oceans has changed. Oceans were first considered vast and limitless. Following centuries of exploration, oceans became areas for nuclear testing, dumping of wastes, and exploitation for food, minerals, oil and gas, and other resources. Given the current challenges,

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<sup>1</sup> "We understand the Blue Economy to be a practical ocean-based economic model using green infrastructure and technologies, innovative financing mechanisms, and proactive institutional arrangements for meeting the twin goals of protecting our oceans and coasts and enhancing its potential contribution to sustainable development, including improving human well-being, and reducing environmental risks and ecological scarcities." (Changwon Declaration 2012)

studies on the state of the marine environment have become more significant. There is now increasing recognition that oceans are finite, with fragile ecosystems and biodiversity under pressure from human activities, and climate and environmental changes. Yet, the benefits derived from the oceans have not been fully quantified as well as the environmental and societal impacts and costs of over-exploitation, pollution, and years of neglect. It has therefore become critical to understand that each of our uses of oceans involves real or potential tradeoffs with other uses. This means we need a much better and more detailed understanding of the economic values of oceans and coastal and marine resources, and the state of ocean health underpinning the sustainable development of oceans and coasts.

Within this context, the term “blue economy” has entered into the vocabulary of economic development in all parts of the world. But the meaning of “blue economy” is still evolving, with some emphasizing the possibilities of new ocean-based industries, such as renewable energy or bio-pharmaceuticals, and others emphasizing the need to transform the traditional ocean economy and the emerging ocean industries into a more sustainable and inclusive blue economy, conserving the oceanic natural capital and providing opportunities across the society. All of these changes are taking place in a changing climate that is altering the physical properties of oceans that may dramatically shift the foundations of ocean and coastal economies. Though changes such as sea-level rise and ocean acidification are becoming known, uncertainty remains about the extent and timing with which these ocean changes will affect resources and coastal areas.

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

## 1.4 Concept and Framework

The development of the NSOC Report entailed the use of the drivers-pressures-state-impacts-response (DPSIR) framework for the analysis, as well as the focus on the blue economy theme. It also involved review of literature, existing studies and reports, and consultations with key government agencies and other stakeholders. The scope of the report is at national level, but includes inputs at the local level on good practices and governance, etc.

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

- **Socioeconomic conditions:** population, economy, social features
- **Ocean economy:** gross value added of the ocean economy and contribution to national economy; valuation of ecosystem services; key ocean economic activities (contribution to income and employment, pressures and issues, response in terms of policies and best practices)
- **Developments in blue economy:** innovative and sustainable ocean economic activities; emerging industries; opportunities for investments and partnerships for blue economy development.
- **State of ocean health underpinning the blue economy:** natural conditions (oceanography and physical features of the seas and coasts); ecosystems and biodiversity; pressures and impacts (risks and threats from human activities, natural hazards, and climate change, impacts on the environment and communities).
- **Governance structure supporting blue economy development:**
  - *Institutional arrangements:*
    - Description of key policies, laws, and international agreements adopted that would address the pressures and threats to ocean health and ocean economy, and support blue economy development.
    - Supporting mechanisms (capacity development; research and development; financing, stakeholder participation; partnerships, etc.) for the implementation of these policies, laws, and international agreements.
  - *Sustainable development strategy and actions:* ocean and coastal management, fisheries management, ecosystem and biodiversity conservation, marine protected areas, pollution reduction, natural hazard management and climate change response to achieve the SDG 14 targets, SDS-SEA targets, other international commitments, and national targets to ensure ocean health and sustainable blue economy.
  - *Driving forces for blue economy*
- **Conclusion and recommendations**

## 1.5 Caveats

The NSOC Report is limited by the availability of data. It was difficult to get disaggregated data for the ocean economy, and up-to-date information on the marine environment and ecosystems, and initiatives related to blue economy development. The timeframe for the information used in the SOC report in general are from 2010 until 2017. However, data from other years are used when current information is not available. Data collection was done through inter-agency research, and multi-stakeholder workshops, coordination with NGO/INGOs, and discussions done with staff of key ministries and academe. The names of ministries and other government agencies are based on the government structure during the period this report was prepared (i.e., 2016-2018), or names used in the cited reports and studies.

**PART 1**

**THE SEAS AND PEOPLE OF  
TIMOR-LESTE**

# 2 Geography

Timor-Leste is a country located on the island of Timor, which is part of the Lesser Sunda Islands, sandwiched between Indonesia and Australia. Lying between latitudes 8.1°S and 9.5°S and 125.0°E and 127.3°E, it is bounded by Nusa Tenggara Timur, a province of Indonesia, in the west; Wetar Strait in the north; Timor Sea in the south; and, Arafura Sea in the east. (Figure 1). Australia is the country's southern neighbor, separated by Timor Sea.

Timor-Leste covers approximately 14,919 square kilometers (km<sup>2</sup>), with a coastline of 782.88 km (Table 2.1). Most of the country's land area is located on the eastern part of the island of Timor, and the Oecusse-Ambeno enclave. The country also includes two outlying islands, Atauro Island (144 km<sup>2</sup>) and uninhabited Jaco Island (8 km<sup>2</sup>) (Sandlund et al., 2001). Timor-Leste's marine area is more than three times its land area. The shelf area is 25,648 km<sup>2</sup>, and the marine area, including the exclusive economic zone (EEZ), is approximately 72,000 km<sup>2</sup> (N DFA, 2012).

At Timor-Leste's eastern tip, Wetar Strait and Timor Sea converge, supporting diverse marine life. This eastern tip is also home to the country's first declared national nature reserve, the Nino Konis Santana National Park.

Timor is divided into 12 municipalities and one special administrative region, which in turn are subdivided into 65 administrative posts, 442 *sucos* (villages), and 2,225 *aldeias* (hamlets). Out of the 13 municipalities, 11 are coastal. (Figure 2.1). Ermera and Aileu are the non-coastal municipalities. Figure 2.2 shows the *sucos* that are coastal, and their respective coastlines.

**Dili**, the capital of Timor-Leste, lies on the north coast of the island. It borders the districts of Manatuto to the east, Aileu to the south, Liquiça to the west, and the Savu Sea to the north. It includes also Atauro Island to the north. It is the country's smallest district.

**Special Administrative Region (SAR) of Oecusse-Ambeno** is located on the north coast

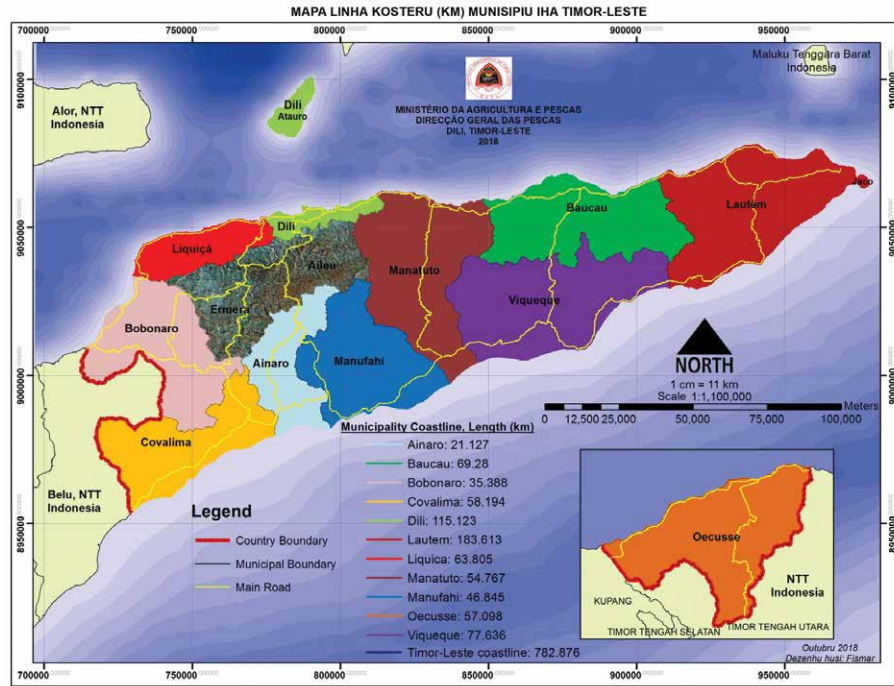
**Table 2.1:** Municipalities of Timor-Leste Religion in Timor-Leste, 2015.

Municipality	Coastline (km)	Area (km <sup>2</sup> )
Aileu*		737
Ainaro	21.127	804
Baucau	69.280	1,506
Bobonaro	35.388	1,376
Covalima	58.194	1,203
Dili	115.123	367
Ermera*		768
Lautem	183.613	1,813
Liquiça	63.805	549
Manatuto	54.767	1,782
Manufahi	46.845	1,323
Oecusse	57.098	814
Viqueque	77.636	1,877
<b>TOTAL</b>	<b>782.876</b>	<b>14,919</b>

\* Non-coastal  
Source: MAF, 2018.

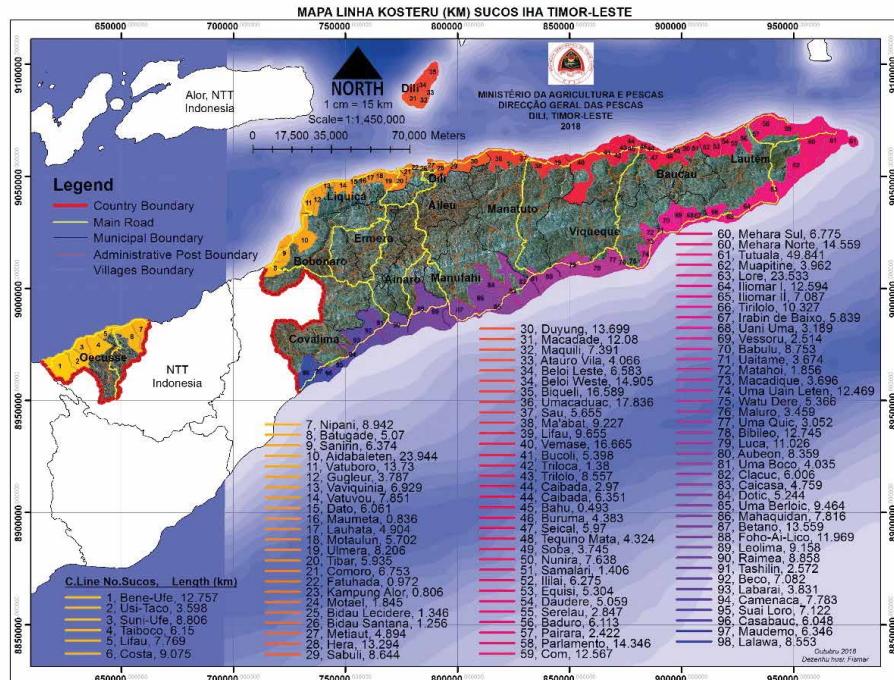
of the western part of Timor Island. It is separated from the rest of Timor by the Indonesian territory, which surrounds the small enclave in all directions, except to the north, where it borders the Savu Sea. Oecussi-Ambeno was named after the two original kingdoms, which now constitute the SAR. Oecussi-Ambeno was the first place on which the Portuguese established themselves at their arrival. This is the reason it is considered the cradle of Timor-Leste.

Figure 2.1: Municipalities of Timor-Leste.



Source: MAF, 2018.

Figure 2.2: Coastal Villages (sukos) of Timor-Leste.



Source: MAF, 2018.

# 3 The People and Economy of Timor-Leste

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## 3.1 Demography

### 3.1.1 Population and Household Size

Based on the Population Census of Timor-Leste in 2015, total population was 1,183,643 (MoF, 2015), which consisted of 601,112 males and 582,531 females. Population growth rate (national) from 2015 to 2016 was estimated to be 2.39%. The population in 2017 was 1,243,261, and increased to 1,267,972 in 2018 (World Bank 2019). In 2018, the urban population was 387,720 (30.58% of total population) while rural population was 880,252 (69.42%). Population density at the national level is 77 people per km<sup>2</sup> in 2010. It increased to 85 people per km<sup>2</sup> in 2017 and 2018.

The average household size increased from 4.7 to 5.5 people in all districts between the 2004 census and the 2010 census. Large households are found in Dili, where people tend to stay with relatives after migrating either for education or employment opportunities. About 14% of households in Timor-Leste are headed by women.

Women tend to get married at a younger age than men. Some marriages occur below the legal age, with more than 1,200 girls and 900 boys marrying before the age of 17. For every 100 widowers in Timor-Leste, 74 are women and 26 are men. Most of the women are widowed, single, divorced or separated. Whereas more than 90% of male household heads are married.

### 3.1.2 Coastal Population Density

The most densely populated municipalities are Dili, Ermera, and Liquiça. All three municipalities have more than 100 people per km<sup>2</sup>. Dili surpasses all other municipalities with a population density of 689 people per km<sup>2</sup>. The municipalities that hold moderate population concentrations (50–100 people per km<sup>2</sup>) are Oecusse, Ainaro, Baucau, Bobonaro, Aileu, and Covalima. The rest of the municipalities – Viqueque, Manufahi, Lautem and Manatuto, are sparsely populated with population density of less than 50 people per km<sup>2</sup> (Result of Preliminary Census by DG Statistica, 2015).

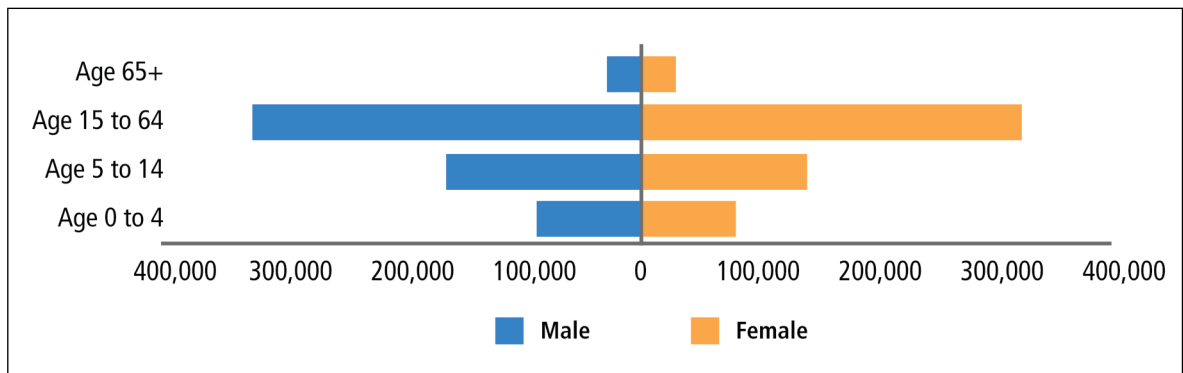
### 3.1.3 Age-Sex Structure

According to the 2015 census, Timor-Leste has a high total dependency ratio of 82 children and older persons per 100 persons of working age. This means that every 100 persons of working age, in addition to supporting themselves, must support 82 individuals who are not of working age. (DGE 2015). In



particular, the child dependency ratio – the share of children 0–14 relative to the working-age population (15–64) – currently drives 58% of the total dependency ratio in Timor-Leste. The country has been experiencing an expanding youth bulge because of historically high fertility rates. However, Timor-Leste is now going through the initial stages of a demographic transition as fertility rates decline and life expectancy increases.

**Figure 3.1:** Population Pyramid, 2015.



Source: Census, 2015.

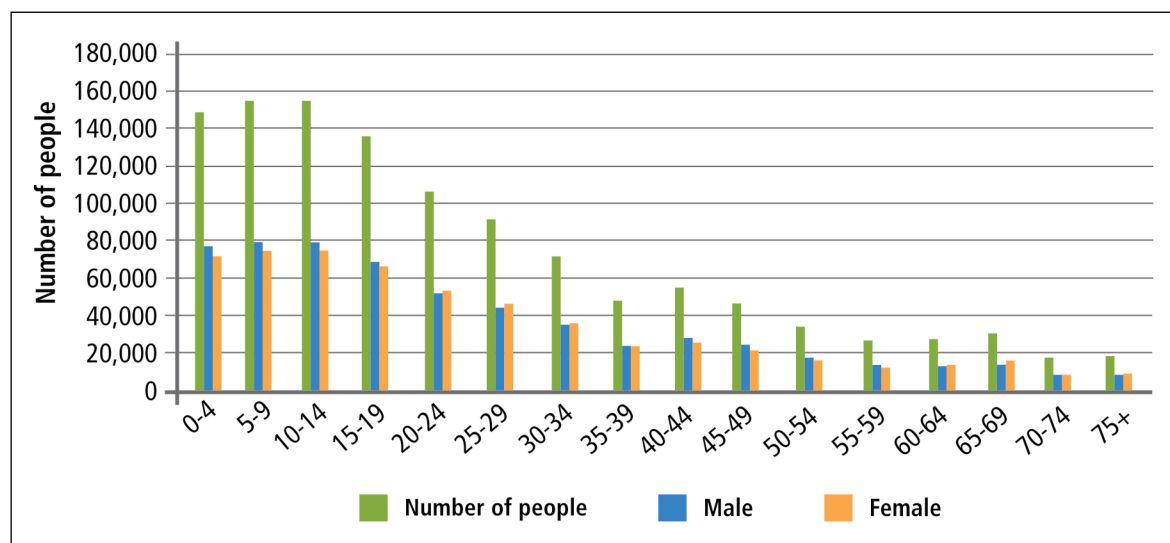
Sex ratio between male and female is 103.19. There are slightly more men than women in Timor-Leste: 50.9% are male and 49.1% are female.

Urban areas have the biggest difference in the number of males and females with 109 males for every 100 females; compared to rural areas where there are 101 males for every 100 females. The highest proportion of males to females (sex ratio) is in the district of Dili, where there are 112 males for every 100 females. In Bobonaro, Lautem and Oecussi districts, females outnumber males; while in other districts, there are more males than females.

**Table 3.1:** Age-Sex Structure (2015).

Age Bracket	Percentage of Total Population	Male	Female
0-14 years	41.43%	268,578	253,897
15-24 years	20.11%	128,678	124,870
25-54 years	29.79%	180,750	194,916
55-64 years	4.88%	31,349	30,194
65 years and over	3.79%	22,852	24,988

Source: Census, 2015.

**Figure 3.2:** Population of Timor-Leste by Age-Sex Structure in 2015.

Source: Census, 2015.

### 3.1.4 Urban Population

The urban population of Timor-Leste was 157,000 in 1990. It increased to 407,000 in 2015. With a growth rate of 4.3%, this means that the urbanization trend is increasing through the years. In 2018, the urban population was 387,720 or 30.58% of total population (World Bank 2018). The urban centers of Timor-Leste are located in coastal areas – the municipalities of Dili, Liquiça, Baucau, and Manatuto.

The rural population in 2000 was 76% of total population. It decreased to 67% in 2015. Growth rate of rural population was only 1.3% in 2015. In 2018, rural population was 880,252 or 69.42% of total population (World Bank 2018).

The urban-rural population ratio was 0.51 in 2015. The rate of urbanization is 3.75% (annual rate of change, 2010-2015 estimate). By 2018, the urban-rural population ratio was 0.44.

Dili, the capital of Timor-Leste, has a population of 277,279 people in 2015, with 143,677 males and 133,602 females. Most of the people in Dili are coming from different districts across the country. The main reasons for migrating were job hunting (at the shops, restaurants, beauty salon, hotels and government, etc.), and looking for a better life. However, there are very limited job opportunities in Dili, thus, unemployment is the primary concern of the government. These migrants are also putting further burden to the city of Dili in relation to living space, energy use, water, sanitation, and crimes. In response, the government is creating more work opportunities outside of Dili, so that the youth could have better job prospects in their own municipality rather than searching for jobs in Dili. Another reason for urban migration is that the alumni/graduates of secondary schools have been moving to the capital every year to continue their studies in the university.

### 3.1.5 Population by Ethnic Composition, Language and Religion

**Ethnic groups:** Majority of the population are Austronesian (Malayo-Polynesian) and Papuan. There is a small Chinese minority.

**Languages:** The main languages spoken are Tetum (official), Portuguese (official), Indonesian, and English. There are about 16 indigenous languages. A significant portion of the population speaks Tetum, Galole, Mambae, and Kemak.

**Religion:** In 2005, 96.9% of the population was Roman Catholic. In 2015: Roman Catholics make up 97.57% of the population. The rest are Protestants or Evangelicals (1.96%), Muslims or Islam (0.24%), Buddhism (0.05%), Hinduism (0.02%), Traditional (0.08%), and others (0.08%). Detailed composition of population by religion in Timor-Leste is shown in **Table 3.2** below.

**Table 3.2:** Composition of Population by Religion in Timor-Leste, 2015.

Gender	Total	Religion						
		Catholicism	Protestantism/ Evangelicalism	Islam	Buddhism	Hinduism	Traditional	Other
<b>Total population</b>	1,179,654	1,150,990	23,100	2,824	560	272	918	990
<b>Male</b>	598,921	584,209	11,622	1,608	336	141	483	522
<b>Female</b>	580,733	566,781	11,478	1,216	224	131	435	

Source: Census, 2015.

## 3.2 Economy

### 3.2.1 Gross Domestic Product

Real gross domestic product (GDP) decreased by 26% - from US\$4.16 billion in 2013 to US\$3.08 billion in 2014 (in constant 2010 US\$). The large decrease is attributed to the decline in the oil sector (39.9%), which dominates the economy. The volume of oil extracted decreased significantly from 65.4 million barrels to 44.9 million barrels.

The economy expanded by 20.6% percent from 2014 to 2015, with GDP increasing to US\$3.72 billion (in constant 2010 US\$).<sup>2</sup> The growth rates for the GDP components, by type of expenditure, are shown in **Table 3.3**. Real GDP increased to US\$3.4 billion in 2017 and US\$3.5 billion in 2018. The GNI and GDP data are shown in **Table 3.4**.

Official development assistance (ODA) was mostly declining; the share of ODA in gross national income was 9% in 2015.<sup>3</sup>

<sup>2</sup> <https://data.worldbank.org/country/timor-leste>.

<sup>3</sup> See Aid at a Glance Charts (database), Organisation for Economic Co-operation and Development, Paris, <http://www.oecd.org/dac/financing-sustainable-development/development-finance-data/aid-at-a-glance.htm>

**Table 3.3:** GDP Components – Growth Rate (%).

GDP Components, by Expenditure	Year	
	2014	2015
<b>Public Expenditure</b>	17.5	3.2
Consumption	24.0	7.1
Investment	7.8	-3.6
<b>Development partners</b>	<b>4.1</b>	<b>-16.6</b>
Consumption	3.7	-15.5
Investment	6.0	-21.6
<b>Private Expenditure</b>	<b>5.5</b>	<b>3.9</b>
Consumption	6.2	4.0
Investment	-0.3	3.3
Change in Inventories	-4.9	-21.4
<b>Exports</b>	<b>20.1</b>	<b>-5.3</b>
Goods	-41.4	133.4
Services	-12.1	-39.9
<b>Imports</b>	<b>18.3</b>	<b>-4.8</b>
Goods	8.1	11.6
Services	27.9	-17.8

Source: MoF

**Table 3.4:** Gross National Income (GNI) and Gross Domestic Product (GDP), 2017.

Indicators	US\$
<b>Gross National Income or GNI (World Bank Atlas method)</b>	
GNI (US\$, in current prices)	2,265,296,161
GNI (US\$, in constant 2010 US\$)	3,459,090,215
<b>GNI per capita</b>	
GNI per capita (PPP, constant 2011 international \$)	7433.6
GNI per capita (US\$, in constant 2010 prices)	2782.3
<b>Gross Domestic Product (GDP)</b>	
GDP (PPP, constant international prices)	8,380,685,868
Nominal GDP (US\$, in current prices)	2,487,269,400
Real GDP (US\$, in constant 2010 prices)	3,403,235,884
<b>GDP per capita</b>	
Nominal GDP per capita (US\$, in current prices)	2000.6
Real GDP per capita (US\$, in constant 2010 prices)	2737.3

Source: World Bank (<https://data.worldbank.org/country/timor-leste> - Retrieved in August 2018).

Given the relatively small level of employment in the oil sector, total GDP is not the best measure of economic performance for Timor-Leste. Instead, it is more useful to monitor economic performance using *non-oil* GDP together with a wide variety of other indicators relating to the non-oil economy. This approach provides a more accurate indication of the real impact of changes in the economy on the people of Timor-Leste (Annual Report, Ministry of Finance, 2016).

In 2014, non-oil GDP growth significantly increased to 5.9%, up from 2.8% in 2013. The high level of economic growth witnessed in 2014 is the result of a combination of strong growth in private sector investment, households consumption, and increases in government capital expenditure associated with the frontloading policy. Household consumption increased by 9.8%, and was aided by the low inflationary environment. This suggests that living standards continue to increase in Timor-Leste. The 17.3% growth in private sector investment shows that, in line with the Strategic Development Plan (SDP) and the frontloading policy, strong progress is being made in developing the private sector. High growth levels were witnessed in the construction sector (16.1%) as well as in the area of public administration, which is highly correlated with the increase in government capital expenditure linked to the frontloading strategy and an increase in public sector employment (Annual Report, Ministry of Finance, 2016).

GDP composition by sector (2016 estimate)<sup>4</sup>

- Agriculture: 7.5%
- Industry: 68%
- Services: 24.4%

The agricultural goods produced for domestic use and exports are listed in **Table 3.5**.

**Table 3.5:** Domestic Production and Supply of Agricultural Goods (US\$ million).

Exports	Years					
	2010	2011	2012	2013	2014	2015
Animal & Animal Products	0.02	0.00	0.00	0.06	0.00	0.00
Crops & Vegetables	28.70	34.64	55.58	23.53	16.93	33.12
Edible fats & oils	0.06	0.04	0.12	0.14	0.16	0.26
Foodstuffs	0.00	0.01	0.00	0.00	0.00	0.00

Source: MAF

<sup>4</sup> CIA - World Fact Book 2016.

### 3.2.2 Unemployment Rate

The unemployment rate in 2017 was 11%, and Timor-Leste is 71 in world ranking. Approved in June 2017, the *National Employment Strategy 2017–2030* emphasizes that “productive employment is the basis for improving household livelihoods and [the] prosperity of the country as a whole, where equal participation of men and women will be the only way of achieving inclusive economic growth and social development” (NES Secretariat 2017, p. III-5). The creation of the new office of the Secretary of State for Youth and Employment in September 2017 clearly demonstrates the Seventh Constitutional Government’s strong commitment to accelerating efforts to create work opportunities among the youth.

### 3.2.3 Inflation

Using Timor-Leste’s Consumer Price Index (CPI, 2010 = 100), inflation was 0.55% in 2015, and declined to -1.34% in 2016.

However, inflation is beginning to show an upward trend with the recent rise in food and non-alcoholic beverage and transport prices. The inflation rate is a possible consequence of the following factors: (a) the value of the US dollar against Timor-Leste’s main trading prices (NEER index); (b) international commodity prices like food products, such as rice; and (c) international oil prices. In 2017, inflation was 0.56%.

The government has set a target of 4%–6% inflation under the *Strategic Development Plan* (SDP), 2011-2030. Timor-Leste is currently operating well below this target.

### 3.2.4 Fiscal Situation

The overall total collection from Domestic Revenue in 2016 tax year has increased from US\$56.216 million to US\$58.285 million compared to the previous tax year. This amount is expected to increase once domestic taxpayers pay the residual Annual Income Tax at the end of March 2017. The government focused on effective management of revenue administration, especially the enforcement of tax collection of debts from domestic taxpayers. The Directorate General for Revenue (DGR), which is mandated to manage and administer the collection of taxes (e.g., Income tax, Services tax, Wages tax and some other types of taxes and other financial contributions), expected the increase of Timor-Leste’s revenue (MoF, 2016).

During the 2016 tax period, the registration department of the DGR conducted re-registration processes of new and existing taxpayers, which resulted in the registration of 24,363 active taxpayers and 46,312 inactive taxpayers. There were 29 tax appeals submitted by taxpayers: 12 cases are closed; 3 are withdrawn; 13 are still being analyzed; and 1 case is in the process of being finalized. On the same tax year, the accounting department of both National Directorates

(petroleum and domestic) processed, captured and reconciled tax payments in the amounts of U\$87.424 million from petroleum revenue and U\$58.285 million from Domestic Revenue. These changes resulted in the revenue increase of 3.5% from 2016 to 2017.



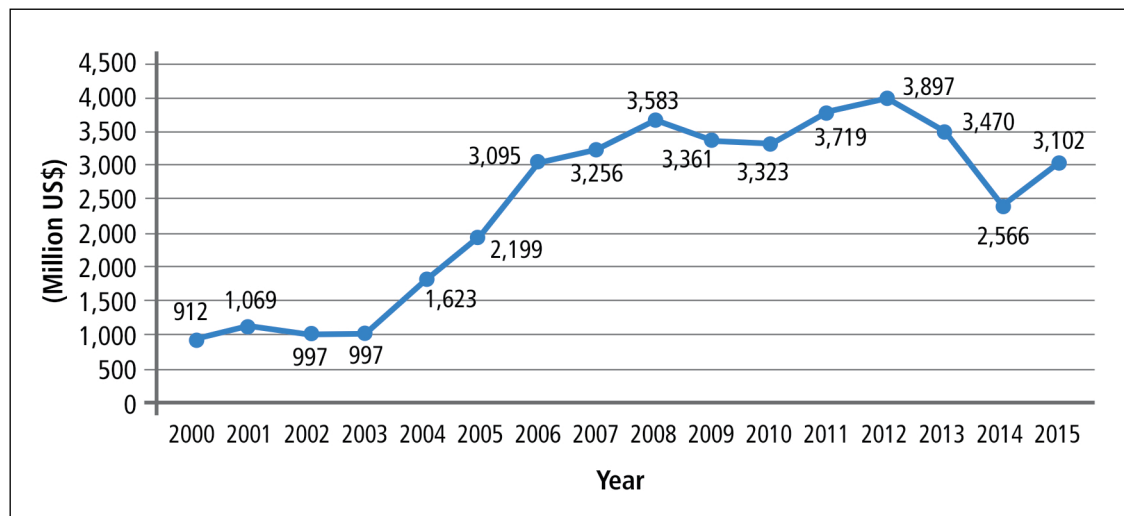
Fiscal reform has been defined as one of the priority programs of the VI Constitutional Government. Since the inception of the Fiscal Reform Commission (FRC) in the early part of 2015, the DGR has taken part in the reform process by sharing its technical opinion on the weaknesses of the tax administration system and the loopholes to the existing tax laws and regulations. As such, DGR has been involved in the process to amend the Taxes and Duties Act (TDA) approved by Decree Law No. 08/2008, to create a new Tax Procedure Code (currently regulated by UNTAET Regulation 2000/18), and to create the new Value Added Tax (VAT) Law, which will then replace the services tax.

During the 2016 fiscal year, the DGR has conducted several important programs/activities in order to support the targets of the Fiscal Reform Commission, such as: (i) implementation of the changes made by DGR's new organic structure, which resulted to MoF's new Organic Law (Decree Law No. 38/2015, 7 October); and, (ii) participation in the meetings, presentations, and discussion of the policy for the new proposed TDA and VAT Law, contributing technical opinion and know-how during the process of drafting the abovementioned laws.

### 3.2.5 Coastal Livelihood

Source of coastal livelihoods are derived from fisheries, salt distillation, tourism, and ecosystem provisioning services, such as bamboo, mangrove, honey and non-fish. These sources are part of main livelihoods of coastal communities both for cash and for family consumption. Over-exploitation of these resources is considered as not responsible as most of these resources have been depleted. Indeed, it requires further attention from decision-makers on how the local government can promote community-based fisheries management, and introduce integrated coastal management (ICM) that will engage all stakeholders from various sectors, such as fisheries, forestry, water and sanitation, infrastructure, human settlement, agriculture, livestock, tourism, ports, and environment.

Through ICM, all resources can be managed to support human wellbeing not only for the present, but also for future generations. This ICM concept was introduced by PEMSEA in some parts of the northern coast. However, it needs to be extended to other parts of the country, particularly in the southern coast, so that all coastal communities will better understand the concept, for it to be implemented in an acceptable and sustainable manner.

**Figure 3.3:** Ocean economy, 2000-2015.

Source: Statistics of MoF, 2017.

### 3.3 Social Characteristics

To achieve the demographic dividend, any favorable changes in the age structure must be accompanied by judicious policies in human capital development, i.e., education and training, health care, and productive employment creation, and infrastructure development. If such policies and actions are not implemented, then the youth bulge in the age structure would become a demographic liability.

#### 3.3.1 Human Development Index (HDI)

Timor-Leste's HDI value for 2017 is 0.624, which puts the country in the medium human development category, positioning it at 132 of the 189 countries and territories. Life expectancy at birth is 69.0 years. Expected years of schooling is 12.4. Mean years of schooling is 4.5. GNI per capita is US\$7,434 (in 2011 PPP \$) (UNDP, 2018).

Between 2000 and 2015, Timor-Leste's HDI value increased from 0.470 to 0.605 – an increase of 28.8%. Between 1990 and 2015, Timor-Leste's life expectancy at birth increased by 20.0 years; mean years of schooling increased by 1.6 years; and expected years of schooling increased by 2.7 years. Timor-Leste's GNI per capita increased by about 138.4% between 1990 and 2015. **Table 3.6** reviews Timor-Leste's progress in human development as shown in each of the HDI indicators.

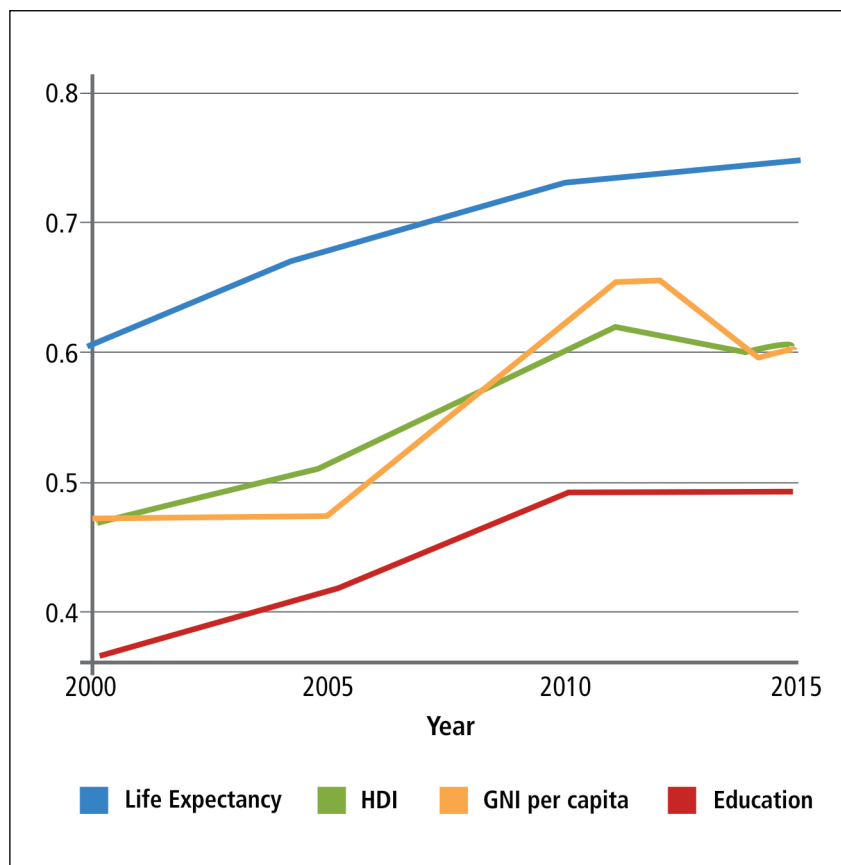


**Table 3.6:** Timor-Leste's HDI Trends Based on Consistent Time Series Data.

Year	Life expectancy at birth	Expected years of schooling	Mean years of schooling	GNI per capita (2011 PPP\$)	HDI value
1990	48.5			4,069	
1995	53.5			5,669	
2000	59.0	9.8	2.8	4,993	0.505
2005	63.9	11.0	3.3	1,818	0.496
2010	67.2	12.4	4.4	8,155	0.620
2015	68.5	12.5	4.5	8,284	0.628
2016	68.7	12.4	4.5	8,350	0.628
2017	69.0	12.4	4.5	7,434	0.624
2018	69.3	12.4	4.5	7,527	0.626

Source: UNDP, 2018.

**Figure 3.4** below shows the contribution of each component index to Timor-Leste's HDI from 2000 to 2015, and illustrates the rapid transformation since 2000.

**Figure 3.4:** Human Development Index, 2000-2015.

Source: UNDP 2015.

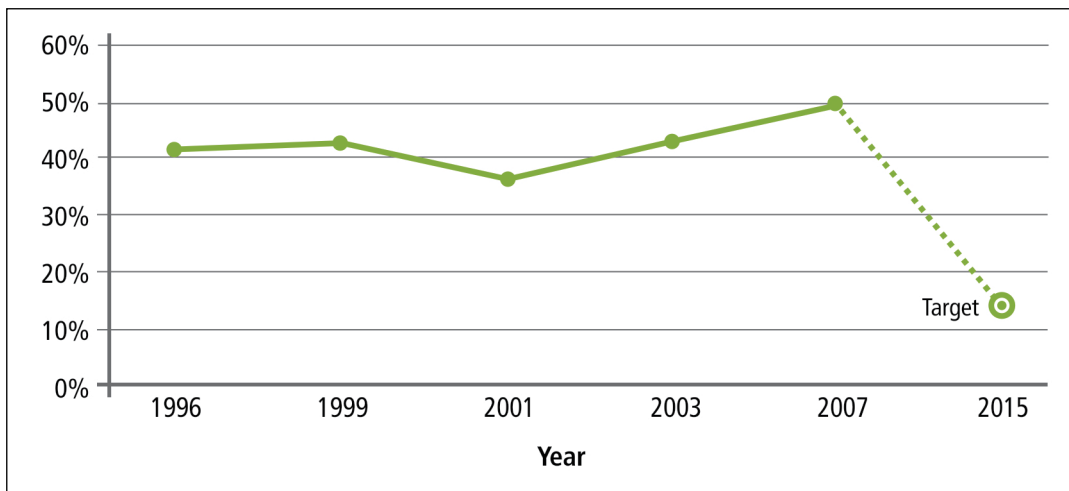
### 3.3.2 Poverty incidence

Poverty incidence (using national poverty lines) declined from 50.4% in 2007 to 41.8% in 2014 (**Table 3.7**). However, more actions and resources are needed to reach the poverty reduction target. The poverty headcount ratio (at national poverty lines) was 28.3% of urban population, and 47.1% of rural population in 2014 (World Bank 2018).

**Table 3.7:** Measures of Poverty.

Year	Headcount (incidence)		Poverty Gaps (depth)		Squared Poverty Gap (severity)	
	2007	2014	2007	2014	2007	2014
Year	50.4	41.8	13.8	10.4	5.1	3.7

**Figure 3.5:** Percentage of the Population below the National Poverty Line (Established 2004).



Source: [www.undg.org/archive\\_docs/5382-Timor-Leste\\_MDG\\_Report\\_2004\\_-\\_Timor-Leste\\_MDG\\_Report.pdf](http://www.undg.org/archive_docs/5382-Timor-Leste_MDG_Report_2004_-_Timor-Leste_MDG_Report.pdf).

Recognising the need for poverty reduction, the East Timor Transitional Administration (ETTA) partnered with four donors – the Asian Development Bank, the World Bank, the United Nations Development Program, and the Japan International Cooperation Agency to address this issue.

### 3.3.3 Literacy and Education

Education is important for many reasons, including economic empowerment, and better health and well-being it promotes. Literacy and educational attainment have improved substantially in Timor-Leste in recent years.

At the end of the Portuguese rule, 95% of the population was illiterate (Note: just 5% literacy). For age 15 years and over, those who can read and write were 37.6% of the total population in 2001. It increased to 58.3% in 2010.

**Table 3.8** shows the schooling status in Timor-Leste in 2015. Only 40.6% are at school, while 29% left school, and 28.9% has never attended school. Children entering school today are expected to complete almost 13 years of education. However, the mean years of schooling among young men and women (4.4 years) need to be raised. With more and better education, young people entering the labor force would become well positioned for manufacturing, services, and knowledge-based industries that provide higher wages.

**Table 3.8:** Schooling Status in Timor-Leste, 2015.

Sex	Total	Schooling Status in 2015							
		At school	%	Left school	%	Never attended	%	Not Stated	%
	<b>1,089,672</b>	<b>442,290</b>	<b>40.6</b>	<b>316,351</b>	<b>29.0</b>	<b>315,418</b>	<b>28.9</b>	<b>15,613</b>	<b>1.4</b>
<b>Male</b>	552,253	230,468	41.7	169,936	30.8	144,071	26.1	7,778	1.4
<b>Female</b>	537,419	211,822	39.4	146,415	27.2	171,347	31.9	7,835	1.5

Source: Census, 2015.

### 3.3.4 Health

Health is at the very core of much of the world's poverty and suffering. Deadly diseases are devastating in many areas. With improving health and economic situation in Timor-Leste, life expectancy is rising (**Table 3.9**).

Health indicators:

- Health expenditures: 1.5% of GDP (2014)
- Life expectancy at birth was 64.16 years in 2005, and increased to 68.53 years in 2015 and 69.3 years in 2018.
- Life expectancy at birth in 2015 was 66.78 years for male, and 70.36 years for female
- Fertility rate is at six births per woman.

**Table 3.9:** Life Expectancy at Birth.

Years	Life expectancy - Female	Life expectancy - Male	Life expectancy
2015	70.36	66.78	68.53
2014	70.06	66.55	68.26
2013	69.77	66.36	68.02
2012	69.47	66.21	67.80
2011	69.16	66.07	67.58
2010	68.80	65.88	67.31
2009	68.37	65.59	66.95
2008	67.83	65.15	66.46
2007	67.18	64.53	65.82
2006	66.42	63.74	65.05
2005	65.56	62.82	64.16

Source: Census, 2015.

Prevalence of waterborne diseases is related to the lack of access to water, sanitation, hygiene, and wastewater management facilities. In general, there are morbidity and mortality cases of waterborne diseases: diarrheal diseases, malaria, skin diseases. There are also cases of esophagus/cough diseases, kidney diseases, and cervix diseases. Around 16% of children under five years old suffered from diarrheal diseases (World Bank 2016). Diseases related to air quality like tuberculosis, pneumonia, lung disease and asthma are also among the top ten causes of death.

**Table 3.10:** Top 10 Diseases and Causes of Death in Timor-Leste Per 100,000 Population.

No.	Diseases	Rate	World Rank
1	Coronary Heart Disease	131.17	47
2	Tuberculosis	125.84	3
3	Stroke	111.52	67
4	Influenza and Pneumonia	72.81	53
5	Lung Cancers	30.87	20
6	Road Traffic Accidents	26.62	28
7	Diabetes Mellitus	26.20	89
8	Lung Disease	25.27	49
9	Breast Cancer	19.47	56
10	Asthma	19.24	12

Source: WHO, 2014.

### 3.3.5 Access to Water Supply and Sanitation

There is an increase in the percentage of the population with access to improved water sources. In 2002, only 50.62% of the population had access to least basic water services, but this increased to 74.53% of the population in 2015. By 2017, 98.32% of the urban population, and 69.69% of the rural population had access to basic water services. There are no data yet on number of people using safely managed drinking water services. The different types of drinking water sources are shown in **Table 3.11**. Public pipe or taps are used by the majority of the households (84%).

**Table 3.11:** Source of Drinking Water for Private Households, Timor-Leste.

Private Household	Types of source of drinking water										
	Piped or Pumped Indoors	Piped or Pumped Outdoors	Public Pipe/ Tap	Tubewell/ Borehole	Protected Well or Spring	Rainwater collection	Bottle water	Well or Spring (Not Protected)	Water vendors/ tank	River, Lake, Stream or Irrigation channel	Other
204,597	10,244	25,188	84,366	13,529	15,333	562	3,662	18,133	1,937	28,991	2,652

Source: Census 2015.

Urban population had increased access to basic sanitation facilities, from 61.73% in 2002 to 74.34% in 2015 and 75.93% in 2017. Similarly, access to basic sanitation facilities by rural population had increased from 28.99% in 2002 to 41.69% in 2015, and 43.82% in 2017. (World Bank, 2018). Data on number of people using safely managed sanitation services are not yet available. Only Dili has a wastewater management system.

## PART 2

# HARNESSING THE OCEANS: BENEFITS AND IMPACTS

# 4 Ocean economy

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

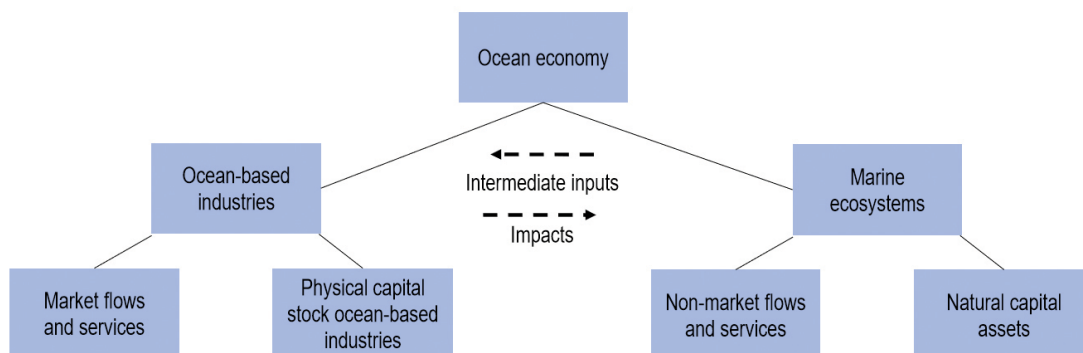
The entire ocean economy is measured as the sum of: (a) the economic activities with dependence on the ocean and coastal and marine resources, and (b) natural assets, goods and services of marine ecosystems upon which these industries depend on, and people rely on for food, income, livelihood, recreation, shoreline protection, etc. (**Figure 4.1**)

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

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

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

**Figure 4.1:** Ocean Economy.



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

## 4.1 Ocean Industry: Contribution to Economy, Income and Jobs

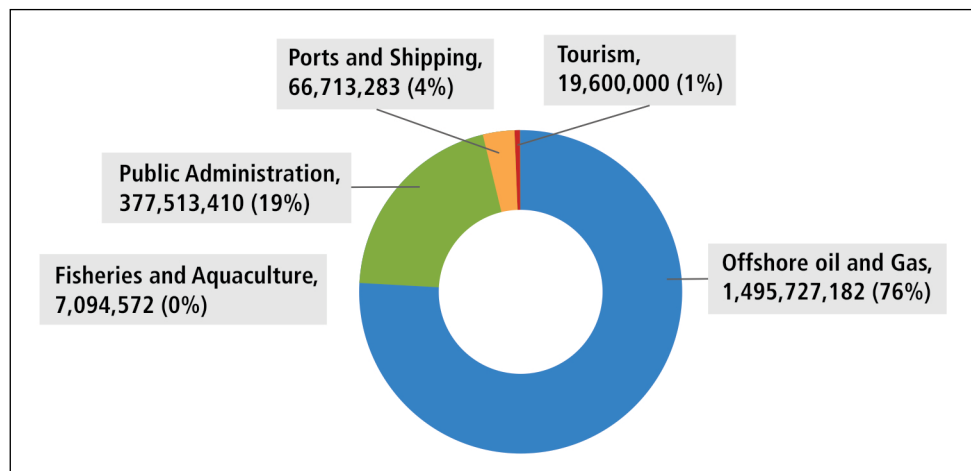
The key ocean economic activities are: (a) offshore oil and gas; (b) port and shipping; (c) coastal and marine tourism; and (d) fisheries and aquaculture. The ocean industry contributes 87% of the country's GDP (**Table 4.1** and **Figure 4.2**). This is just a preliminary estimate. More work needs to be done to develop the ocean accounts of Timor-Leste.

**Table 4.1:** 2015 GDP and Ocean Industry (Gross value added, US\$, in constant prices).

Economic Activities	Gross Value Added in 2015*	GVA of Ocean-based Industries
<b>Agriculture, hunting, forestry, fishing (ISIC A-B)</b>	122,383,113.76	
Fisheries and aquaculture		7,094,571.89
<b>Mining, Manufacturing Utilities (ISIC C-E)</b>	1,564,450,688.71	
Offshore oil and gas		1,495,727,182.16
<b>Manufacturing (ISIC D)</b>	6,200,036.47	
<b>Costruction (ISIC F)</b>	152,057,309.68	
<b>Wholesale, retail trade, restaurants and hotels</b>	116,300,477.11	
Tourism		19,600,000.00
<b>Transport, storage and communication (ISIC I)</b>	66,713,283.19	
Shipping and ports		66,713,283.19
<b>Other activities (ISIC J-P)</b>	245,173,596.89	
Government		377,513,410.15
<b>TOTAL</b>	<b>2,273,279,405.81</b>	<b>1,966,648,447.38</b>
		<b>=87%</b>

\* Source: <http://data.un.org>.

**Figure 4.2:** Gross Value Added of Ocean-based Economic Activities in 2015. (in US\$)



## Fisheries and aquaculture

Gross value added (GVA, US\$, 2015, in constant prices): US\$7,094,571.89

Number of fisherfolk: 4,723 (in 2015)

Policy and law:

- Law No. 12/2004 “Fishing-Related Offences”
- Decree-Law No. 6/2004 of 21 April 2004: General Bases of the Legal Regime for the Management and Regulation of Fisheries and Aquaculture
- Decree-Law No. 4/2005 of 20 July 2005: Amending Decree-Law No. 6/2004 of 21 April 2004
- Government Decree No. 5/2004: General Regulation on Fishing
- Decree-Law No. 21/2008 (25 June 2008): Implementation of Satellite System for Monitoring Fishing Vessels

National action plan:

- A policy and strategy for development of fisheries in Timor-Leste (draft is waiting to be represented to the Parliament)
- Aquaculture: Strategy for aquaculture

## Marine Tourism

GVA (US\$, 2015, in constant prices): US\$19.6 million

Marine tourism is 56% of tourism.

Employment: 43,000 people.

Policy and law:

- Timor-Leste National Tourism Policy: Growing Tourism to 2030 – Enhancing a National Identity (2017)
- Respect to all law/decreed law, and traditional law (Tara bandu) related to other sectors (environment, agriculture and fisheries, land and property, etc.)

National action plan:

- National action plan: Timor-Leste Strategic Development Plan for Tourism 2011–2030

## Ports and shipping

GVA (US\$, 2015, in constant prices): US\$66,731,283.19 or 3% contribution to GDP

Employment: 50,000 people

Policy and law: Investments in new port under public-private partnership (PPP) arrangement; Five IMO Conventions to be ratified, with corresponding national laws to be adopted.



**Government/Public sector**

GVA (US\$, 2015, in constant prices): 377,513,410.15

**Oil and gas industries: US\$1.496 billion**

GVA (US\$, 2015, in constant prices): 1,495,727,182.16

The economy is largely dependent on oil and gas revenue. Around 76% of the total gross value added of the ocean economy comes from the offshore oil and gas. The accumulated wealth in the Petroleum Fund of Timor-Leste—a sovereign wealth fund created by the government from income produced from petroleum and gas extraction—amounted to US\$16.2 billion at the end of 2015, approximately six times the country's GDP. Only 10%–12% of domestic revenue is derived from non-oil sources (IMF 2016).

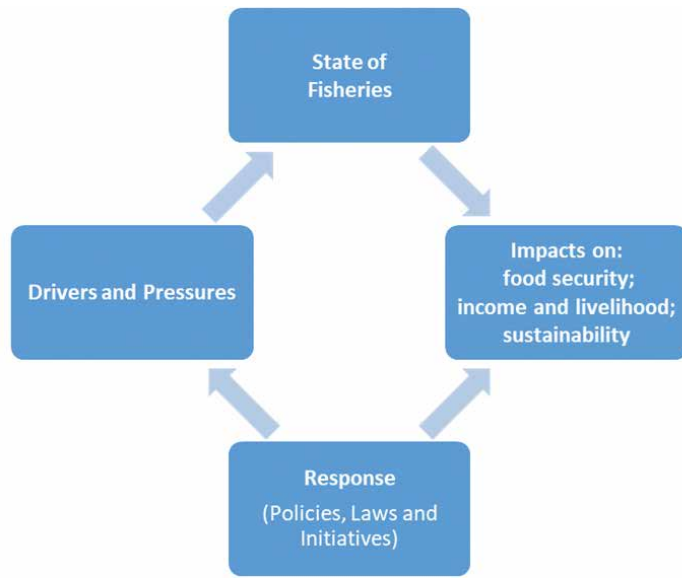
## 4.2 Valuation of Ecosystem Services

Using studies and benefits transfer method, the estimated value of the coastal and marine ecosystems in Timor-Leste is US\$5.25 billion (**Table 4.2**).

**Table 4.2:** Area and Value of Coastal and Marine Ecosystems.

	Area (km <sup>2</sup> )	Valuation (US\$ million)	Status
Mangroves	2.90	116.96	Decreasing
Seagrass	23.78	959.05	increasing
Coral reefs (hard)	59.08	2,382.71	increasing
Coral reefs (soft)	41.22	1,662.41	increasing
Tidal swamps	3.28	132.28	remained the same
<b>Total</b>		<b>5,253.41</b>	

# 5 Fisheries and Food Security from Coastal and Marine Resources

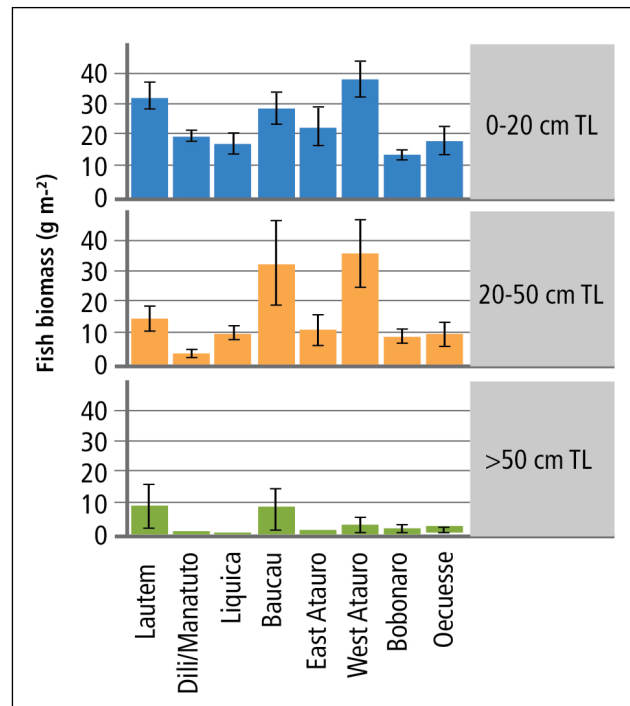


## 5.1 Fishery Resources and Stock Assessment

There are 739 species (234 genera, 61 families) of reef fish that were recorded. The coral Fish Diversity Index are expected to predict 921 species. The site diversity ranged from 64 to 293 species/site, with an average of 210 species/site, which is extremely high. Approximately 70% of sites had >200 species recorded.

Several new reef fish species were collected, including *Chrysiptera caesifrons* and *Eviota santanai*. Sites with the highest fish diversity included Atauro Island with barrier reefs (293), Loikere (271), Ete Asa Lepek (259), west Jaco Island (249), and Tenu in Lautem (243).

Fish biomass per size class were also monitored and identified particularly on the northern coast (**Figure 5.1**).

**Figure 5.1:** Mean Fish Biomass per Size Class.

Source: Fish monitoring brief: Timor-Leste North Coast, June 2013.

## 5.2 Fisheries

### 5.2.1 Volume of Fish Catch

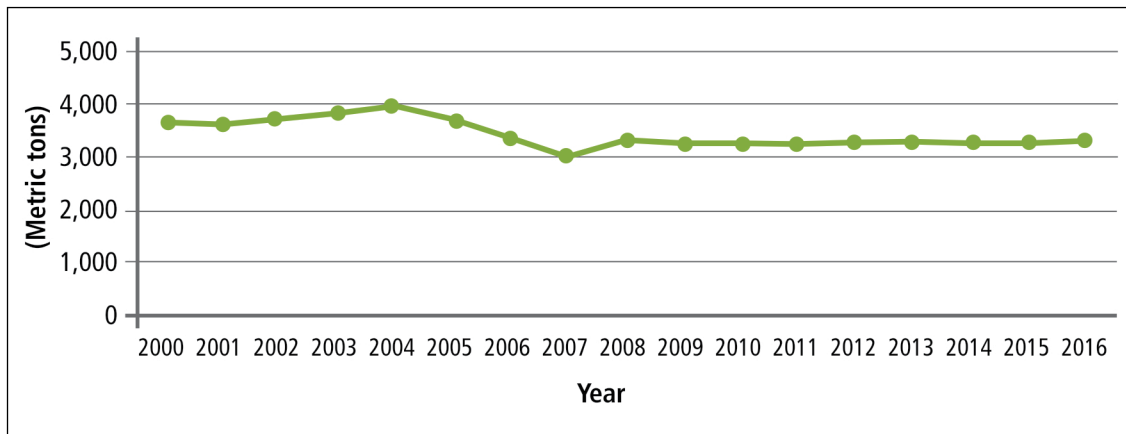
From 2000 to 2016, the annual average growth rate of capture fisheries production was -0.8% (World Bank, 2017). As can be gleaned from **Table 5.1** and **Figure 5.2**, production declined from 2004 to 2007, and has not changed from 2009 to 2016 at 3,200 tonnes.

**Table 5.1:** Capture Fisheries Production, 2000-2016.

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008
TONNES	3,621	3,561	3,720	3,850	4,000	3,650	3,300	2,911	3,243
YEAR	2009	2010	2011	2012	2013	2014	2015	2016	
TONNES	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	

Source: World Bank, 2017.

**Figure 5.2:** Capture Fisheries Production, 2000-2016.

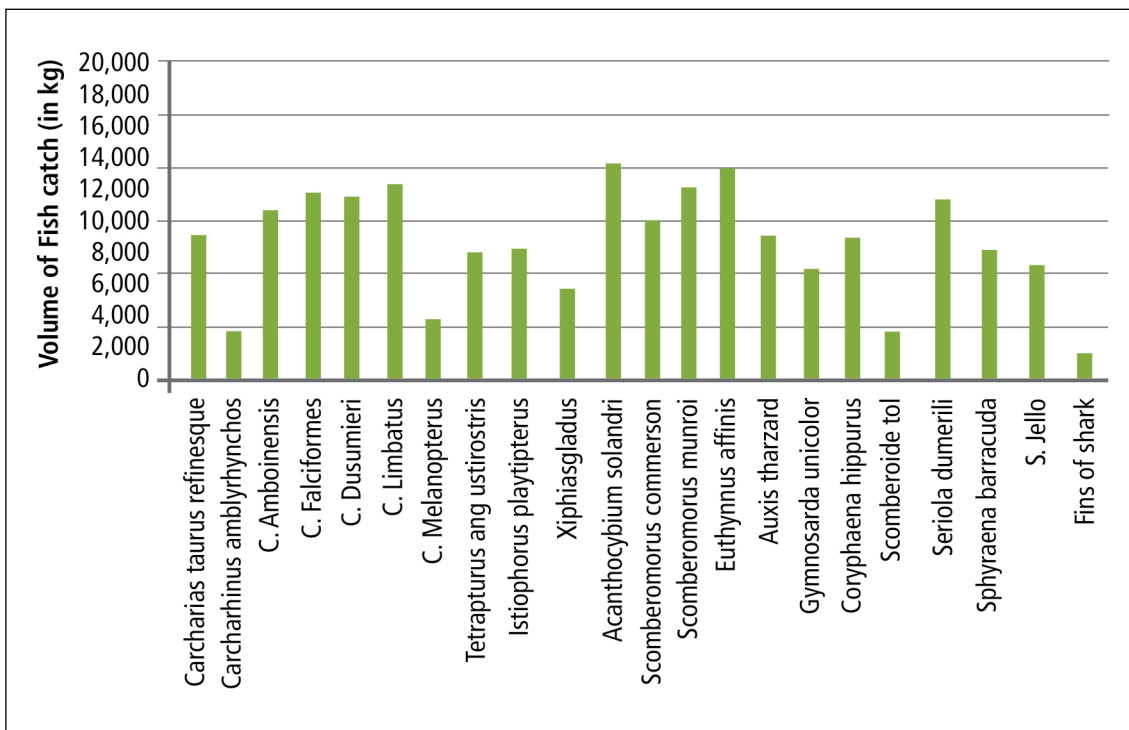


Source: World Bank, 2018.

To identify the species typically caught, the fish catch of three boats of Best Sea Food firm for two months in 2017 was examined. The volume of fish catch for each species is shown in **Figure 5.3**. The total volume was 259.29 tonnes, plus 2.26 tonnes of fins of sharks. (This is an issue that needs to be examined and addressed more effectively.) Total export volume was 261.55 tonnes.

Total value of fish caught in August until September 2017 was US\$1,522,440. There are groupers, shrimps, crabs, tuna, etc., which are higher-valued species.

**Figure 5.3:** Volume of Fish Catch, by species.



Source: MAF, 2017.

## 5.2.2 Major Species Caught

The major species of fish found or caught in Timor-Leste are shown in **Tables 5.2** and **5.3**. Approximately 90% of the fish caught is low-valued type of fish.

**Table 5.2:** Composition of 10 Fish Species with Abundance and Proportion of Abundance in Com and Along the Lautem Coasts.

Species	Category of Fishes	Abundance Individual (7.354)	Proportion of Abundance (%)
<i>Pomacentrus lepidogenys</i>	Major	650	8
<i>Chromis. viridis</i>	Major	600	8
<i>Pseudanthias hutchtii</i>	Major	400	6
<i>Pterocaesio tile</i>	Target	372	5
<i>Odonus niger</i>	Major	342	5
<i>Chromis margaritifer</i>	Major	300	4
<i>Lepidozygus tapeinosoma</i>	Major	290	4
<i>Pseudanthias squamipinni</i>	Major	250	3
<i>Lutjanus gibbu s</i>	Target	180	3
<i>Chromis ternatensis</i>	Major	160	2

Source: MAF.

**Table 5.3:** Major Species of Fish Caught.

English name	Volume
Sardine	92496.03
Garfishes	83997.85
Frigate Mackerels	39911.00
Flying Fish	29847.63
Mackerel Scads	5999.93
Mackerel Tuna	4961.29
Bullet Tuna	2981.11
Long Tom	2627.42
Skipjack Tuna	1966.73
Spine foots (Rabbit fishes)	1436.83
Dark-Banded Fusilier	880.52
Indo-Pacific Sailfish	842.77
Longfin Emperor	765.00
Barracudas	636.79
Rainbow Runner	630.56
Thumbprint Emperor	570.00
Hump-Headed Parrotfish	403.20
Giant Trevally	363.56
Gold spotted Trevally	340.65

90%

Source: WorldFish, 2016.

The research by ATSEA (2011) identified the species and catch composition of the bottom waters as observed in Suai district. Trawling was the method applied with a towing time of 30 minutes (min) at depths of 23 m to 25 m. The geographical position is between 9°25.840' and 9°25.716'S and 125°09.540' and 125°11.527'E.

Total catch was 42.84 kg/30 min (or 85.68 kg/day). Catch rate composition (kg/day) consists of demersal fishes of 61.4 kg (71.7% from total catch), followed by 20.8 kg (23.3%) sea urchin, 2.6 kg (3.0%) penaeid shrimp, and 0.8 kg (1.0%) other crustacea (non-edible crab).

The ten dominant fish families caught are sweet lips, with the main species being *Pomadasys argyreus* and *P. kaakan*, followed by threadfin breams of the family Nemipteridae, and fish of the family Triacanthidae.

- Of the Nemipteridae family, the dominant species are *Nemiperus tolu* and *N. japonicus*.
- The fourth dominant fish group is ponyfish of the Leiognathidae family, followed by the big-eye of the Priacanthidae family and polka dot fish of Apogonidae family. The ponyfish are dominated by the species *Leiognathus daura*, the big eye group by *Priacanthustayenus*, and the polka dot fish group by *Apogon septemstriatus* and *A. poecilotherus*.
- The next dominant fish group are the Sciaenidae family (the bearded croakers), the Mullidae family, the Platycephalidae family, and lizard fishes of the family Harpadontidae. The Sciaenidae were dominated by the species *Penahia macrocephalus*, *Upeneus vittatus*, *U. sulphureus*, and *Coeciellacrocodila*. The lizard fish is dominated by the species *Saurida micropectoralis* and *S. undusquamis*.

During the trawling, some juvenile of red snappers (*Lutjanus malabaricus*) of 10 cm long were captured together with the small pelagic anchovy *Stolephorus indicus*.

Non-fish biota found included the sea urchin. Penaeid shrimps were only caught at a rate of 2.6 kg/hr, dominated by the endeavor shrimp (*Metapenaeus ensis*) and *Trachypenaeus fulvus*. The most captured crustacea is the non-edible crab *Charybdis spp.*

### 5.2.3 Fishing Centers and Number of Fisherfolks

Based on the FAO reported by D. Baticados (2005) in Socio-economic Issues in Fishing Communities and Socio-Economic Indicator to Monitor and Evaluate Sustainable Fisheries Development in East Timor, there are 151 fishing centers and 5,415 fisherfolks.

The 2015 report from the Government of Timor-Leste stated that there were 62 fishing centers, 4,723 fisherfolks, and 3,009 fishing boats. The number of fishing centers and fisherfolk has decreased since the 2005 study. The detailed data of fisherfolk by municipality is shown in **Table 5.4**. The data does not include six fishing centers: We Katar in Ainaro; Georhata and Cusobauk in Liquiça; Gadi and Tokoderek in Manatuto; and Betano in Manufahi.

**Figure 5.4** illustrates boat ownership as confirmed by FAO boat census and registration. Atauro Island and Bobonaro have the highest ownership of boats. Approximately 95% of the boats are small-scale. Around 36.3% of fisherfolk do not have their own fishing boats.

Around 76% of the fishing boats are without engines. There are three types of engines used in the fishing boats (**Table 5.4**).

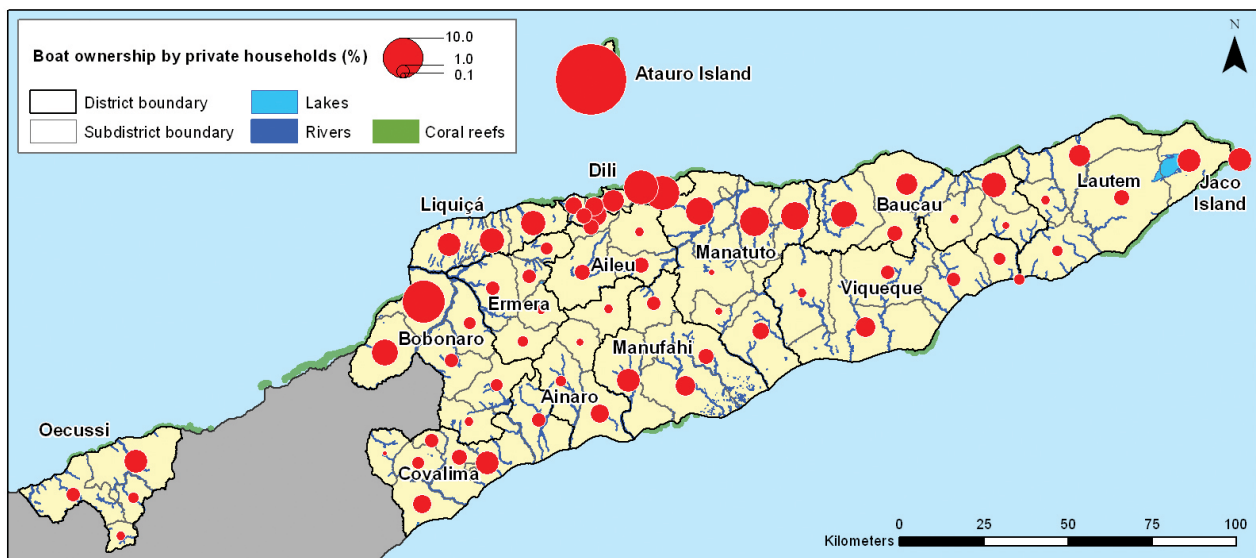
Average weekly income per fisherfolks as observed is \$22.89.

**Table 5.4:** Types of Boats and Engines Owned by Fishermen in Different Districts.

Municipality	Fisherfolk	Boats	Engine			Fishing Gear	Fishing Centers
			Djonson	Long Tail	Yamaha	Long Line	
Viqueque	266	167	9	12	4	3	6
Lautem	429	168	53	19	11	55	18
Manatuto	253	152	30	23	8	112	14
Liquiça	319	409	39	17	12	98	23
Bobonaro	162	409	39	17	12	98	11
Covalima	275	158	6	11	3	20	14
Manufahi	153	150	1	12	0	11	6
Ainaro	25	13	9	12	4	3	4
Baucau	271	256	29	73	0	64	14
Dili (Atauro)	633	326	99	63	13	129	34
Oe-Cusse	110	102	20	111	3	27	18
<b>Total</b>	<b>2896</b>	<b>2310</b>	<b>334</b>	<b>370</b>	<b>70</b>	<b>620</b>	<b>162</b>

Source: DIGPRP, 2015.

**Figure 5.3:** Boat Ownership.



Source: WorldFish, 2016.





There is increasing promotion of aquaculture, which is attracting many people in rural areas to this economic activity, even using only simple technology. They have a good interest in tilapia, milkfish, and golden fish farming in the areas of Same, Ermera, Aileu, Baucau, and Lospalos municipalities.

**Table 5.6** shows the aquaculture production, and the species that are raised in Dili.

**Table 5.6:** Aquaculture Production, by Species, in Dili Municipality.

No.	Species	Organization/ Person	Area (ha)	Period	Quantity (Kg)	Value of production (US\$)
1	<b>Crabs</b> ( <i>Schylla serata</i> )	ACDI/VOCA		April 2013 – July 2014	26.145.625 Zoea*	
				July 2014	32.998 instar (0.5cm–0.7 cm) = 16,499 kg	1649.9
				Aug-Sept 2014	12.000 = 6 kg	600
					17.243 (1 cm –2 cm)	4310.75
2	<b>Tilapia</b>		8 ha	2015	104.000 kg	416,000
3	<b>Catfish</b>	Community	2 ha	2015	32.500 kg	260,000
4	<b>Milkfish</b>	Community	2.5 ha	2014-2016	2,000	10,000
5	<b>Grouper</b>	Kadiak Timor				3,000 Fingerling: \$2/fish
6	<b>Koku</b>	Kadiak Timor				
7	<b>Snapper</b>	Kadiak Timor				0.25 – \$1/fish
8	<b>Kitang</b>	Kadiak Timor				
9	<b>Bawal putih</b>	Kadiak Timor				
10	<b>Gracilaria</b>	Kadiak Timor				
11	<b>Boek</b>		(loes)		?	?
12	<b>Sea cucumber</b>	Community			500 kg	

Note: \* a larval form of certain crustaceans (e.g., crabs)

Source: MAF (2015) and Primary data (2017).

**Table 5.7** shows the aquaculture production of seaweeds and other aquatic plants, expressed in tonnes and on a wet-weight basis. From 2009 to 2016, Timor-Leste produced 1,500 tonnes of seaweeds per year, with an annual value of US\$113,000 (FAO 2018).

**Table 5.7:** Aquaculture production of aquatic plants in 2007-2013.

Year	2007	2008	2009	2010	2011	2012	2013	2011	2012	2013
<b>Quantity (Tonnes)</b>	370	1,000	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
<b>Value (US\$ '000)</b>	28	75	113	113	113	113	113	113	113	113

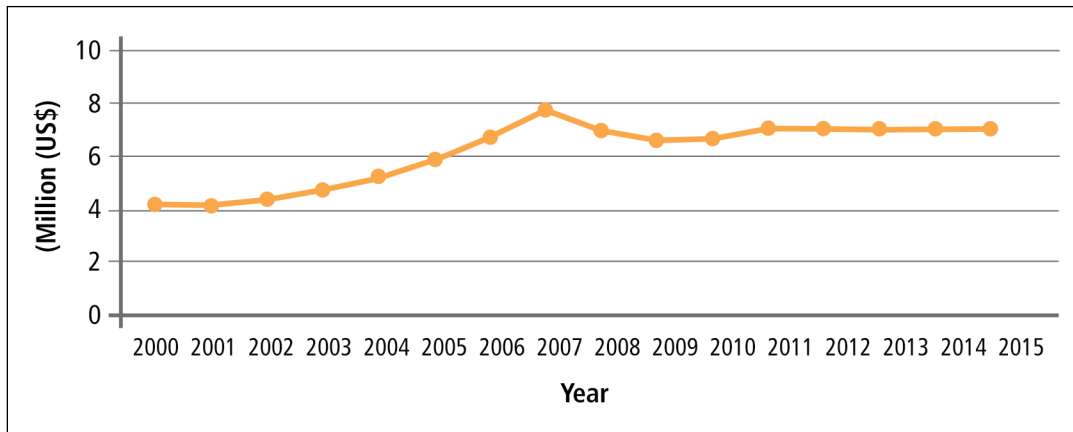
Note: Quantity (in tonnes); Value (in US\$ 1000)

Source: FAO. 2018. FAO yearbook. Fishery and Aquaculture Statistics 2016. Rome. 104 p.

## 5.4 Gross Value Added of Fisheries and Aquaculture

Gross value added (GVA) of fisheries, aquaculture and other fish and aquatic products in 2015 is US\$0.007 billion (DNSS of MoF Timor-Leste, 2017). **Figure 5.6** shows the trend of the GVA of fisheries sector from 2000 to 2015. Currently, the fisheries sector contributes a small share of Timor-Leste's GDP.

**Figure 5.6:** Gross Value Added of Fisheries.



Source: MoF 2017.

## 5.5 Contribution to Income and Livelihood

Estimates of the number of artisanal fishers in Timor-Leste have fluctuated widely. A 2002 study estimated 20,000 fishers, whereas recent surveys calculated 5,415 fishers nationwide. However, it is possible that including the number of part-time subsistence fishers would increase the latter figure. With about 30% of the Timor-Leste population estimated to be experiencing hunger and nearly half living in poverty, it is likely that poverty and hunger exist at relatively high rates in fishing communities. Despite the lack of commercial fisheries and the prohibitive prices of seafood in local markets, fisheries probably play a critical role in food security for subsistence households. Women and children collect juvenile fishes, crabs, mollusks, and sea urchins through shoreline activities known as "meti" or use of rotenone-based pesticides derived from derris root.

Socioeconomic data on the contribution of coral reefs and fisheries to the livelihoods and food security are sparse. Fishing and other marine activities were common from the earliest human settlements in Timor-Leste. Now, except for Dili, few urban settlements are on the coast. Despite its long coastline and apparent abundant marine resources, the fisheries sector is still underdeveloped. Timor-Leste has no commercial fisheries, although a few semi-industrial licenses have been issued. In 2010, agriculture (including fisheries) contributed up to 94% of the income of communities dominated by subsistence farming systems (i.e., up to 85% of the total population). However,

with the current growth rates of 3%-4% per annum, the population (including subsistence fishers) will grow significantly, thus resulting in more pressure on the country's natural resources. Catch from artisanal fishers is usually sold in roadside markets at an average price of US\$5 per kg (MAF, 2012). The species of fish consumed and the corresponding price as shown in **Table 5.8** indicate the availability and affordability of fish in Timor-Leste. The average price of fish is quite high.

**Table 5.8:** Top Species of Fish Consumed in Timor-Leste.

No.	Species	Average Price/Kg (US\$)
1	Saba mackerel	3.50
	Sardine	2.00
2	Garfishes	2.00
3	Emperor	5.00
4	Snapper	5.00
5	Tuna	5.00
6	Grouper	10.00
7	Travelly	10.00
8	Milkfish	4.50
9	Sea perch	5.00
10	Casio	4.50
11	Tilapia	1.50

Source: MAF.

## 5.6 Demand for Fish and Seafood

Fish consumption in Timor-Leste is relatively low, at only 6.1 kg per person per year (Food and Agriculture Organization (FAO), 2012). This is way below the 27 kg (edible portion) per person per year target of the World Health Organization (WHO) and FAO. The factors that contribute to the lower demand and consumption of fish include high prices of fish, and availability of only lower-valued species. It is also imperative that fishermen be equipped with appropriate boats, technology and skills so that they can catch more fish without harming the marine and coastal habitats and ecosystems.

## 5.7 Exports of Fish and Seafood

The volume and value of fish and seafood exports of Timor-Leste are shown in **Table 5.9**.

Seaweed culture in Atauro Island is a major income-generating activity, bringing in a total revenue of about US\$19,130 from seaweed export in 2009 (MAF, 2012).

**Table 5.9:** Volume and Value of Fish Species Caught and Exported, 2009-2016.

Exports	Quantity of Export in Fiscal Year (Kg)								Total (Kg)	Value (US\$)
	2009	2010	2011	2012	2013	2014	2015	2016		
<b>FISHES</b>										
Bigeye Tuna	5,339						10,000		15,339	69,025.50
Yellowfin Tuna	1,636								1,636	7,362
Albacore	2,991								2,991	13,459.50
Swordfish	3,862								3,862	17,379
Peixe Salgado (Black marlin)	363						300		663	2,983.50
Sailfish	25								25	112.5
Ikan Tuna (Sidat)/eel	15								15	67.50
Mangrove Jack (Reddish form)					1,000				1,000	4,500
Yellow and Blueblack Fusilier					1,000				1,000	4,500
Tubarao Salgado (Salted Fish)							20,000		20,000	90,000
Shark Fins							252		252	1,134
Mackerel Tuna							77		77	346.50
Skipjack Tuna							275		275	1,237.50
Peixes Arraias Congelados (Rhynchobatidae)								77,098	77,098	346,941
Peixes Arraias Congelados (Squatidae)								23,721	23,721	106,744.50
Peixes Arraias Congelados (Urolophidae)								25,932	25,932	116,694
Peixes Arraias Congelados (Dasyatidae)								27,663	27,663	124,483.50
Peixes Lutjanus Congelados (Lutjanidae)								39,775	39,995	178,987.50
Peixes Sardas Congelados (Carangidae)								35,876	35,876	161,442
Peixes Garoupas Congelados (Serranidae)								37,646	37,646	169,407
Peixes Cirurgiao Congelados (Nemipteridae)								32,573	32,573	146,578.50
Peixes Pargos Emperial Congelados (Sillaginidae)								21,384	21,384	96,228
Peixes Pargos de Coral congelados (Priacanthidae)								24,451	24,451	110,029.50
Peixes Emperadores Congelados (Lethrinidae)								25,565	25,565	115,042.50
<b>SUBTOTAL</b>	<b>14,231</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2,000</b>	<b>0</b>	<b>30,904</b>	<b>370,684</b>	<b>371,684</b>	<b>1,884,685.50</b>

**Table 5.9:** Volume and Value of Fish Species Caught and Exported, 2009-2016. (cont.)

Exports	Quantity of Export in Fiscal Year (Kg)								Total (Kg)	Value (US\$)
	2009	2010	2011	2012	2013	2014	2015	2016		
<b>MOLLUSCA</b>										
Sand Sea Cucumber			1,002	1,075					2,077	16,616
White Teatfish (Holothuria Fuscogiva)				200					200	1,600
Black Teatfish (Holothuria whitemaei)				50					50	400
Prickly Redfish (Thelonata Ananas)				60					60	480
Curry Fish (Stichopus Herrmanni)				1,175					1,175	3,525
Tiger Fish (Bohadschia Argus)				150					150	450
Surf Fish (Actinopyga Mauratania)				150					150	450
Stone fish (Antinopyga Lacanora)				125					125	375
Curry Pilla (Stichopus Variegates)				375					375	1,125
Lolilo (Holothuria Atra)				1,625					1,625	4,875
Amba Fish (Thelenota Anax)				220					220	660
Pink Fish (Holothuria Edulis)				975					975	2,925
Black Fish (Actinopyga Milianas)				25					25	75
Snake Fish (Holothuria Coluber)				175					175	525
Brown Sandfish (Bohadschia Vitienis)				80					80	240
Shalk Fish (Bohadschia Similis)				500					500	1,500
Flower Fish (Pearsonothuria Graeffei)				175					175	525
Elephant Trunk Fish (Holothuria Fuscipunctata)				50					50	150
<b>SUBTOTAL</b>	<b>0</b>	<b>0</b>	<b>1,002</b>	<b>7,185</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>8,187</b>	<b>36,496</b>
<b>CRUSTACEA</b>										
Camarces/Shrimp	2,010								2,010	20,100
Concha do Mar/Sipu		400							400	2,400
Antecardina sp.	6,000								6,000	36,000
Sipu			3,851						3,851	23,106
Conchas de Bivalves	16		500	8					524	3,144
Corais			1						1	6
Concha do Mar (watu lola)/ Sipu caussan			2,500	5,000		3,200			10,700	64,200
Concha do Mar (watulaga)/ Sipu Marmoratus				5,000		246			5,246	31,476
Conchas						6			6	36
Lagosta Congelados (palinuridae)								1,040	1,040	6,240
<b>SUBTOTAL</b>	<b>8,026</b>	<b>400</b>	<b>6,852</b>	<b>10,008</b>	<b>6</b>	<b>3,446</b>	<b>0</b>	<b>1,040</b>	<b>29,778</b>	<b>186,708</b>

Source: MAF.

**Table 5.10:** License, Export and Inspection of Fish Products and Scaling-up of Aquaculture.

No.	Name of Project / Program	Summary of result achieved	Local operation (national and municipality)	Number of Beneficiaries (M/F)	Funding (US\$)	Photo relevant (yes / no)	Remarks
<b>License, Export and Inspection in 2015</b>							
1.	License for commercial fishing in 2015.	1. License for commercial and non-commercial fishing (non-commercial boat, artisanal, and semi-industry, Industry - Non-commercial boat for research, recreational and sports 2. Export 3. Inspection	Village, sub-districts and Municipality	21	8,030	No	National income (GDP)
	Tax for exports in 2015	Fish products		44	1,180	No	National income
	Tax for Inspection 2015	Quality of the fish products			75	No	National income
<b>License, Export and Inspection in 2016</b>							
2.	License for commercial fishing and non-commercial fishing in 2016	1. License for commercial and non-commercial fishing (non-commercial boat, artisanal, and semi-industry, Industry - Non-commercial boat for research, recreational and sports 2. Export 3. Inspection		26	343,975	No	National income
	Tax for exports in 2016	Fish products		3	80	No	
	Tax for Inspection in 2016	Quality of the fish products		5	61,000	No	

Table 5.10: License, Export and Inspection of Fish Products and Scaling-up of Aquaculture. (cont.)

No.	Name of Project / Program	Summary of result achieved	Local operation (national and municipality)	Number of Beneficiaries (M/F)	Funding (US\$)	Photo relevant (yes / no)	Remarks
<b>License, Export and Inspection in 2017</b>							
3.	License for commercial fishing and non-commercial fishing in 2017	1. License for commercial and non-commercial fishing (non-commercial boat, artisanal, and semi-industry, Industry) - Non-commercial boat for research, recreational and sports 2. Export 3. Inspection		-	-	No	National income
	Tax for Exports in 2017	Fish products		1	260	No	
	Tax for inspection in 2017	Quality of the fish products		-	-	No	
4.	Aquaculture						
	Scaling-up of Tilapia production, development of freshwater aquaculture, including marine and brackishwater ponds	<b>Many fish ponds have been established in 2016, as following:</b> - A total of 138 new ponds/units for tilapia has been developed: <ul style="list-style-type: none"> <li>• 8 units in Mausiga Village in Ainaro</li> <li>• 17 units in Gari-uai in Baucau</li> <li>• 16 units in Miligo Village in Bobonaro</li> <li>• 7 units in Laktos Village in Covalima</li> <li>• 31 units in Sare Village in Ermera</li> <li>• 10 units in Com Village in Lautem</li> <li>• 10 units in Lisadila Village in Liquiça</li> <li>• 7 units in Salau and Leohat Village in Manatuto</li> <li>• 15 units in Fatucahi Village in Manufahi</li> <li>• 17 units in Uaibobo Village in Viqueque</li> </ul> - All these ponds were launched in September 2016.	Com Village, in Lautem; Gari-uai Village in Baucau; Uaibobo Village in Viqueque; Salau and Leohat Villages in Manatuto; Mausiga Village in Ainaro; Aktos Village in Covalima; Miligo Village in Bobonaro; Sare Village in Ermera; Lisadila Village in Liquiça.	The fish farmers consist of 10 groups including 50 aqua-culturists	452,000	Yes	The first national harvest of Tilapia has been done in Sare Village on 17 March 2017

**Table 5.10:** License, Export and Inspection of Fish Products and Scaling-up of Aquaculture. (cont.)

No.	Name of Project / Program	Summary of result achieved	Local operation (national and municipality)	Number of Beneficiaries (M/F)	Funding (US\$)	Photo relevant (yes / no)	Remarks
		<p><b>In 2017, same plan has been established:</b></p> <ul style="list-style-type: none"> <li>• Develop around 64 new ponds for Tilapia farming <ul style="list-style-type: none"> <li>◦ 45 Tilapia farmers being identified and 400.000 fingerlings of Tilapia will be produced;</li> <li>◦ 389 tonnes of Tilapia targeted to be produced within 10 ha of freshwater (8 ha developed for Tilapia and 2 ha developed for Catfish;</li> </ul> </li> <li>• Provide 13 tonnes fingerlings to support 11 groups or 60 aqua-culturists;</li> <li>• Develop 1 ha pond to provide fingerlings of milkfish in brackishwater to produce approx. 3,200 kg and at the same time develop 1 ha of marine algae in order to support fingerlings of milkfish</li> </ul>	Districts of Ainaro and Viqueque	2 groups (20 aqua-culturists)	72,000	No	

Source: MAF.

## 5.8 Fish Ports

The first fish port of Timor-Leste is Com in Lautem Municipality, and another place that is available for fish landing and as a fish port is in Vemasse, Baucau. These ports are not being fully utilized due to lack of commercial fishing activities.

### 5.8.1 Volume and value of fish landed

No major fish products have been landed yet in both Com and Vemasse fish ports. Some foreign commercial fishing boats previously operated on the southern coast, but were stopped from further operations due to being found to have caught some species that are under protection.



### 5.8.2 Fishing boats (number, size, capacity, types)

There are no commercial fishing boats operating in Timor-Leste seas. There are only small canoes with traditional equipment being used by local fishermen for fishing within 1-5 miles only.

### 5.8.3 Storage Facilities

Storage facilities at each fish port are not being developed. There is only a house built for temporary staff in each fish port.

### 5.8.4 Investments in Fish Ports

The government has not allocated state budget and related investment for fish port development.

### 5.8.5 Employment

There are no people employed by the government to work in the fish ports.

## 5.9 Issues, Pressures and Threats

The following characterize the issues affecting the fisheries sector:

- Almost no data!
- Extreme bathymetry poses a big challenge for the artisanal fisheries. There is lack of access to deep sea fish.
- Around 95% of the fishing boats are very small. Given the bathymetry, only near-shore fishing can be done and only small, low-valued types of fish can be caught.
- Fish consumption is very low (6 kg/person/yr) for an island nation. Pigs seem to be more important than fish.
- 'Underperforming sector': potential is high, but not given much importance.
- Limited skills, techniques and gears, and lack of access to modern technology.
- Unpredictable rainy season (rainy season brings fish).
- Lack of price stability: due to absence of electricity to make ice for fish preservation, as well as lack of a regulated fish landing site.
- Increased pressure: lack of alternative sites or livelihoods.
- Destruction of reef habitat.
- Other issues: colonial history of larger scale, scorched earth departure.

Fishing communities were found to be experiencing hunger, with nearly half of them living in poverty. This is about 30 % of the Timor-Leste population. Despite the lack of commercial fisheries and the prohibitive prices of seafood in local markets, fisheries probably play a critical role in food security for subsistence households, especially in the coastal areas.

## 5.10 Response

### 5.10.1 Existing Laws and Regulations

Laws and regulations have been established by the government to protect and conserve the environment and natural resources. However, these laws need to be reinforced because some of these laws and regulations (**Table 5.11**) are not compatible with socio-economic conditions of the Timorese people. People are still heavily reliant on natural resources for survival, but they lack awareness on how to exploit these resources in a responsible way.

**Table 5.11:** Existing Laws and Regulations that Regulate Environment and Natural Resources.

Key legislation	Content
UNTAET Regulation No. 19/2000 on Protected Places	2,883,191,369 (in constant LCU); 2,277,716,887 (in current US\$ prices)
Government Decree No. 5/2004	General Regulation on fishing
Ministerial Diploma No. 04/115/G [M]/lv/2005 >	List of Protected Aquatic Species
Ministerial Diploma No. 06/42/GM/l/2005	Fisheries crimes
Government Resolution No. 8/2007	Establishment of the Nino Konis Santa National Park
Constitution of the Democratic Republic of Timor-Leste (2002):	Fundamental Principles, Objectives of the State; Sections 61, 96, 139 relating to environmental and natural resource protection, preservation, and sustainable use.

### 5.10.2 Programs and Actions

Aquaculture and marine-culture in Timor-Leste have been made a priority in the programs by CRS, WorldFish Centre, Coral Triangle Initiative (CTI), Arafura-Timor Seas Ecosystem Action (ATSEA) Project, Partnerships in Environmental Management for the Seas of East Asia (PEMSEA), Regional Fisheries and Livelihood Program of the Food and Agriculture Organization (FAO), HIVOS<sup>5</sup>, United Nations Agency for International Development (USAID), Australian Embassy, Republic of Korea, Kadiuk Timor, and the Office of the Minister of State, Minister Coordinating Economic Affairs (MECAE).<sup>6</sup>

<sup>5</sup> HIVOS: Dutch: *Humanistisch Instituut voor Ontwikkelingssamenwerking*, Humanist Institute for Cooperation with Developing Countries

<sup>6</sup> MECAE: *Ministrerio do Estado Coordenador Assuntus Economico*

Livelihood diversification in coastal communities is also promoted. Seaweed culture is playing an increasing role as a result of a successful project of the National Directorate for Fisheries and Aquaculture (NDFA). Other seafood products are also being tested through a US Government-funded project.

The CTI is the first program to introduce the concept of payment of ecosystem services (PES) in Timor-Leste as a means of generating incentives for the efficient management of the country's marine and coastal resources. Clear policies and strengthened institutional arrangements are needed to make PES system work.

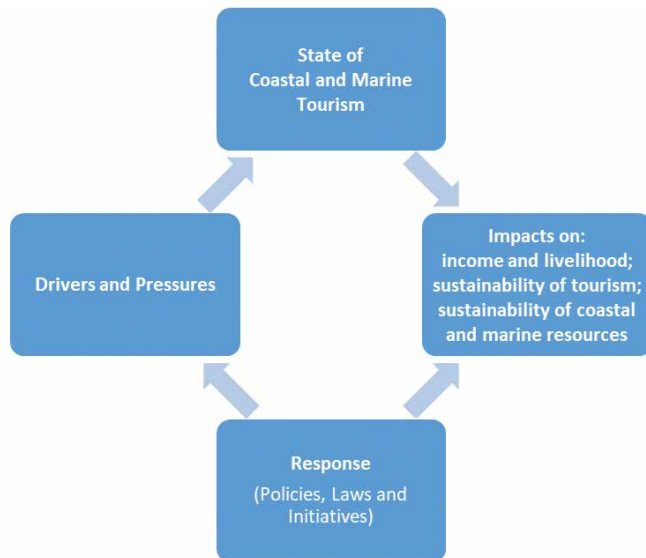
In addition, the WorldFish Centre is assisting Timor-Leste in devising a national aquaculture strategy and action plan for the development of sustainable aquaculture. The Worldfish Center's activities include:

- Long term engagement on fish and food security assured through funding from New Zealand and Norway;
- Strong policy engagement towards developing a National Fisheries Strategy;
- Increasing capacity for participatory stock assessments;
- Ongoing research on fishing aggregate devices (FADs) and sustainability;
- Extensive capacity building work with the Ministry of Agriculture and Fisheries; and
- Increasing livelihoods focus and engagement with broader food security and agricultural research in Timor-Leste.



*Photo by: WorldFish*

# 6 Tourism, Recreational, and Heritage Sites



The tourism sector is one of the key economic development areas in Timor-Leste. The tourism sector can provide opportunities for job creation, income generation, and diversification. Timor-Leste has natural beauty and heritage sites that include extensive recreational areas that attract foreign nationals to visit for relaxation and adventure. Major tourism sites in Timor-Leste have been visited not only by the locals but by foreign nationals as well.

## 6.1 National Parks, Historical and Heritage Sites, Cultural Sites in Coastal and Marine Areas

The Nino Konis Santana National Park is located in the eastern part of Timor-Leste. It is the country's first national park. Established on 3 August 2007, the national park has an area of 1,236 km<sup>2</sup> (477 square miles). It is linked to important bird areas, such as Lore, Mount Paitchau, Lake of Ira Lalaro, and Jaco Island. The park also includes 556 km<sup>2</sup> (215 square miles) within the Coral Triangle Initiative. The coral triangle underwater area, which contains the world's greatest diversity of both coral and coral reef fish. Some of the rare birds protected by this park include the critically endangered yellow-crested cockatoo, the endemic Timor green-pigeon, the endangered Timor imperial-pigeon, and the vulnerable Timor sparrow.

The Nino Konis Santana National Park is named in honor of the independence movement's national hero, Nino Konis Santana, a former commander of the Revolutionary Front for an Independent of East Timor (FRETILIN). He was born in Tutuala, a village within the borders of the national park.

Within the national park is a historical and heritage site called *Ili-kerekere*. This heritage site is part of the tourism destination, which has been visited by many people/tourists both local and international.

Another site being promoted as tourist destination, the Nature and Parks in Maliana, is among the protected areas targeted for rehabilitation and protection.

## 6.2 Tourism Indicators

### 6.2.1 Revenues

Total tax revenue from the visas issued to visitors from 2011 until 2016 amounted to US\$16,722,452.20. Based on the type of visas issued, there are US\$1,831,110 collected for class 1/tourist in 2015, with US\$7,822,530 collected for this type of visa from 2011 until 2016. Details of the visas and taxes paid by year are listed in **Table 6.1** below.



Photo by: M. Ebarvia

**Table 6.1:** Annual Tourist Visa and Taxes.

Exports	Years						TOTAL
	2010	2011	2012	2013	2014	2015	
Class 1/Tourist	1,086,270.00	1,047,060.00	1,324,380.00	1,469,580.00	1,831,110.00	2,150,400.00	7,822,530.00
Class 2/Transit	12.20	6,960.00	9,380.00	5,000.00	3,240.00	680.00	25,272.20
Class 3/ Education	900.00	3,150.00	550.00	700.00	1,950.00	1,100.00	8,350.00
Class 4/ Research	43,400.00	62,500.00	31,000.00	39,800.00	86,550.00	155,200.00	418,450.00
Work	23,450.00	25,400.00	5,450.00	664,050.00	887,100.00	762,550.00	2,368,000.00
Fix Permanent	3,750.00	1,750.00	2,300.00	900.00	10,800.00	3,850.00	23,350.00
Residence	1,640,300.00	1,129,750.00	1,379,600.00	513,400.00	777,750.00	615,700.00	6,056,500.00
UN Staff	-	-	-	-	-	-	-
Seamen Book	-	-	-	-	-	-	-
Special Stay	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-
<b>TOTAL ARRIVAL</b>	<b>1,711,812.20</b>	<b>2,276,570.00</b>	<b>2,752,660.00</b>	<b>2,693,430.00</b>	<b>3,598,500.00</b>	<b>3,689,480.00</b>	<b>16,722,452.20</b>

Source: RDTL, 2016.

### 6.2.2 Tourist Arrivals

The top ten nationalities of foreign tourists who visited Timor-Leste and were listed in the country's tourist arrivals (total, local, and foreign) are shown in **Table 6.2**.

**Table 6.2:** Origins (Countries) of Foreign Tourists.

No.	Nationality	Year						Total
		2011	2012	2013	2014	2015	2016	
1	American/USA	2,269	2,240	2,162	2,039	2,161	2,429	10,871
2	Australia	13,499	14,476	13,351	13,846	14,229	13,030	69,401
3	British/UK	1,194	1,320	1,361	1,380	1,186	743	6,441
4	China	3,549	3,010	3,704	3,821	5,321	7,569	19,405
5	Philippines	3,063	4,655	4,234	4,345	4,014	3,489	20,311
6	Indonesia	47,115	82,673	55,706	57,274	56,188	65,798	298,956
7	Japan	1,281	1,489	1,541	1,510	1,401	1,391	7,222
8	Malaysia	2,168	2,493	1,527	1,736	1,826	1,769	9,750
9	Portugal	6,148	6,016	6,186	6,674	8,603	7,821	33,627
10	Singapore	1,529	1,438	1,462	1,523	1,404	1,380	7,356
<b>TOTAL</b>		<b>81,815</b>	<b>119,810</b>	<b>91,234</b>	<b>94,148</b>	<b>96,333</b>	<b>105,419</b>	<b>588,759</b>

Source: RDTL, 2016.

### 6.2.3 Tourism Accommodation

Tourism accommodation in Timor-Leste includes the Plaza Hotel, Novo Turismo Resort and Spa, Casa Minha Backpackers, da Terra, D'City Hotel, Casa do Sandalo Boutique Guest House, Malinamoc Paradise, Hotel Lecidere, Hotel Esplanada, Hotel Timor, Dili Central Backpackers, Discovery Inn, Timor Plaza Hotel & Apartement, Palm Beach Hotel Dili, Sakura Tower Hotel, Vila Bemori, Caz Bar Seaside Villa, Timor Lodge, Golgota Hotel & Resort, Arbiru Beach Resort, Hotel The Ramelau, Beach Garden Hotel, Excelsior Resort, and Metiaut Apartements.

## 6.3 Contribution to Income and Jobs

### 6.3.1 Gross Value Added of Tourism Sector

Gross value added (GVA) of the tourism sector in 2015 was US\$19,600,000, where it contributed 1% to the GDP.

The tourism sector is part of the economic services and other non-oil activities.

### 6.3.2 Employment in the Tourism Sector

The Ministry of Tourism is working on a professional branding and marketing strategy to raise Timor-Leste's attractiveness among potential visitors. The agency hopes to open investment opportunities and create jobs in the sector, and other related activities.

Estimates suggest that in 2015, Timor-Leste's tourism sector directly employed approximately 4,300 people. This number is expected to exceed and reach 15,000 by 2020.

## 6.4 Major Issues

There is cause for concern that the country's delicate social and cultural fabric is vulnerable to negligent decision-making that will likely have negative impacts and quickly diminish Timor-Leste's allure and tourism potential.

Timorese people and the communities are under pressure to develop, and often do not recognize the value of their natural asset, particularly in terms of tourism. However, tourism activities sometimes produce more solid waste (plastics) that are left in the beaches, putting the environment at risk.

Tourism activities will push Timor-Leste to open its borders to the international community. However, exposure to different cultures could possibly change the unique socio-culture of Timor-Leste.

Tourism also involves using multiple resources from other sectors. If utilization of natural resources is not planned and integrated with other relevant sectors/stakeholders, conflicts could arise.

## 6.5 Response: Making Tourism Sustainable

Timor-Leste considers these key pillars in developing its National Tourism Policy.

The World Economic Forum (WEF) publishes the biennial Travel and Tourism Competitiveness Report, which establishes and measures a set of factors and policies that enable the sustainable development of a country's tourism sector and contribute to the overall competitiveness of a country. The WEF index comprises four sub-indexes (Enabling Environments, Travel and Tourism Policy and Enabling Conditions, Infrastructure, and Natural and Cultural Resources); as well as 14 pillars and 90 individual indicators that collectively serve as a baseline for tourism policy and strategic development.

From a destination management perspective, tourism should be viewed as a complex system entailing the movement of people to countries and places outside their usual environment where they interact with the physical environment and local community.

Under Enabling Environments, there are five pillars that need attention: 1) business environment, 2) safety and security, 3) health and hygiene, 4) human resources and labor markets, and 5) ICT readiness.

On the other hand, there are four pillars under the Travel and Tourism (T&T) Policy and Enabling Conditions: 1) prioritization of T&T, 2) international openness, 3) price competitiveness, and 4) environmental sustainability.



For Infrastructure, there are three pillars: 1) air transport infrastructure, 2) ground and port infrastructure, and 3) tourist service infrastructure.

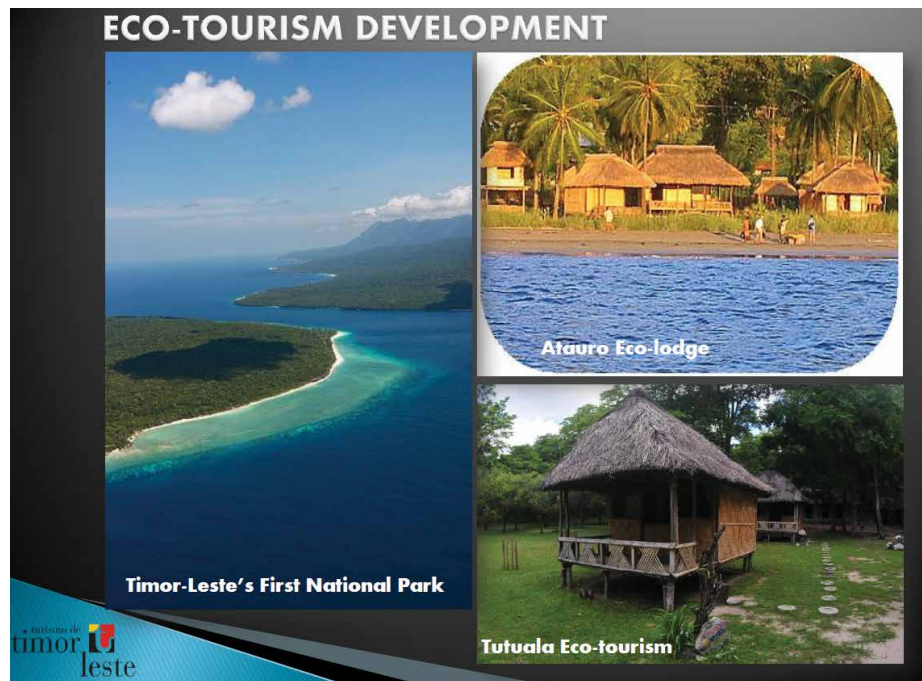
The last sub-index is the Natural and Cultural Resources. It has two pillars: natural and cultural resources and business travel.

## 6.6 Examples of Good Practices

### 6.6.1 Ecotourism Sites

Timor-Leste is developing sites, which have potential for ecotourism, and is now applying sustainable and inclusive principles. The following are key ecotourism destinations:

- Area Branca, Cristo Rei, Largo de Lecidere, Tasi Tolu in Dili Municipality
- Akrema Beach and Atauro Island in Dili Municipality
- Nino Konis Santana National Park
- One-dollar Beach in Manatuto Municipality
- Illi kere-kere and Jaco Island in Tutuala Village Lautem Municipality
- Beach in Liquisa Municipality
- Vemase Beach in Baucau
- Lifau Beach in Oecussi special region
- Atauro eco-lodge
- Tutuala ecotourism



Source: Tourism National Directorate, Ministry of Tourism, Trade and Industry.

**Joao Paulo Segundo in Tasi Tolu - Dili Municipality***Photo by Lince Dessy, 2014.***One Dollar Beach in Manatuto Municipality***Photo by Lince Dessy, 2018.***Valu Sere Beach and Jaco Island in Tutuala Village in Lautem Municipality***Photo by Lince Dessy, 2018.***Com Beach in Lautem Municipality***Photo by Lince Dessy, 2018.***Watabo Beach in Baucau Municipality***Photo by Lince Dessy, 2018.*

### 6.6.2 Sanitation, Wastewater, and Solid Waste Management Facilities in Tourist Establishments

The Directorate of Environment plays a major role in overseeing environment and natural resources issues together with key government line agencies, local leaders and communities. The Directorate is also responsible for issuing licenses for large scale projects. This means that the Directorate has to conduct an environmental impact assessment prior to the implementation of a project. The major issue faced by the Directorate is management of solid and liquid wastes in an acceptable way. People still have limited awareness in managing their own wastes into proper endpoints. The Directorate is expected to work closely with local government and other entities to manage all the wastes and provide proper facilities, such as rubbish bins and proper treatments, recycling and disposal facilities.

An example of wastewater management is in Atauro where there is site treatment of sludge (toilet waste), which is then used as soil conditioner for plants.

## 6.7 Supporting Policies

The Ministry of Tourism have a *National Tourism Policy 2011-2030*, *Timor-Leste Strategic Development Plan 2011–2030*, *Respect to All law/decrees*, and the traditional law (*Tara bandu*) related to other sectors (e.g., environment, agriculture and fisheries, land and property, etc.)

The Tourism Policy is a pledge by the Government of Timor-Leste to develop a unified and holistic tourism sector that places emphasis on sustainability, community, quality, and business competitiveness. The objective of the policy is to build a tourism sector-enabling environment that will be inclusive, viable, and beneficial for all Timorese people.

The key headline goals of the Tourism Policy are, by 2030:

- Revenue from overseas tourism, excluding carrier receipts (air fares and ferry charges) will be US\$150 million per year (at 2016 prices, i.e., adjusted for inflation between the present and 2030).
- Employment in the tourism sector will reach 15,000 (approximately 4,300 at present).
- Around 200,000 international tourists will visit Timor-Leste annually, with an average stay of 4 days.
- In order to achieve these goals, a range of policy priorities have been identified that will assist in marshaling the efforts of the government, the tourism industry, development partners, and the wider community. There are five key elements, which collectively provide a national vision and direction for tourism:
  - A universally acknowledged and understood sense of purpose behind developing tourism as a national priority for economic and social development.
  - A commitment to improve prosperity, particularly for young Timorese and local communities, who will be gainfully employed in the tourism sector as service providers and entrepreneurs.

- A spirit of stewardship focused on the protection of the nation's natural and culture resources and ensuring a safe visitor experience.
- A commitment to a partnership in which all stakeholders have a voice and shared responsibility on how tourism is developed and implemented at the national and local levels.
- An acknowledgement that people are at the core of tourism, and as such, must be instilled with appropriate knowledge, skills, and attitude.

The Tourism Policy considers the myriad of challenges that Timor-Leste faces in developing an internationally competitive tourism sector and provides guiding principles for achieving success.

There shall be supporting strategies and action plans put in place that take into consideration and be responsive to external factors, at home or abroad. These shall be crafted in a consultative fashion in a regular planning cycle by relevant government ministries and departments. There will be a framework for implementation that addresses both the political dialogue level and the technical operational level.

The Timor-Leste Tourism Policy has a goal of inspiring the Timorese people to resolutely embrace tourism as a core element of their country's future.

Timor-Leste, endowed with a unique blend of cultural heritage and pristine environments, has an exceptional opportunity to develop a distinctive tourism sector that is respectful of the environment, profitable to communities, and pleasing to international visitors.

The Tourism Policy recommends the creation of an inclusive tourism industry that is environmentally and economically sustainable and that promotes, values, recognizes, and protects the unique culture, environment, and heritage of Timor-Leste. It aspires for tourism to be a driver of the country's economic growth, a standard bearer of national pride, and the essence of an internationally recognized country brand.

Achieving this aspiration will require harmonization of all tourism stakeholders, both public and private, as well as civil society, who must rally around the vision for tourism as defined in this policy.

Governmental ministries and agencies must work collaboratively and invest in enabling infrastructure and execution of policies, legislation and regulations that respect and protect the unique culture and environment of the country.

The private sector must strive to deliver internationally recognized standards of quality and service through a diversified range of tourism products that are attractive to a wide range of visitors from around the world. The private hotels, resorts and other tourism establishments should also have adequate water, sanitation, solid waste and wastewater management systems, and ensure the protection of habitats and wildlife.

The workforce must be educated and trained to reach accredited international standards, and there must be continuous investment in developing requisite knowledge, skills, and attitude.

The Timorese people and civil society actors must be empowered to fully participate in the tourism economy and embrace roles of stewardship.

### **Supporting Policies and Plans for Tourism Development**

*Source: Tourism National Directorate, Ministry of Tourism, Trade and Industry*

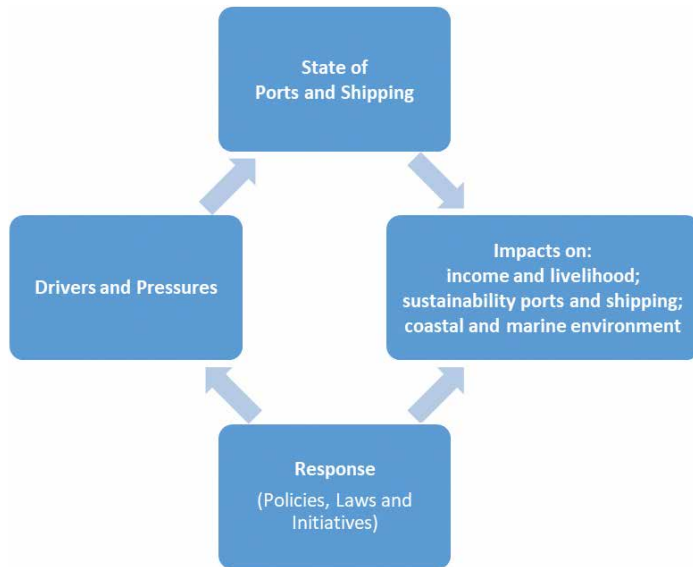
- National Tourism Development Plan for short, medium and long term;
- Human Resources Development;
- Tourism Infrastructure Development;
- Participation of local community in tourism development;
- Marketing and promotion
- Primary focus on marine and coastal tourism
- Secondary focus on land tourism;
- Strive for sustainable tourism development.

### **Tourism Development Strategies**

*Source: Tourism National Directorate, Ministry of Tourism, Trade and Industry*

- Strengthening National Tourism Directorate and private sector role;
- Marketing and product development;
- Environment and tourism planning;
- Tourism awareness campaign;
- Eco-tourism development;
- Infrastructure and facilities development by attracting foreign investors;
- Establishment of Inter-ministerial Commission.

# 7 Ports and Shipping



Port construction.  
(Photo: M.Ebarvia)

There is one major port in Timor-Leste, which is located in Dili. All goods, cargo, and construction materials are loaded in this port. The Port Authority is responsible for all goods imported into the country. They work closely with Customs in monitoring all the goods, and ensuring that all containers and cargo are with legal documents so they can pay tax accordingly.

Com-Lautem has a very small port, which is utilized for fishing activities. Navigational lanes of Dili port serve national and international lines, e.g., Atauro Island, Oecussi, Indonesia, Singapore, China, etc.

## 7.1 Port Performance Indicators

### 7.1.1 Cargo and Container Throughput

Ship arrivals, volume of cargo, container throughput, and number of passengers each year are described in **Tables 7.1** and **7.2**.

**Table 7.1:** Total Cargos and Containers Recorded at the Main Port by Year.

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Ships Arrivals	325	487	519	520	684	849	1,074	1074	972	840
Break-Bulk Cargo (MT)	106,8	117,58	127,66	137,87	172,18	224,85	189	238,42	219,25	191,31
Container (TEUs)	15,26	21,877	23,957	29,946	36,816	41,384	45,608	41,845	51,822	49,427
Passengers (>12 yrs)	27,93	36,887	55,116	60,628	66,69	86,4	158,4	86,4	86,4	86,4
Oil Products	n/a	n/a	64,95	36,093	61,429	100,00	106,33	96,208	127,03	128,927
Domestic Ferries Arrival	144	147	145	146	147	150	146	146	131	135

**Table 7.2:** Report of Dili Port Timor-Leste/Administração dos Portos de Timor-Leste Porto de Dili (APORTIL) 2017.

Nationality	Year		Year	
	Quantity	Price (US\$)	Quantity	Price (US\$)
<b>IMPORT</b>				
Vehicle (unit)	309		190	
Rice (ton)	72,575.99		81,050	
Sugar (ton)	0		500	
Cement (ton)	113,562.24		165,217	
Others (ton)	0		6,008.23	
Wood (m <sup>3</sup> )	5,173.23		4,424.56	
Combustive (Kit)	128,937.59		151,725.63	
Container 20'	16,745		17,106	
Container 40'	4.27		3,909	
<b>Total</b>	<b>337,303.05</b>		<b>430,130.42</b>	
<b>EXPORT</b>				
Container 20'		15,486.00		16,911
Container 40'		4,319.00		3,671
<b>Total</b>		<b>19,805.00</b>		<b>20,582.00</b>
<b>LOCAL PASSENGER</b>				
Nakroman		73,519		60,708
Laju-laju		0		15,976
Star Craft		0		21,453
Motorcycle by Nakroman		1,555		1,530
Cars by Nakroman		1,743		1,193
Cars by Laju-laju		0		1,112
Motorcycle by laju-laju		0		580
<b>Total</b>		<b>76,817</b>		<b>102,552</b>
<b>INTERNATIONAL PASSENGER</b>				
MV. Orion	3	668		
MV. Pacific Jewel	1	1,769		
MV. Silver Discoverer			6	632
MS. Caledonia Sky			1	74
MV. Pacific Eden			1	1,263
MV. Coral Discoverer			1	53
<b>Total</b>	<b>4</b>	<b>399,812.05</b>	<b>9</b>	<b>512,427.68</b>

Source: APORTIL, 2017.

### 7.1.2 Contribution to Income and Employment

The gross value added (GVA) of ports and shipping sector in 2015 was around US\$66.7 million (in constant prices), contributing 3% of the country's GDP.

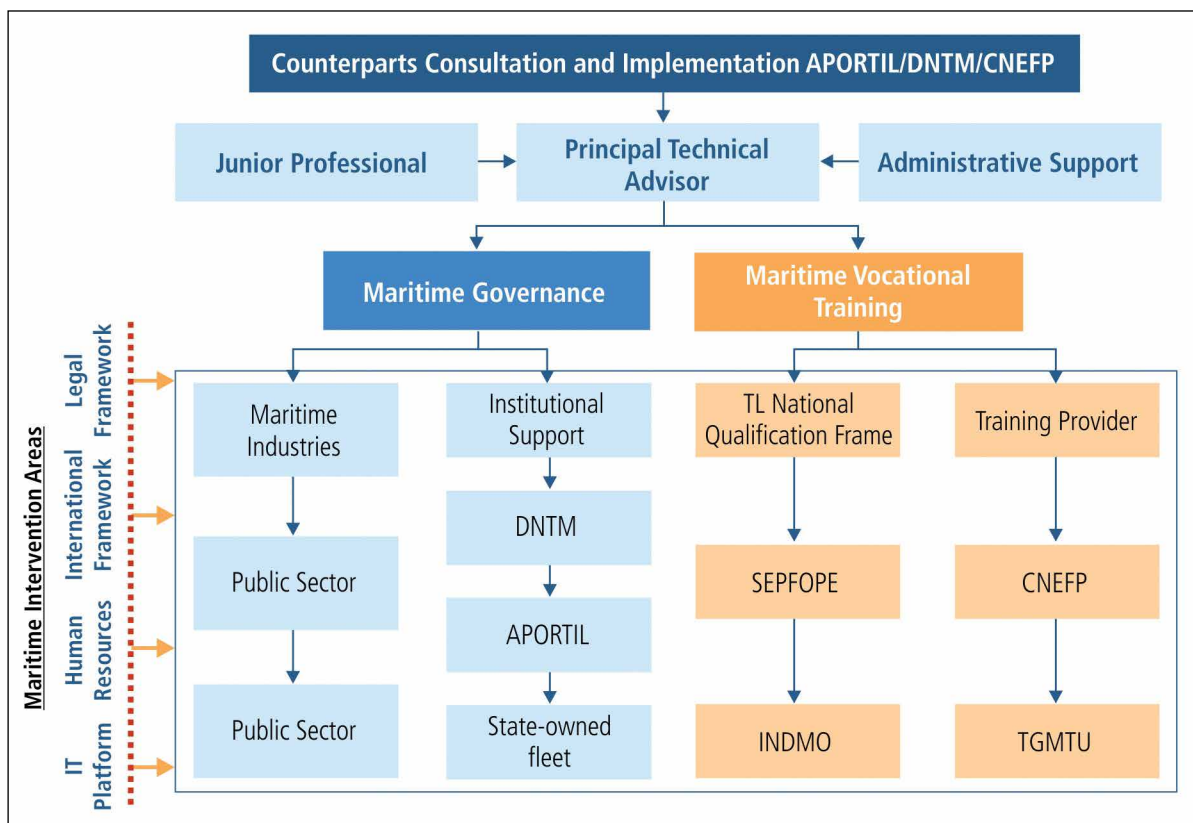
### 7.1.3 Employment

Employment in the Dili Port of Timor-Leste averages around 50 people. There are many employers in the port. Many of them are coming from customs services, Port Authority, environment staff, quarantine, and members of the police. Apart from legal entities, there are also civil workers who are working on a casual basis. The total number of workers are not consistent. It depends on the amount of cargos for each week. The payment is also relatively different based on their duration of work. Some of the workers can work 2-3 days a week and some can work 4-6 days a week. The legal workers, especially from the Customs Office under the Ministry of Finance, and its structure can be seen in **Figure 7.1**.

#### Role of Stevedores

- Increase port productivity and efficiency;
- Adjusting the yard to assist in current conditions;
- Removal of overstaying cargo;
- Cut and run of empties; and
- Open on Saturdays to receive cargos.

**Figure 7.1:** Structure of the Customs Services for Cargos and Imports.







### 7.1.4 Storage Facilities

- Warehouses
- Set Traffic Flow
- Restricted Access Zones
- Separate Stevedore
- Stacking Areas: 26.9 ha for container terminal; 2.7 ha for general cargo area; 11.6 ha for office and workshop
- Increase Storage Rates
- Utilize Tasi-Tolu Dry Port

All of the facilities in Tasi-Tolu Port have been planned and designed for standard quality and quantity.

## 7.2 Pressures and Issues

Potential impacts expansion of existing port, construction of new port, and operation of these ports on marine and coastal ecology:

- Affects aquatic fauna and flora through change of water quality, coastal hydrology, and bottom contamination;
- Land reclamation from the sea destroys bottom habitat and displaces fishery resources;
- Diminution of bottom habitat is usually linked to reduction of fishery resources and occasionally to an increase of undesirable species;
- Deterioration of water quality which reduces the number of species or increases the quantity of one or two specific species;
- Construction activities may cause displacement of fishery resources and other mobile bottom biota;

- Dredging removes bottom biota and dumping of dredged material covers of bottom habitat may reduce fishery resources;
- Settlement of suspended sediments on fragile marine fauna and flora damages the ecosystem, particularly the coral reef;
- Pile, concrete surfaces, rubble mounds and other similar structures in water column and seabed can form new habitats that will introduce undesirable species;
- Toxic substances and other contaminants are suspended through dredging or dumping that may lead to contamination of fishery resources; and
- Leakage of oils, oily wastes, and mixture may directly cause damage to fishery resources, aquatic biota and coastal habitat. Biodegradation of oil also generates polymerized oil particles and toxic aromatic frictions using dissolved oxygen (DO) in the water, which indirectly cause damage to the bottom biota and habitat.

### 7.3 Investments in Ports

In order to facilitate customs clearance and trade, the government created the necessary conditions for increasing investments, improving management, and to work effectively at the port, airport, dry port, and land borders. Sea ports facilitate trade, transportation and economic development.

The government invested in the new Tibar Port in Tibar Bay located at around 10 km from Dili (extends: 1.6 km E-W and 1 km N-S) (**Figure 7.2**). The government, through a public-private partnership (PPP), signed a contract with Bolloré Transport & Logistics to build the Tibar Port. By means of an international competitive tender, the government selected Bolloré to develop a greenfield (new) port at Tibar Bay through design, build, co-finance, operate and transfer (DBFOT) basis. The company started construction work in October 2017. To undertake the development of the new port, the government signed an agreement on 3 June 2016 with Timor Port S.A. (a company registered in Timor-Leste and owned by Bolloré) granting a 30-year concession. The new port will have modern equipment to ensure quick and efficient movement of containers and cargo, and will be able to accommodate much larger ships than Dili Port. This will allow for savings in freight costs that will ultimately mean lower consumer prices.

The passenger terminal in Dili Port is being improved and expanded with support from Japan (JICA-funded). Additionally, the Ministry of Finance also signed a contract with Bernabad, an architecture and urban planning firm, for the engineering design of the Customs House in Dili Port. All these investments seek to create conditions for providing services, facilitate trade, increase revenue, and prepare for Timor-Leste's membership in ASEAN.

The creation of a new port at Suai is envisaged as part of the large-scale development plan, which consists of a variety of project components, such as a port that will act as a supply base, a refinery, LNG plant, and petrochemical industry.

**Figure 7.2:** Development Plan for the Port of Tibar.

### Ongoing construction of Tibar Port

- The government will allocate around US\$2 million for the port and will engage around 500 workers.
- The port will require the creation of a 200-m wide approach channel through the western side of the reef across the mouth of the bay.
- The construction involves establishing the 600-m diameter turning cycle within the bay, construction of wharf, land reclamation, and some landscaping.
- Environmental impacts: The site will require the removal of around 20 ha of marine habitat (18 ha seagrass bed, 0.1 ha coral reef, and 1-3 ha mangrove).
- Dredging volume: 4.4 million m<sup>3</sup>.

*Dili Port offices.*

# 8 Offshore Oil and Gas

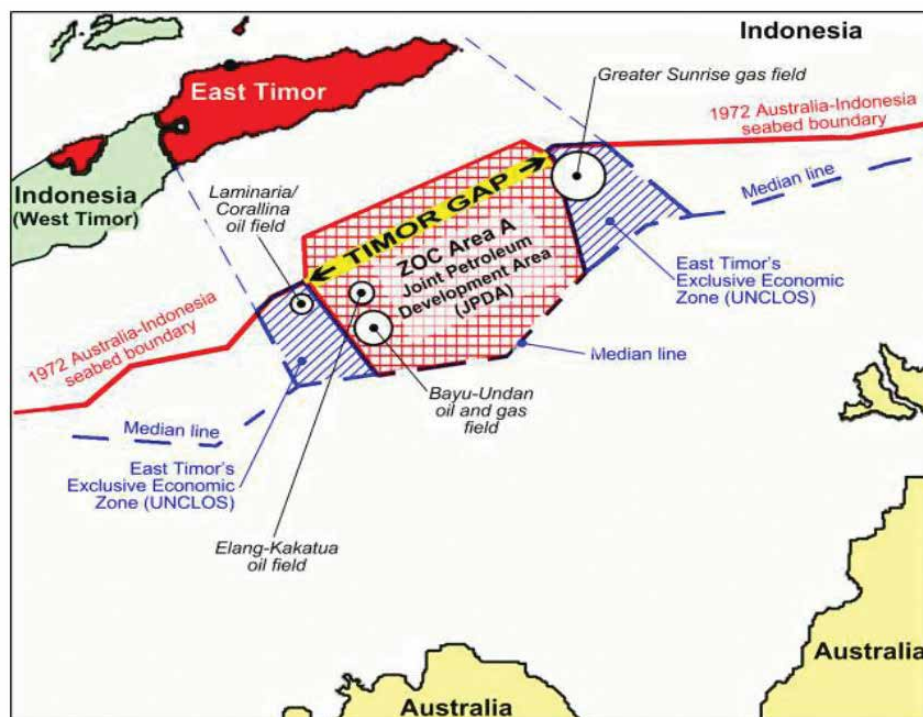
## 8.1 Location

Since the restoration of independence, three offshore fields have been developed, namely: Elang Kakatua, Bayu Undan, and Kitan in the Joint Petroleum Development Area (JPDA).

- Elang Kakatua – production in 1998 to 2006
  - Bayu Undan – production since 2004 - estimated to stop in 2022 (may be longer)
  - Kitan – production in 2011 and suspended operations in 2015 (can start operations again).
- In 2005/2006, the first bidding round was done for exploration blocks in JPDA and Offshore Exclusive areas.

Marine exploration activities for oil and gas in Timor Sea are still in progress. Oil and gas fields in the Timor Sea (Elang-Kakatua Bayu-Undan Chudditch Kuda Tasi Jahal; Greater Sunrise; and Laminaria-Corallina Buffalo in Timor-Leste's side of the median line; Evans Shoal Petrel-Tern Blacktip in the Australia side of the median line) have an estimated reserve of 4.840 billion of Barrel Oil Equivalent (BOE) (Wirasantosa, et al. 2011). There are no explorations onshore or inland.

**Figure 8.1** Oil and Gas Exploration in Timor Gap.



Source: *The La'o Hamutuk Bull.* V.4, no. 3-4, August 2003 in Wirasantosa, et al., 2011.

## 8.2 Production

Potential value of oil to be explored and developed in the next 50 years:

- Timor-Leste's total Petroleum Initial-In-Place (PIIP) is in the range of 12-17 Billion BOE;
- TIMOR GAP estimates the recoverable resources will be around 6.3 Billion BOE (as a comparison, Bayu Undan reserve is ~ 1 Billion BOE); and
- The monetary value of these resources at an average of US\$59 per barrel in the next 50 years is US\$372 Billion.

## 8.3 Contribution to Timor-Leste's Economy and Ocean Economy

Revenues received in the form of royalties, profit and taxes from petroleum have been supporting the development of the country with its annual budget contribution. The oil and gas sector contributes two-thirds of the GDP.

Approximately US\$87.4 million were collected from petroleum tax revenues during the period of January to December 2016. The overall total petroleum collection figures have decreased from the previous tax year, from US\$461.2 million to US\$87.4 million. The collection decline in 2016 (81%) was a result of the global decline in oil prices, and the assessment of the actual income tax liability of some contractors, which revealed to be lower than the estimated income tax liability for the 2014 and 2015 tax years. Such assessment, which determined that the contractors made tax overpayments, resulted in tax credits that had to be granted to the contractors. Consequently, the contractors offset those 2014 and 2015 tax credits against their 2016 income tax liabilities. This situation may continue to occur in the 2017 tax year, since some of the contractors' overpayments have not been totally offset yet. This is part of the ongoing fiscal reform process (See **Section 3.2.4** – Fiscal Situation).

## 8.4 New Investment Opportunities

### **Oil and Gas Services and Infrastructure Corridor: Suai Supply Base**

Potential US\$372 billion worth of resources are yet to be monetized in the next 50 years. This requires exploration, development, and maintenance worth US\$222 billion in the next 50 years. When fully explored, approximately US\$31 billion worth of income may be acquired by the government through taxes and profits from oil (upstream take), plus TIMOR GAP dividends of around US\$16 billion.

To capture the full value, however, Timor-Leste should move from an upstream, extractive-oriented industry to more of a transformational industry by way of developing services; manufacturing of fabrications and goods, and establishing the Suai Supply Base, refineries/petrochemicals, and LNG plant. This will ensure that around 27% of the US\$100 billion is captured in Timor-Leste's economy with additional multiplier effects, creation of thousands of jobs, increased trade, commerce, and SME development, and overall sustained GDP growth in the next 20 years or so. The government can take around US\$16 billion from the downstream services, including TIMOR GAP dividends. However, this requires state investment of up to US\$2.2 Billion (in Suai Airport, Suai Supply Base, Highway), and the rest by commercial entities.

## 8.5 Environmental Impact Assessment and Mitigation Measures

Many studies on wastes from offshore oil and gas have been conducted, mostly done by the Australian partners, including monitoring and analysis of water and sediments. The results showed no impacts in the offshore areas. There are no mitigation measures being undertaken by the government.

Considering the large amount of estimated oil reserves, the occurrence of oil spill is possible due to exploration and exploitation works in the area.

According to some reports, the Environmental Impact Assessment of the proposed Suai oil and gas infrastructure and industry corridor needs to be improved.

# PART 3

## DEVELOPMENTS IN BLUE ECONOMY

# 9 Blue Economy Initiatives

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## 9.1 Innovative and Sustainable Economic Activities

The following industries are still being developed and improved with sustainable and inclusive development principles:

- Mariculture: grouper and seaweed farming
- Aquaculture: milkfish (*bangus*) and tilapia cultivation ; mudcrabs in mangroves; clean or sustainable shrimp farms
- Co-management of fishery resources and habitats
- Ecotourism/sustainable tourism
- Island tour
- Boat transportation
- Traditional salt making: Traditional production of salt is done in Maabat in Manatuto, Ulmera in Liquiça, and Atabae in Maliana.

Other activities to support sustainable development of the coastal and marine areas include the following:

- Sustainable commercial fishing (Issues: Need capacity development for artisanal fisherfolk; need fishing boats and gears, new technologies, and storage facilities to support fisherfolk).
- Crocodile management: The Government of Timor-Leste has been conducting management of crocodiles in Hera Metinaro.
- Investment in solid waste management (landfills) is being handled by the Administrative Dili in Tibar, Dili Municipality.
- Investment in sewerage and wastewater management: The Ministry of Commerce Industry has contracted an agency from India to manage wastewater in Tibar-Dili municipality.
- Recycling industry (for used oil and recyclable solid waste).

## 9.2 Emerging Industries

### 9.2.1 Marine protected areas (MPAs) and ecotourism

There are three existing MPAs in Atauro (Vila, Adara, and Varuana); five MPAs in Nino Konis Santana National Park; and one MPA in Maliana.



The total area of the protected area including the marine areas is around 3,200 km<sup>2</sup>. The MPA in Nino Konis Santana National Park consists of 586 km<sup>2</sup> out of a total park's area of 1,257 km<sup>2</sup>.

The MPA in Atauro Vila is 50.85 ha, composed of 31.34 ha of coral reef, 18.36 ha of seagrass, 0.97 ha of mangrove, and 0.18 ha of beach/seashore.

The total area of terrestrial protected area network is approximately 2000 km<sup>2</sup>, which is around 13.06% of total land area (World Bank 2018) to 15% of the nation's land area. (Hedley et al., 2010).

The *dugong* and seagrass conservation is also being developed to become a model of ecotourism in Timor-Leste.

### Box 1. Potential of ecotourism

Ecotourism is another area with potential for social enterprises. It represents an alternative to fly-in, fly-out high-end tourism, such as has been established across the Pacific, where visitors pay to stay in luxury international hotels, eat largely imported food and have minimal contact with the local people. Ecotourism aims to develop small-scale, locally run hotels and restaurants that will use local products and local staff as much as possible. The aim is to benefit the community through increased tourism, greater demand for fresh produce and the creation of new employment opportunities. A social enterprise for tourist accommodation has been established by Haburas, an environmental NGO that offers cabins in Tutuala, near Jaco Island National Park, at the eastern tip of Timor-Leste. Haburas has launched another social enterprise, a restaurant in Dili that provides organic food at lunchtime. There is plenty of potential for sustainable tourism in the underdeveloped tourist market of Timor-Leste. The return of migrant workers who have participated in the hospitality industry in northern Australia could also inject important skills into such enterprises.

*Source: Haburas.*

### Community-based tourism

Tutuala in Lautem already has a community-based tourism business. Community members listened to explanations of the benefits that marine conservation could bring to the fishing industry, and to their lodge and tours. They are excited by the likely increase in income from these two livelihoods. When the management plan for the MPA was completed, the village council quickly voted for it, and sent it to the DNPA for approval. Natural resource management fits Tutuala's cultural traditions,

and the information the community got through the CTSP made it easy for them to appreciate the value of an expanded MPA. They have done their part, and are hoping that the national government will be able to provide enforcement assistance in patrolling against illegal commercial fishing boats in their managed areas (USAID-CTSP, n.d.). Community-based ecotourism is a form of responsible ecotourism that emphasizes the development of local communities and allows for local residents to have substantial control over, and involvement in, its development and management, and a major proportion of the benefits remain within the community. It is tourism based on the natural attractions of an area. Local residents (often rural, poor and economically marginalised) invite tourists to visit their communities with the provision of overnight accommodation. The residents earn income as land managers, entrepreneurs, service and farm produce providers, and employees.

**Atauro Island in Dili Municipality**



*Photo by Lince Dessy, 2016.*

**Valu Sere Beach and Jaco Island in Tutuala Village in Lautem Municipality**



*Photo by Lince Dessy, 2018.*

**Lore Beach with Mangrove in Lautem Municipality**



*Photo by Lince Dessy, 2018.*



## 9.3 Investment Opportunities

### 9.3.1 Sustainable and Climate-smart Aquaculture

Aquaculture is a promising industry in Timor-Leste. Potential areas for various types of aquaculture have been identified as shown in **Table 9.1** and **Figure 9.1**. Capacity development and access to new technologies are needed to ensure sustainability and resiliency of the aquaculture industry.

Aquasilviculture is a management strategy that combines and harmonizes fish production and mangrove development. Mudcrabs, shrimps and other species can be cultured in mangrove areas.

Species identified for marine culture are grouper and snapper, with farms using impounding net system (in Dili). More impounding systems are expected to be established because of feasibility and high demand from both local and international markets. Other potential species for aquaculture are milkfish, crabs, shrimps, baramundi, Koku, sea cucumber, clams, and seaweeds (*Gracilaria sp.*).

Seafood processing industry could also offer job opportunities and potential products for domestic use and exports.

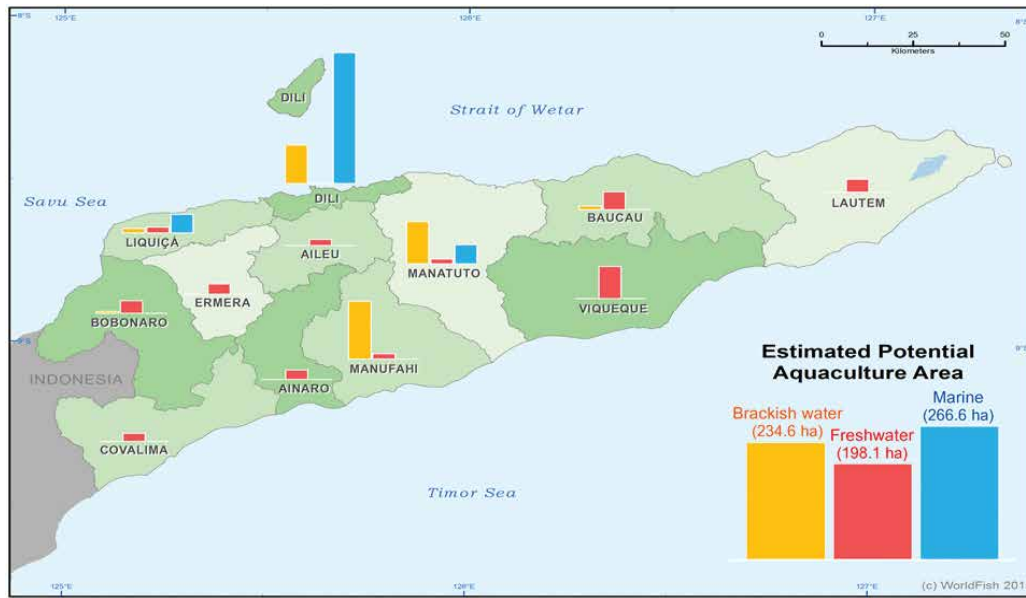
### 9.3.2 Diversification of the Petroleum Industry

Diversification in the petroleum sector including a more diversified services and downstream industries, since over a decade ago, it has always been concentrated in upstream or extractive operations.

**Table 9.1:** Potential areas for aquaculture in Timor-Leste.

Municipality	Brackishwater (ha)	Freshwater (ha)	Marine (ha)	Lake (ha)	Total (ha)
Dili	60.8	0.5	207.1		268.4
Manatuto	66.7	7.5	30.3		104.5
Manufahi	91.4	8.4			99.8
Viqueque		51.0			51.0
Liquisa	7.0	9.0	29.1		45.1
Baucau	5.7	28.3			34.0
Bobonaro	3.0	19.9			22.9
Lautem		20.3		5,425	5,445.3
Ermera		16.1			16.1
Ainaro		14.8			14.8
Covalima		12.8			12.8
Aileu		9.5			9.5
<b>Total</b>	<b>234.6</b>	<b>198.1</b>	<b>266.5</b>	<b>5,425</b>	<b>6124.2</b>

Source: MAF, 2015.

**Figure 9.1:** Potential Aquaculture Areas in Timor-Leste.

Source: MAF, 2015.

- This will move the sector towards a transformational industry, ensuring the industrialization of the sector and contributing greatly to the socioeconomic development of the nation with provisions of jobs, trade, infrastructure, services, and fabrications, which may last even after the end of Timor-Leste's upstream operations.
- Assuming the cost per barrel is equal to US\$35/barrel, then a total of US\$220 billion will go into the expenditures for exploration, engineering, simple to complex services, fabrications (small, medium to larger scale), installations/constructions, and operations and maintenance.
- Therefore, the country would want to develop its infrastructure, capabilities in the services, engineering, and fabrications in the next decades to get financial return from these expenditures and investments.

Some proposed projects that are related to the ocean economy include:

#### a. Tasi Mane Project

- Suai Supply Base (SSB) includes a port with draught of up to 9 m and several berths of 6 m draught, with protection from more than 3-km breakwater.
- There will be several mini-shore bases and typical warehouses, yard and open area of up to 1,000 ha for industries, fabrications, and services in oil and gas industries, such as drilling, fuel bunkering, catering, waste management, pipe threading and repairing, storage and warehousing, wire lines, drilling mud services, seismic and drilling services, supply vessels, tug boats, compressors and pumps repairs, spare parts supplies, emergency and oil spill response services, etc.
- Jobs: 2,000+ during construction and 250 direct jobs during operation; up to 5,000 direct jobs if fabrications and services are set up. Therefore, over 25,000 indirect jobs (industry ratio: 1 direct job generates up to 5 indirect jobs).

- Timor-Leste businesses and locals can compete to supply goods and services for upstream exploration and development of over US\$4 billion (25 years) – assumed to be not generated without SSB.
- Timor-Leste businesses and locals can compete to supply goods and services for downstream operations and maintenance of over US\$15 billion (25 years) – assumed to be not generated without SSB.
- New businesses, such as maintenance, engineering, small fabrications, repairing, specialized welding, specialized equipment cleaning, transport, gardening, cleaning, security guard services, chemical supplies, crude tanker business, product tanker business, tug boats, electricity usage, offices and accommodation, hotels and entertainment, food, fruit and vegetable supplies, etc. – all of which will generate thousands of indirect jobs and stimulate economic activities around Suai and Timor-Leste at large, paying taxes and contributing to GDP growth.
- Trade and commerce – Timor-Leste can be active in world trade.
- Build geopolitical influence in supply chain.
- Reduce trade imbalance by increasing exports.
- Increase hard currency inflow into Timor-Leste economy.
- Infrastructure: set the basis for future expansions.
- Education: science and technology exposure, skills and experience, and technology transfer.
- Help in negotiation for securing the pipeline and LNG-plant to Timor-Leste, and the industry in general.

#### **b. Beaçõ LNG Plant**

- Jobs: 5,000+ during construction and 300 direct jobs during operation; over 1,500 indirect jobs (industry ratio: 1 direct job generates up to 5 indirect jobs).
- Timor-Leste businesses and locals can compete to supply fabrications, services and work worth almost US\$5 billion in capital expenditures (before production) – not generated without the project.
- Timor-Leste businesses and locals can compete to supply services and goods for LNG, pipeline and tanker operations worth over US\$1.5 billion (25 years) – not generated without the project.
- New businesses, such as maintenance, engineering, small fabrications, repairing, specialised weldings, specialised equipment cleaning, transport, gardening, cleaning, security guard services, chemical supplies, LNG tanker business, tug boats, electricity usage, offices and accommodation, hotels and entertainment, food, fruit and vegetable supplies, etc. – all of which will generate thousands of indirect jobs and stimulate economic activities around Beaçõ and Timor-Leste at large, paying taxes and contributing to GDP growth
- Trade and commerce: Timor-Leste can be more active in world trade and be known as an LNG supplier.
- Build geopolitical energy influence.
- Reduce trade imbalance by increasing exports.

- Increase hard currency into Timor-Leste economy.
- Infrastructure: set the basis for future expansions.
- Education: science and technology exposure, experience, and transfer.

### 9.3.2 Marine Bioprospecting

Marine bioprospecting has a great potential for the ocean economy development and for the prosperity of the Timorese people. The government needs to invest not only financially, but also in human capital development so that more skilled people will be able to harness the potential genetic resources for food, medicines, etc. and manage marine resources in acceptable and sustainable way. Strong regulations are needed and should be implemented together with local knowledge in order to prevent unregulated activities, over-extraction and destruction of marine resources, and discharge of solid and liquid waste. More effort is needed from the government, academe, civil society and other development partners to work more closely together to promote this innovative industry.

### 9.3.3 Ocean Energy

The ocean has potential for energy production similar to other renewable energy, such as wind, solar, and biomass (Sinulingga, 2014). The innovative ocean energy can be implemented at the southern coast of Timor-Leste because of the potential wind, wave and current power. Based on notes of community leaders of Lore I and Tutuala (in August 2018), winds are strong enough to destroy houses and agriculture production. More scientific and engineering studies are needed to assess the technical viability and financial feasibility of ocean energy and coastal wind power.



Photo by: M. Ebarvia

PART 4

STATE OF OCEAN HEALTH  
UNDERPINNING THE  
BLUE ECONOMY

# 10 Oceanography and Seawater Quality

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## 10.1 Currents and Tides

Surface currents in Timor-Leste are influenced by the southeast monsoon from May to November, and the northwest monsoon from November to March. However, a weak drift current flows through the Arafura Sea throughout the year. In the Timor Sea, a south-westerly current prevails all year round due to its axis running close to the coast (Salm and Halim, 1984; cited in Tomascik et al., 1997).

Two major currents influence the waters surrounding Timor-Leste: the Indonesian monsoon current and the *Indonesian Throughflow* (Wagey and Arifin, 2008). The Indonesian Throughflow, which plays a significant role in mid-latitude circulation in the Pacific, is strongest from June to August; and weakest from December to February. The prevailing path of the Indonesian Throughflow is from the Pacific to the Indian Ocean. While it causes some movement to the Indian Ocean water from the south into the eastern seas, most of this water ends up being recycled southward as it flows past Timor Island and back into the Indian Ocean. The deep flow through the Timor Trough originates in the Indian Ocean and contributes to the formation of a recirculation pattern into the Seram Sea, the North Banda Sea, and back into the South Banda Sea before moving back into the Indian Ocean. Flows through the Timor Straits provide links to the Indian Ocean.

The Indonesian Throughflow is characterized by large internal waves and tides, which are thought to cause the intermittent high primary production events experienced in the predominantly oligotrophic sea (McKinnon et al., 2011). In Timor-Leste, local winds appear to generate much of the wave action. The northern coast tends to experience low-energy waves, while the southern coast experiences larger waves, particularly during April–November (Wyrcki, 1961; cited in Tomascik, 1993).

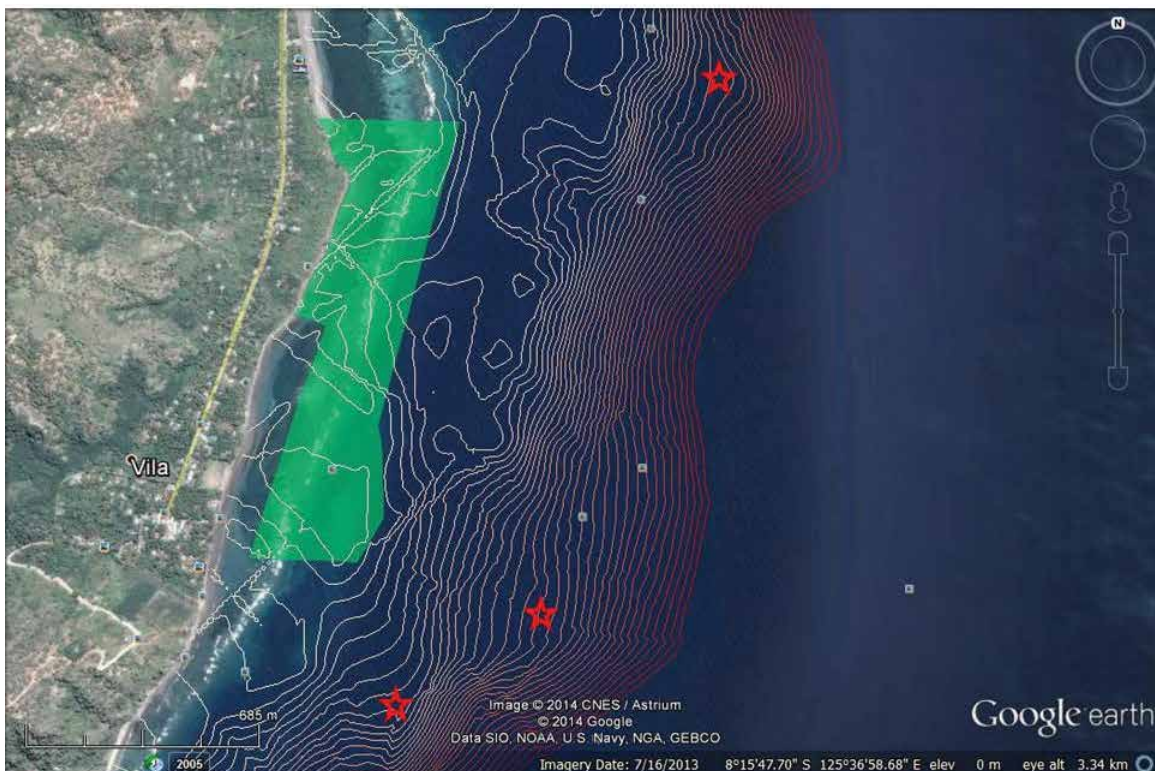
Currents in the Timor Sea at 20 meters (m) to 100 m are from the southeast to northwest (115.67-236.19°) with an average velocity of 650.09 millimeter per second (mm/s) to 1,016.73 mm/s. The current velocities in Timor Sea are 547.85 mm/s to 853.24 mm/s. The current direction at 20 m to 40 m occurs on the south to southwest (165.57°-210.55°). At 50 m to 100 m, the water mass



moves southeast (115.67°-148.89°). The pattern of current water mass near the coast moves in a different direction as the water mass offshore. The movement of the currents near the coast is southern. However, in the offshore, the current moves southwest, which is parallel to the south coast of Timor. The surface current in the Timor Sea moves toward the southwest for most of the year, from October to March; while the current in the northeast part of the Timor Sea moves northeast (Wirasantosa et al., 2011). This current and water mass movement has a great impact on ecology, ecosystem dynamics, availability of nutrients, and distribution of phytoplankton and fisheries in general. **Figure 10.1** illustrated the currents in Atauro Island.

Tides are known to influence the vertical water structure. Tides in the Indonesian archipelago and Timor-Leste are caused by wave propagation across the shelves and into the basins from the Pacific and Indian Oceans. Timor-Leste has mixed tides with prevailing semidiurnal tides. Tides, together with currents, play an important role in providing a continuous supply of oxygen to reef communities. The most obvious effect of tides on coral reefs is the cyclic nature of exposure and inundation of reef flat areas (Tomascik et al., 1997).

**Figure 10.1:** Currents in Atauro Island.

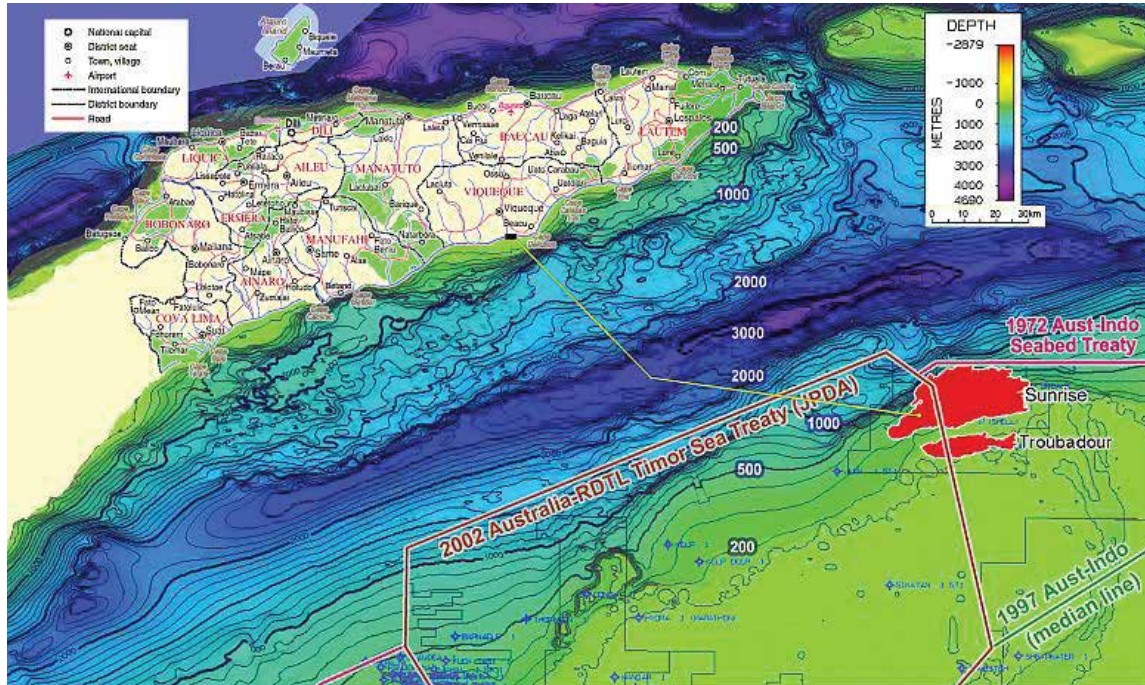


Source: NOAA, 2014.

## 10.2 Bathymetry

**Figure 10.2** shows the extreme bathymetry of the southern shores and sea of Timor-Leste. This is one of the factors that limit the development and scaling up of the capture fisheries industry.

**Figure 10.2:** Bathymetry of South Sea of Timor-Leste.



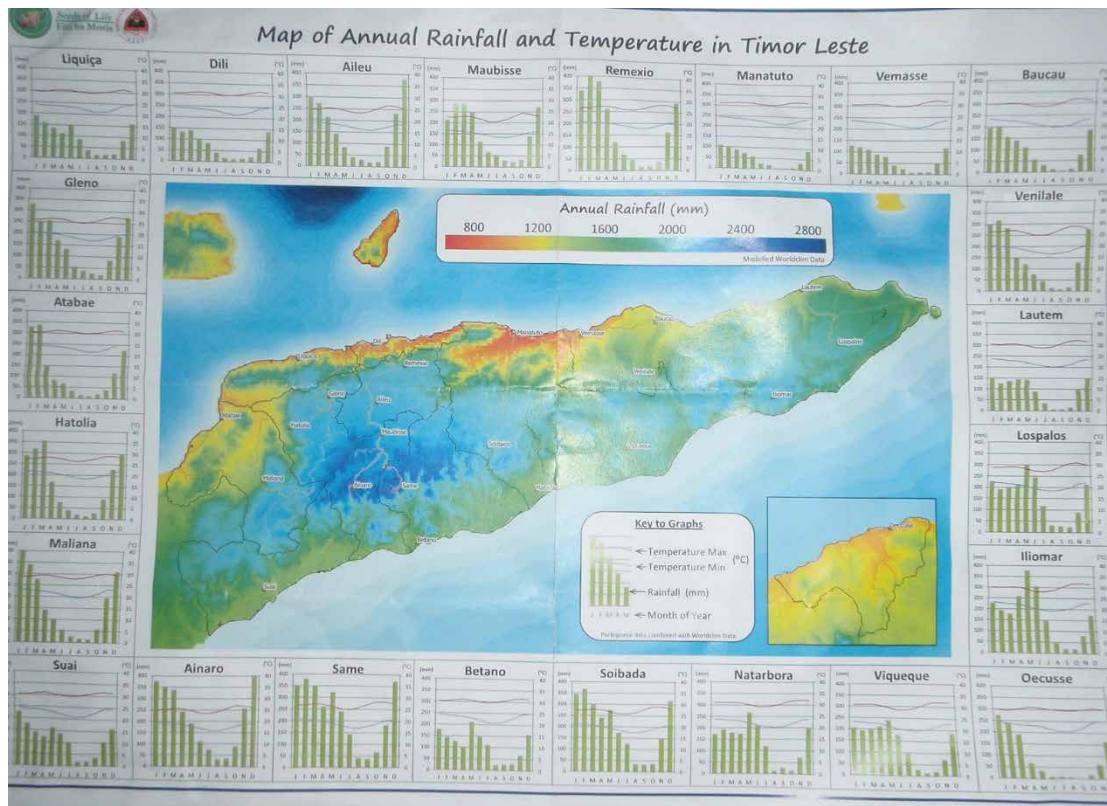
Source: WorldFish, 2016.

## 10.3 Geology

Timor-Leste's north coast is rocky and steep, and arid woodlands tend to be the dominant vegetation type. Geologically, Timor is controlled by the collision in Middle-Miocene to Mid-Pliocene between the Australian continental plate and the Banda arc plate (Asia microplate). This collision has emplaced thrust sheets, including the ophiolites that host a number of important minerals. Potential metallic minerals in Timor-Leste are gold, copper, chromite, manganese, and silver. Non-metallic minerals are widely distributed, namely, (a) sand, gravel and other aggregates, which can be used for construction materials, (b) clay for bricks, (c) marble for ornaments, etc.

## 10.4 Meteorology and Climate

The northern coast shows a different rainfall pattern compared to the southern coast and middle part of the island. **Figure 10.3** presents the annual rainfall and temperature in Timor-Leste, and for each district.

**Figure 10.3:** Map of Annual Rainfall and Temperature in Timor-Leste.

Source: MAF, 2014.

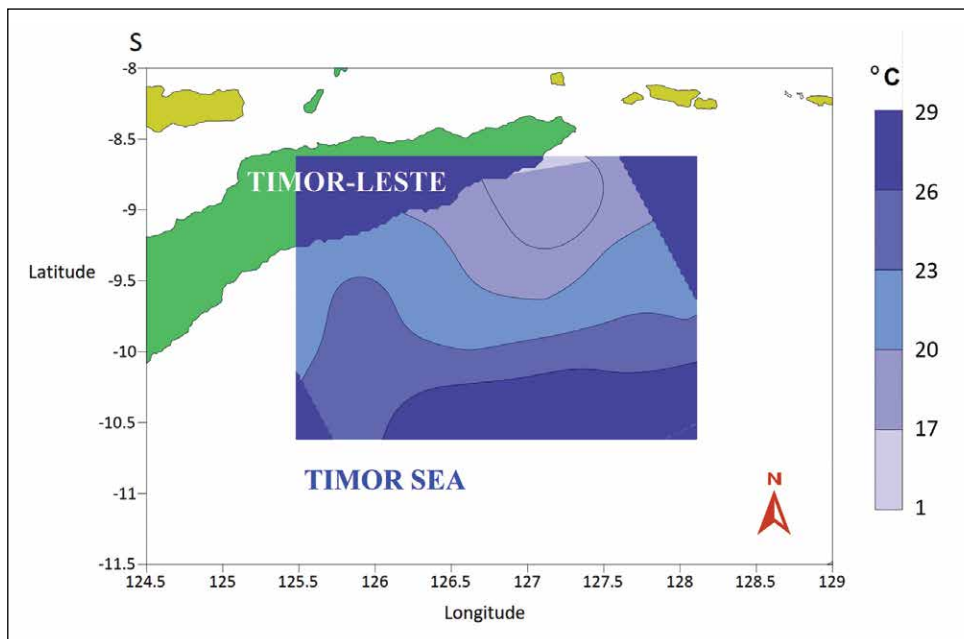
## 10.5 Sea Water Density

“The surface water density ranged between  $20.62 \text{ kg/m}^3$  and  $21.84 \text{ kg/m}^3$ , with an average of  $21.03 \text{ kg/m}^3$ . The northern part of the Timor Sea shows lower density water compared to the southern part. The horizontal distribution of water density in the Timor Sea is quite homogeneous but increases with depth. Water density at 25 m is  $22.07 \text{ kg/m}^3$ . At a depth of 50 m, water density varies between  $21.89 \text{ kg/m}^3$  and  $22.62 \text{ kg/m}^3$ , with an average of  $22.28 \text{ kg/m}^3$ . At 75 m, it ranges from  $22.69 \text{ kg/m}^3$  to  $23.19 \text{ kg/m}^3$  with an average of  $22.95 \text{ kg/m}^3$ ; and at 100 m, it increases to  $23.25 \text{ kg/m}^3$  to  $23.83 \text{ kg/m}^3$  with an average of  $23.49 \text{ kg/m}^3$ . The horizontal distribution of water density at 50 m is isopycnal lines that continue from the north to south, reflecting a similar characteristic of the water mass that flows from north to south in the Timor Sea. The water density distribution also indicates that the water mass density is lower towards the offshore. The vertical distribution of water density indicates a stratification of the water column. The thickness of the mixed layer in the Timor Sea is less than 50 m” (Wirasantosa, et al., 2011).

## 10.6 Sea Surface Temperature

“Sea surface temperature ranged from 27°C to 29°C, with an average of 28.75°C. Sea water temperature at 25 m depth is between 27°C and 29°C, with an average of 28.51°C. Then at 50 m, it is between 25°C and 27°C, with an average of 26°C. Water temperature decreases with water depth, and at 75 m, temperatures are between 24°C and 25°C, with an average of 24.77 °C. The water temperature at 100 m ranged from 22°C to 23°C, with an average of 23°C.” (Wirasantosa, et al., 2011). **Figure 10.4** illustrates the sea water temperature.

**Figure 10.4:** Water Temperature of Timor Sea.



Source: SEAFDEC, 2011.

## 10.7 Water Quality

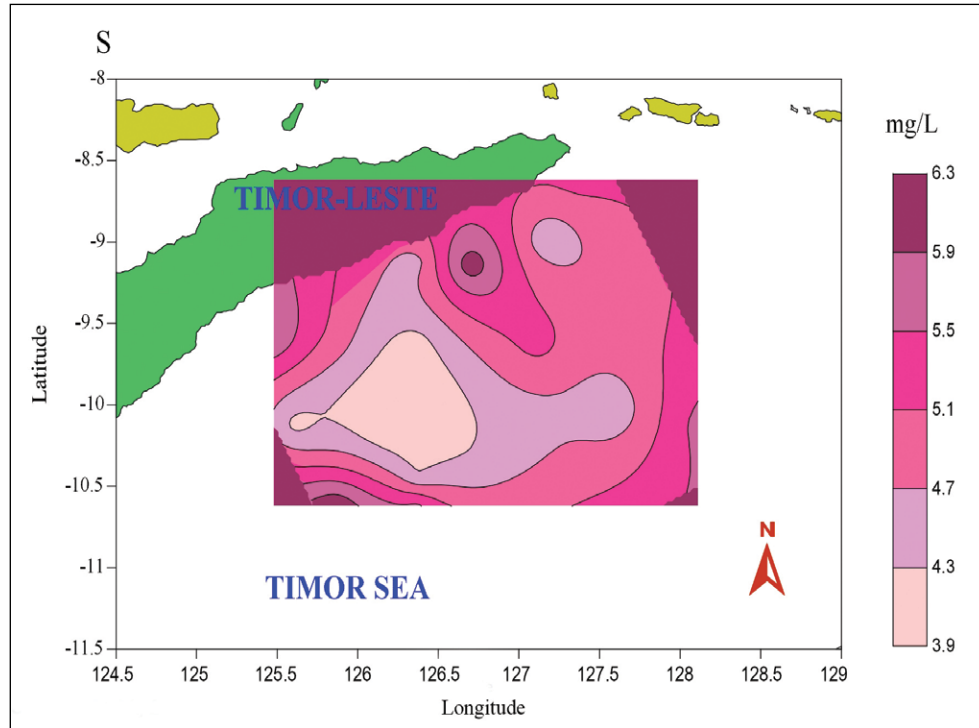
### 10.7.1 Salinity

“Salinity at the surface is between 33 parts per million (ppm) and 34 ppm. Likewise, at 25 m deep, salinity ranged from 33 ppm to 34 ppm, with an average of 33.83 ppm. Higher salinity is always near the coast, while the offshore is slightly lower. In terms of horizontal distribution, salinity at 50 m, 75 m, and 100 m is homogeneous. Salinity at 50 m ranged from 34.14 ppm to 34.35 ppm, with an average of 34.27 ppm. The salinity at 75 m is between 34.36 ppm and 34.44 ppm, with an average of 34.38 ppm. Salinity at 100 m ranged from 34.44 ppm to 34.51 ppm, with an average of 34.47 ppm. In general, the horizontal distribution of salinity in the offshore fluctuates more widely at depths <50 m. Salinity of the southern water mass is higher than that of the northern water mass.” (Wirasantosa, et al., 2011).

### 10.7.2 Dissolved Oxygen (DO)

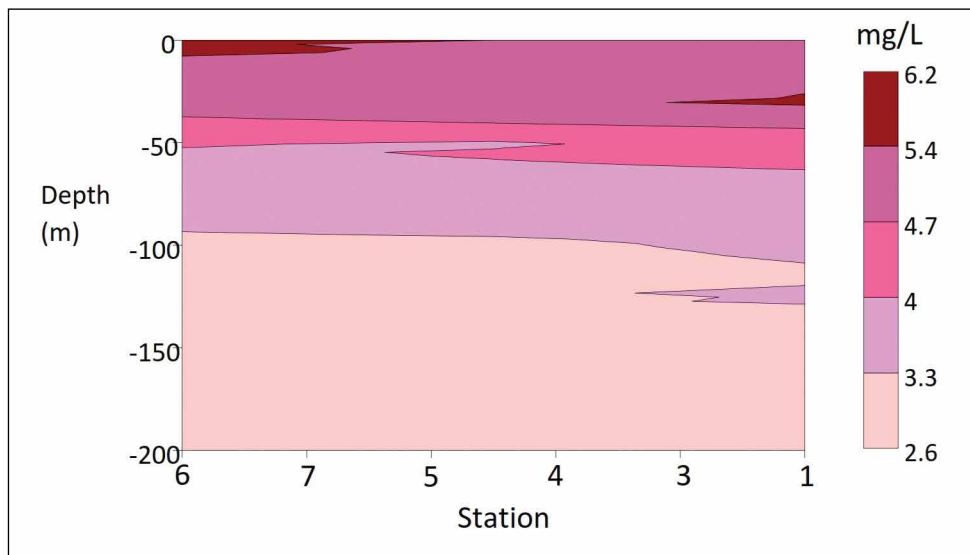
Dissolved oxygen (DO) is also dynamic as it depends on salinity and surface temperature. DO varies across the water column and by location (near-shore and offshore). DO near the coast and at the surface is high, but goes down with increasing depth (**Figures 10.5 and 10.6**) (ATSEA, 2011).

**Figure 10.5:** Distribution of Dissolved Oxygen Concentration in the Surface Layer.



Source: ATSEA, 2011.

**Figure 10.6:** Vertical Profile of Dissolved Oxygen Concentration along the Coast of Timor-Leste.



Source: ATSEA, 2011.

### 10.7.3 Nutrients

Nitrite concentration were mostly high at level of 50 m–75 m depth. Two peaks were found at 50 m and 300 m in one of the sampling stations.

Nitrate, silicate and phosphate concentrations were very low to undetectable near the surface. Their concentrations tended to increase from sea surface to deep water.

### 10.7.4 Chlorophyll and Primary Production

Water-column casts at all of the sampling stations revealed some evidence of upwelling of cold, nutrient-rich water into the reefs of the Sahul Banks; and more significantly, extensive upwelling along the entire edge of the southern Timorese shelf. This cold water may account for fairly slow benthic oxygen consumption. However, high levels of chlorophyll suggest enhanced primary production because of these upwelling intrusions.

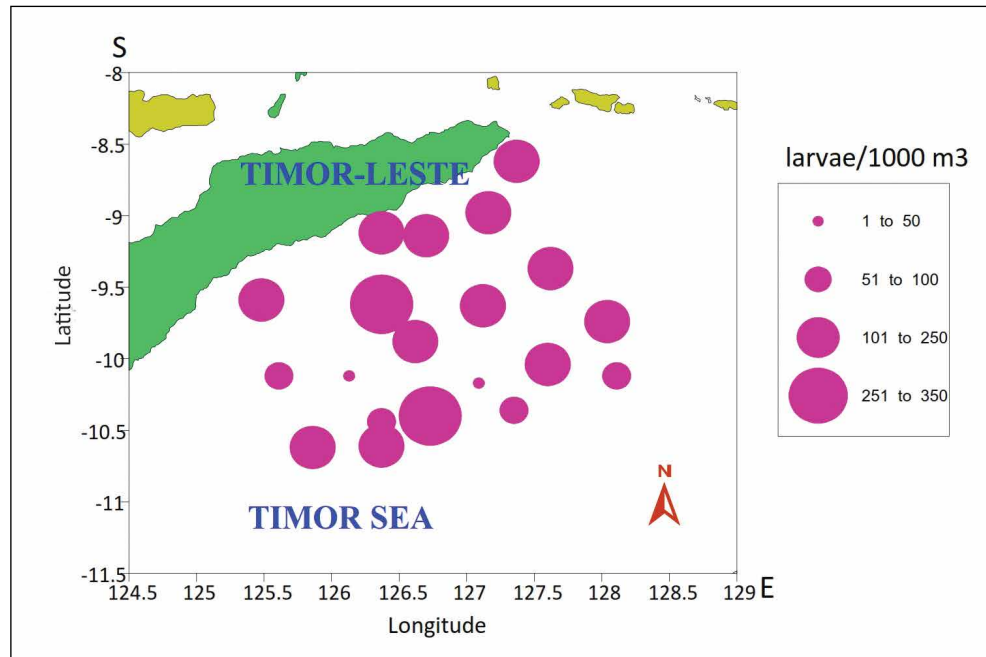
The seabed along the southern coast of Timor-Leste is dominated by extensive deposits of mud, probably derived from enhanced erosion of land within southern river catchments. Rates of anaerobic respiration were very high, suggesting intense recycling of organic matter derived from both enhanced land runoff and phytoplankton production. These high rates of phytoplankton activity may help to explain why this area has high fish productivity, and is a key migratory pathway for large pelagic species, such as tuna, dolphins, and whales (ATSEA, 2011). **Figure 10.7** shows the distribution and abundance of total fish larvae observed between 30 April and 22 May 2005.

### 10.7.5 Phytoplankton

A total of 81 genera and 224 species were identified. The species that dominated the phytoplankton population were *Bacteriastrium delicatulum*, *Chaetoceros affinis*, *C. anastomosans*, *C. compressus*, *C. dichchaeta*, *C. lorenzianus*, *C. messanensis*, *C. pseudodichaeta*, *Eucampia cornuta*, *Proboscia alata*, *Pseudoguillardia recta*, *Thalassionema frauenfeldii* and *Thalassiosira oestrupii*. *C. lorenzianus* was the dominant species mainly distributed in the study area.

Plankton species, abundance and density were observed in Atauro Island, Dili, Liquiça and Manatuto. The major species of plankton in Atauro Vila are shown in **Figure 10.8**. The species and number of planktons in Dili, Manatuto and Liquiça Municipalities are shown in **Tables 10.1, 10.2, and 10.3**, respectively. The Biodiversity Index of plankton is 3.51 at Dili Municipality (Atauro Vila), 3.83 at Manatuto Municipality, and 2.89 at Liquiça Municipality (SOC Reports of Dili, Manatuto, and Liquiça, 2016).

**Figure 10.7:** Distribution and Abundance of Total Fish Larvae between 30 April-22 May 2005.

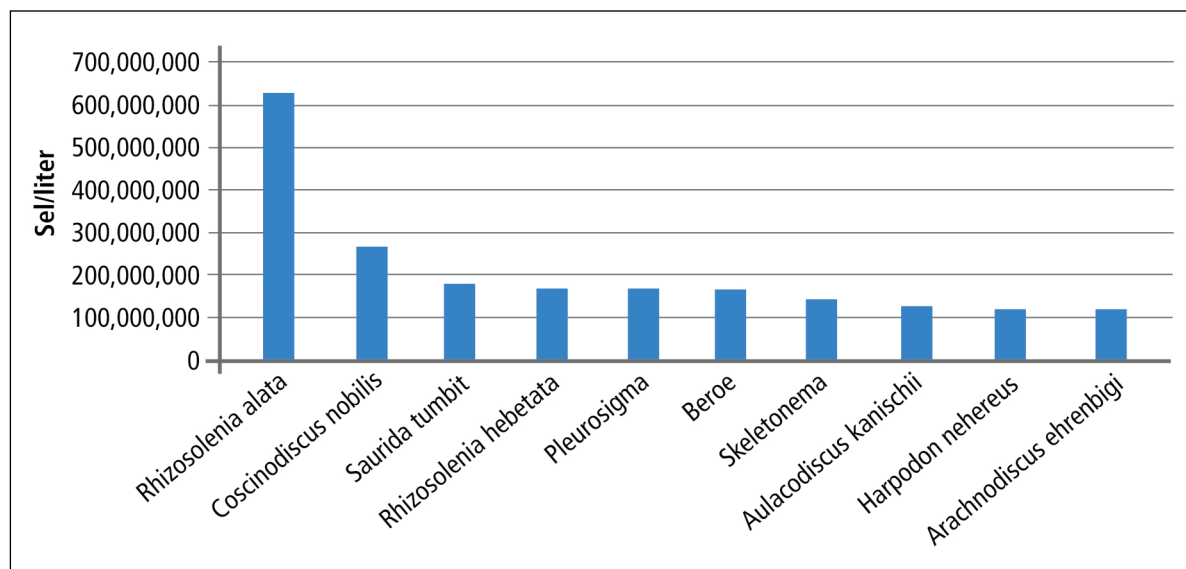


Biodiversity is affected by water quality.<sup>7</sup> Using the Shannon-Wiener biodiversity index, water quality in Dili is still in good condition. In Dili Municipality's coastal water sample, Atauro Vila got 68 plankton species identified with index biodiversity of 3.51. The Biodiversity Index of plankton is 3.83 in Manatuto Municipality, indicating good water quality, while Liquiça got a biodiversity index of 2.89, an indication of polluted water.

<sup>7</sup> Criteria of Water Quality Based on Biodiversity Index (Shannon-Wiener).

Biodiversity Index	Water Quality	Reference
>3	Good	Wilha (1975)
1 – 3	Polluted	
< 1	Extremely polluted	
3.0 – 4.0	Had little pollution	Lee, et al (1975)
2.0 – 3.0	Polluted	
1.0 – 2.0	Extremely polluted	

Source: Wilha, 1975 and Lee et al., 1975 in Fachrul, 2007.

**Figure 10.8:** Major Plankton in Atauro Vila, 2016.**Table 10.1:** Major Species of Plankton in Dili Municipality.

No.	Name of Plankton	Cell/liter	Pi In Pi	No.	Name of Plankton	Cell/liter	Pi In Pi
1	<i>Rhizosolenia alata</i>	6.3E+08	-0.29	21	<i>Velamen</i>	6.8E+07	-0.07
2	<i>Coscinodiscus nobilis</i>	2.7E+08	-0.18	22	<i>Janthina</i>	5.7E+07	-0.06
3	<i>Saurida tumbit</i>	1.8E+08	-0.14	23	<i>Rhizosolenia robusta</i>	5.5E+07	-0.06
4	<i>Rhizosolenia hebetata</i>	1.7E+08	-0.14	24	<i>Shrimp euphausiid (larva)</i>	5.3E+07	-0.06
5	<i>Pleurosigma</i>	1.7E+08	-0.14	25	<i>Ceratium</i>	5.2E+07	-0.06
6	<i>Beroe</i>	1.7E+08	-0.13	26	<i>Trichiurus sp</i>	4.6E+07	-0.05
7	<i>Skeletonema</i>	1.4E+08	-0.12	27	<i>Evadne tergestina</i>	4.2E+07	-0.05
8	<i>Aulacodiscus janischi</i>	1.2E+08	-0.11	28	<i>Muraena sp</i>	4.0E+07	-0.05
9	<i>Harpodon nehereus</i>	1.2E+08	-0.11	29	<i>Heteropoda</i>	3.9E+07	-0.05
10	<i>Arachnodiscus ehrenbigi</i>	1.2E+08	-0.11	30	<i>Noctiluca</i>	3.6E+07	-0.04
11	<i>Coscinodiscus</i>	1.0E+08	-0.09	31	<i>Larva alpheid</i>	3.3E+07	-0.04
12	<i>Pyrococypis</i>	9.8E+07	-0.09	32	<i>Triceratium favus</i>	3.1E+07	-0.04
13	<i>Larva ofiopluteus</i>	9.5E+07	-0.09	33	<i>Chirocentrus dorab</i>	3E+07	-0.04
14	<i>Larva ikan teri</i>	9.0E+07	-0.09	34	<i>Heteropoda dewasa</i>	3E+07	-0.04
15	ND	8.4E+07	-0.08	35	<i>Nauplius dalam telur</i>	2.6E+07	-0.03
16	<i>Rhizosolenia stolterforthii</i>	7.7E+07	-0.08	36	<i>Physalia</i>	2.6E+07	-0.03
17	<i>Decapterus kurra (layang)</i>	7.6E+07	-0.08	37	<i>Asterionella</i>	2.6E+07	-0.03
18	<i>Lucifer</i>	7.4E+07	-0.08	38	<i>otot aduktor</i>	2.0E+07	-0.03
19	<i>Euconchoecia</i>	7.2E+07	-0.07	39	<i>thalassiosira</i>	1.9E+07	-0.03
20	<i>Coscinodiscus excentricus</i>	6.9E+07	-0.07	40	<i>Obilis</i>	1.8E+07	-0.03



**Table 10.1:** Major Species of Plankton in Dili Municipality. (cont.)

No.	Name of Plankton	Cell/liter	Pi In Pi	No.	Name of Plankton	Cell/liter	Pi In Pi
41	<i>Pleurobrachia</i>	1.7E+07	-0.02	55	<i>Oit hona</i>	7.0E+06	-0.01
42	<i>Trichodesmium</i>	1.7E+07	-0.02	56	<i>Hyperia</i>	7.0E+06	-0.01
43	<i>Biddulphia</i>	1.7E+07	-0.02	57	<i>Liriope</i>	7.0E+06	-0.01
44	<i>Larva bipinaria</i>	1.3E+07	-0.02	58	<i>Sel mundella bitentaculata</i>	6.0E+06	-0.01
45	<i>Eretmocarls larva lysmata</i>	1.3E+07	-0.02	59	<i>Larva aurikularia</i>	4.0E+06	-0.01
46	<i>Misis udang penacid</i>	1.3E+07	-0.02	60	<i>Cybiun maculatun (tenggiri)</i>	4.0E+06	-0.01
47	<i>Larva phoronis</i>	1.1E+07	-0.02	61	<i>Nauplius pontelid</i>	4.0E+06	-0.01
48	<i>Caranx macrosoma</i>	1.1E+07	-0.02	62	<i>Hemiramplus sp.</i>	4.0E+06	-0.01
49	<i>Nauplius Cyclopid</i>	1.1E+07	-0.02	63	<i>Mnemiopsis</i>	2.0E+06	-0.004
50	<i>Echeines naucrates (gemih)</i>	7.0E+06	-0.01	64	<i>Chanos chanos</i>	2.0E+06	-0.004
51	<i>Larva gastropoda</i>	7.0E+06	-0.01	65	<i>Larva tornaria</i>	2.0E+06	-0.004
52	<i>Cleupea fimbriata</i>	7.0E+06	-0.01	66	<i>Eudovid</i>	2.0E+06	-0.004
53	<i>Sagitella</i>	7.0E+06	-0.01	67	<i>Nauplius Eucalanus</i>	2.0E+06	-0.004
54	<i>Protozoa lucifer</i>	7.0E+06	-0.01	68	<i>Sagita</i>	2.0E+06	-0.004
<b>Index of Biodiversity (-Σ Pi In Pi)</b>							<b>3.51</b>

Source: Dili Municipality, SOC Report, 2016.

**Table 10.2:** Major Species of Plankton in Manatuto Municipality.

No.	Name of Plankton	Cell/liter	No.	Name of Plankton	Cell/liter
1	<i>Arachodiscus ehrenbergi</i>	1.07E+09	19	<i>Decapterus kurra</i>	2.47E+08
2	<i>Asterionella</i>	9.63E+08	20	<i>Dino physis</i>	2.47E+08
3	<i>Aulacodiscus janischii</i>	8.69E+08	21	<i>Diphyes</i>	2.35E+08
4	<i>Baeteriastrum delienutula</i>	6E+08	22	<i>Dorosoma chacunda</i>	2.27E+08
5	<i>Beroe</i>	5.63E+08	23	<i>Engraulis kammalensi</i>	2.26E+08
6	<i>Bougainihillia</i>	5.10E+08	24	<i>Eudoxid</i>	1.85E+08
7	<i>Candacia bradyi</i>	5.01E+08	25	<i>Euphausiid</i>	1.69E+08
8	<i>Caranx macrosoma</i>	4.68E+08	26	<i>Evadna tergestina</i>	1.68E+08
9	<i>Chaetoceros</i>	4.65E+08	27	<i>Gymnodinium</i>	1.57E+08
10	<i>Chanos-chanos</i>	3.85E+08	28	<i>Habidocera acuta</i>	1.47E+08
11	<i>Chirocentrus dorab</i>	3.25E+08	29	<i>Harpoda nehereus</i>	1.39E+08
12	<i>Corethron</i>	3.12E+08	30	<i>Hemiramplus sp</i>	1.29E+08
13	<i>Corycacus</i>	2.99E+08	31	<i>Heteropoda</i>	1.28E+08
14	<i>Coscinadiscus</i>	2.65E+08	32	<i>Janthina</i>	1.23E+08
15	<i>Coscinadiscus excentricus</i>	2.64E+08	33	<i>Kepala lobster</i>	1.23E+08
16	<i>Coscinodiscus nobilis</i>	2.60E+08	34	<i>Kepala lucifer</i>	1.23E+08
17	<i>Cybiun maculata</i>	2.57E+08	35	<i>Larva aurikularia</i>	1.09E+08
18	<i>Daety lonicta</i>	2.53E+08	36	<i>Larva gastropoda</i>	1.02E+08

Source: Manatuto Municipality, SOC Report, 2016.

**Table 10.3:** Major Species of Plankton in Liquiça Municipality.

No.	Name of Plankton	Cell/liter	No.	Name of Plankton	Cell/liter
1	<i>Beroe</i>	3E+05	13	<i>Lucifer</i>	4.2E+04
2	<i>Bidduiphia</i>	1E+05	14	<i>Muraena sp</i>	4.2E+04
3	<i>Bougainvillia</i>	1E+05	15	<i>Otot aduktor</i>	4.2E+04
4	<i>Coscinodiscus nobilis</i>	1E+05	16	<i>Pleurosigma</i>	4.2E+04
5	<i>Diphyes</i>	8.4E+04	17	<i>Pseudophasia</i>	4.2E+04
6	<i>Eudoxid</i>	8.4E+04	18	<i>Rhizosolenia alata</i>	4.2E+04
7	<i>Heteropoda</i>	8.4E+04	19	<i>Rhizosolenia stolterforthii</i>	4.2E+04
8	<i>Hyperia</i>	6.3E+04	20	<i>Sagitella</i>	2.1E+04
9	<i>Kepala lucifer</i>	6.3E+04	21	<i>Salpa</i>	2.1E+04
10	<i>Larva alpheid</i>	6.3E+04	22	<i>Saurida tumbil</i>	2.1E+04
11	<i>Larva bipinaria</i>	4.2 E+04	23	<i>Udang euphersiid</i>	2.1E+04
12	<i>Larva ikan teri</i>	4.2 E+04	24	<i>Velamen</i>	2.1E+04

Source: Liquiça Municipality, SOC Report, 2016.

### 10.7.6 Heavy Metals in Fish and Sea Water

#### a. In fish

The concentrations of cadmium (Cd), copper (Cu), iron (Fe), and lead (Pb) were determined in the tissue of 31 species of fish (**Table 10.4**).

**Cadmium (Cd).** The concentration of cadmium contamination in fish ranged from 0.096 to 0.689 µg/g wet weight, with an average of 0.306 µg/g wet weight. The maximum concentration of 0.689 µg/g wet weight was observed in *Hapalogenys kishinougei* while the minimum concentration of 0.096 µg/g wet weight was observed in *Thunnus albacares*.

**Copper (Cu).** The concentration of copper contamination in fish ranged from 0.177 µg/g to 2.929 µg/g wet weight, with an average of 0.753 µg/g wet weight. The maximum concentration of 2.929 µg/g wet weight was observed in *Pristipomoides multidentis* while the minimum concentration of 0.177 µg/g wet weight was observed in *Wattsia mossambica*.

**Iron (Fe).** The concentration of iron contamination in fish ranged from 2.980 µg/g to 14.374 µg/g wet weight, with an average of 6.134 µg/g wet weight. The maximum concentration of 14.374 µg/g wet weight was observed in *Lutjanus vitta* while the minimum concentration of 2.980 µg/g wet weight was observed in *Auxis rochei*.

**Lead (Pb).** The concentration of lead contamination in fish ranged from 0.425-0.852 µg/g wet weight with an average 0.689 µg/g wet weight. The maximum concentration of 0.852 µg/g wet weight was observed in *Hapalogenys kishinougei* while the minimum concentration of 0.425 µg/g wet weight was observed in *Epinephelus morrhua*.

**Table 10.4:** Concentrations of Heavy Metals in Fish Tissue.

Species	Weight (g)	TL (cm)	Cadmium (Cd)	Lead (Pb)	Copper (Cu)	Iron (Fe)
<i>Argyrops spinifer</i>	500	31.50	0.275	0.696	0.374	5.282
<i>Auxis thazard</i>	400	32.00	0.452	0.426	0.374	8.630
<i>Auxis rochei</i>	220	25.70	0.368	0.696	0.720	2.980
<i>Cephalopholis sonnerati</i>	190.0	23.70	0.448	0.704	0.358	4.154
<i>Cephalopholis aurantius</i>	205.0	25.00	0.175	0.636	0.329	3.466
<i>Cephalopholis sexmaculatus</i>	410.0	30.40	0.519	0.724	0.253	9.585
<i>Cephalopholis igarashiensis</i>	560.0	28.40	0.262	0.739	0.342	5.368
<i>Choerodon robustus</i>	445.0	28.00	0.380	0.719	0.259	5.642
<i>Diagramma pictum</i>	2,500.0	60.00	0.381	0.709	2.929	3.815
<i>Epinephelus areolatus</i>	580.0	33.50	0.154	0.716	0.319	4.936
<i>Epinephelus morrhua</i>	670.0	35.50	0.270	0.425	0.198	6.800
<i>Epinephelus latifasciatus</i>	965.0	41.50	0.408	0.570	0.481	4.020
<i>Euthynnus affinis</i>	4,000.0	73.00	0.148	0.703	0.540	7.820
<i>Gymnocranius japonicus</i>	900.0	39.60	0.128	0.703	0.431	9.385
<i>Hapalogenys kishinougei</i>	460.0	26.00	0.689	0.852	0.260	3.033
<i>Istiophorus platypterus</i>	2,800.0	247.00	0.580	0.739	0.342	4.630
<i>Lethrinus semicinctus</i>	420.0	29.00	0.278	0.685	0.357	3.427
<i>Lutjanus malabaricus</i>	840.0	36.00	0.390	0.719	0.353	5.475
<i>Lutjanus madras</i>	300.0	27.20	0.275	0.696	0.374	5.282
<i>Lutjanus vitta</i>	490.0	33.70	0.159	0.781	0.791	14.374
<i>Parascopopsis eriomma</i>	600.0	41.00	0.192	0.766	0.718	9.620
<i>Parascopopsis inermis</i>	500.0	36.00	0.381	0.709	2.929	3.815
<i>Pristipomoides multidentis</i>	400.0	34.00	0.381	0.709	2.929	4.520
<i>Pristipomoides typus</i>	1,100.0	47.60	0.115	0.738	0.536	5.914
<i>Pristipomoides sieboldii</i>	450.0	36.00	0.158	0.670	0.465	5.321
<i>Saurida elongata</i>	700.0	45.00	0.510	0.650	0.595	7.400
<i>Sthenoteuthis ounlaniensis</i>	280.0	16.72	0.381	0.709	2.929	3.815
<i>Thunnus albacares</i>	5,000.0	72.00	0.096	0.766	0.718	13.861
<i>Thunnus obesus</i>	2,000.0	109.00	0.128	0.703	0.431	9.385
<i>Wattsia mossambica</i>	960.0	37.50	0.233	0.593	0.177	3.197
<i>Xiphias gladius</i>	206.8	86.00	0.170	0.694	0.545	5.206

Source: SEAFDEC, 2011.

## b. In Seawater

The heavy metal concentration of all samples collected from 19 stations were lower than detection limit, as shown in **Table 10.5**. The criteria are as follows: Cd = 0.0004 milligrams per liter (mg/L), Pb = 0.0086 mg/L, Cu = 0.0011 mg/L and Fe = 0.0014 mg/L.

**Table 10.5:** Heavy Metal Concentrations in Seawater.

Station (ST)	Weight (g)	Heavy metal (mg/L)			
		Cadmium (Cd)	Lead (Pb)	Copper (Cu)	Iron (Fe)
ST1	5	< 0.0004	< 0.0086	< 0.0011	< 0.0014
	50	< 0.0004	< 0.0086	0.0020	< 0.0014
	100	< 0.0004	< 0.0086	< 0.0011	< 0.0014
ST2	5	< 0.0004	< 0.0086	0.002	< 0.0014
	50	< 0.0004	< 0.0086	0.002	< 0.0014
	100	< 0.0004	< 0.0086	0.002	< 0.0014
ST3	5	< 0.0004	< 0.0086	0.004	< 0.0014
	50	< 0.0004	< 0.0086	0.002	< 0.0014
	100	< 0.0004	< 0.0086	0.002	< 0.0014
ST4	5	< 0.0004	< 0.0086	0.002	< 0.0014
	50	< 0.0004	< 0.0086	0.002	< 0.0014
	100	< 0.0004	< 0.0086	0.002	< 0.0014
ST5	5	< 0.0004	< 0.0086	0.002	< 0.0014
	50	< 0.0004	< 0.0086	0.002	< 0.0014
	100	< 0.0004	< 0.0086	0.002	< 0.0014
ST6	5	< 0.0004	< 0.0086	0.002	< 0.0014
	50	< 0.0004	< 0.0086	0.002	< 0.0014
	100	< 0.0004	< 0.0086	0.002	< 0.0014
ST7	5	< 0.0004	< 0.0086	0.002	< 0.0014
	50	< 0.0004	< 0.0086	0.002	< 0.0014
	100	< 0.0004	< 0.0086	0.002	< 0.0014
ST8	5	< 0.0004	< 0.0086	0.002	< 0.0014
	50	< 0.0004	< 0.0086	0.002	< 0.0014
	100	< 0.0004	< 0.0086	0.002	< 0.0014
ST9	5	< 0.0004	< 0.0086	0.002	< 0.0014
	50	< 0.0004	< 0.0086	0.002	< 0.0014
	100	< 0.0004	< 0.0086	0.002	< 0.0014
ST10	5	< 0.0004	< 0.0086	0.002	< 0.0014
	50	< 0.0004	< 0.0086	0.002	< 0.0014
	100	< 0.0004	< 0.0086	0.002	< 0.0014
ST11	5	< 0.0004	< 0.0086	0.002	< 0.0014
	15	< 0.0004	< 0.0086	0.002	< 0.0014
	50	< 0.0004	< 0.0086	0.002	< 0.0014

**Table 10.5:** Heavy Metal Concentrations in Seawater. (cont.)

Station (ST)	Weight (g)	Heavy metal (mg/L)			
		Cadmium (Cd)	Lead (Pb)	Copper (Cu)	Iron (Fe)
ST12	5	< 0.0004	< 0.0086	< 0.0011	< 0.0014
	30	< 0.0004	< 0.0086	< 0.0011	< 0.0014
	50	< 0.0004	< 0.0086	< 0.0011	< 0.0014
ST13	5	< 0.0004	< 0.0086	0.002	< 0.0014
	15	< 0.0004	< 0.0086	0.002	< 0.0014
	30	< 0.0004	< 0.0086	0.002	< 0.0014
ST14	5	< 0.0004	< 0.0086	0.002	< 0.0014
	50	< 0.0004	< 0.0086	0.002	< 0.0014
	100	< 0.0004	< 0.0086	0.002	< 0.0014
ST15	5	< 0.0004	< 0.0086	< 0.0011	< 0.0014
	30	< 0.0004	< 0.0086	< 0.0011	< 0.0014
	50	< 0.0004	< 0.0086	0.002	< 0.0014
ST16	5	< 0.0004	< 0.0086	0.002	< 0.0014
	50	< 0.0004	< 0.0086	0.002	< 0.0014
	100	< 0.0004	< 0.0086	0.002	< 0.0014
ST17	5	< 0.0004	< 0.0086	0.002	< 0.0014
	30	< 0.0004	< 0.0086	0.002	< 0.0014
	100	< 0.0004	< 0.0086	0.002	< 0.0014
ST18	5	< 0.0004	< 0.0086	0.002	< 0.0014
	50	< 0.0004	< 0.0086	0.002	< 0.0014
	100	< 0.0004	< 0.0086	0.002	< 0.0014
ST19	5	< 0.0004	< 0.0086	0.002	< 0.0014
	50	< 0.0004	< 0.0086	< 0.0011	< 0.0014
	100	< 0.0004	< 0.0086	< 0.0011	< 0.0014

Source: SEAFDEC, 2011.

# 11

## Coastal and Marine Ecosystems and Biodiversity

### 11.1 Coastal and Marine Habitats

From the PIFSC-NOAA (2017) study, bathymetry was derived from the shoreline to approximately 15-m depths for Atauro Island, Oecusse, and most of the north shore of Timor-Leste with relatively few spatial gaps.<sup>8</sup> Shallow-water (0 m-20 m) habitats were identified and classified into into eight habitat types, namely: 1) hard substrate, 2) soft substrate, 3) seagrass, 4) mangrove, 5) macroalgae, 6) intertidal, 7) emergent rocks, and 8) lagoon (**Table 11.1**). Benthic habitat data covering 135.3 km<sup>2</sup> of nearshore habitats in Timor-Leste (excluding unknown areas) were developed around Atauro Island (13.1 km<sup>2</sup>), along the coast of Oecusse (12.6 km<sup>2</sup>), north shore 76.9 km<sup>2</sup>, and south shore (32.7 km<sup>2</sup>).

**Table 11.1:** Shallow-water Habitats in Timor-Leste.

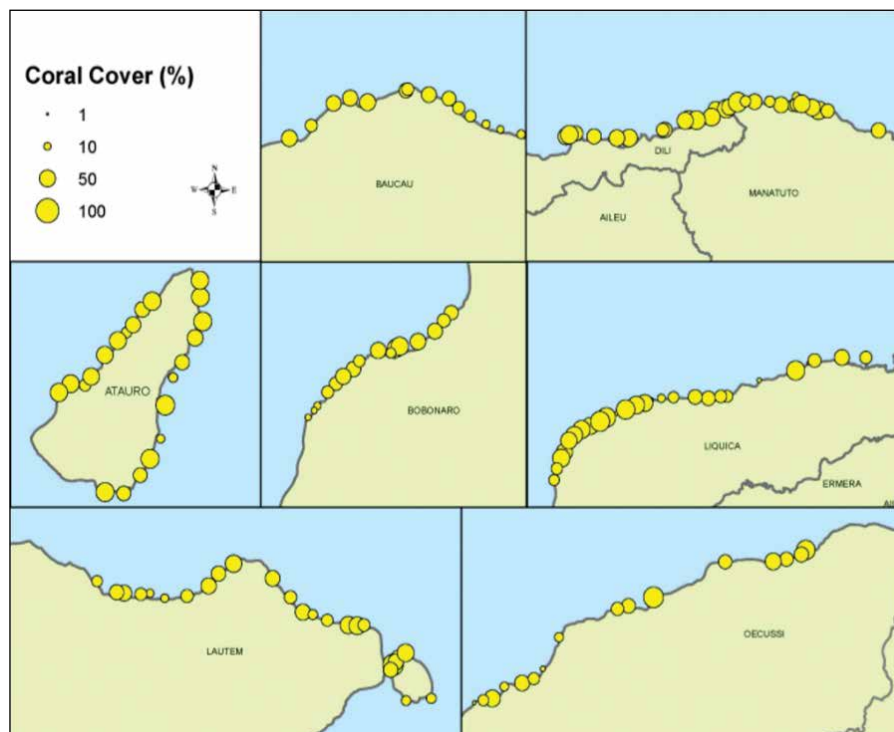
Region	Derived Bathymetry (km <sup>2</sup> )	Benthic Habitat (km <sup>2</sup> )	Hard Substrate (km <sup>2</sup> )	Soft Substrate (km <sup>2</sup> )	Seagrass (km <sup>2</sup> )	Mangrove (km <sup>2</sup> )	Macroalgae (km <sup>2</sup> )	Intertidal (km <sup>2</sup> )	Emergent Rocks (km <sup>2</sup> )	Lagoon (km <sup>2</sup> )	Unknown (km <sup>2</sup> )
Atauro Island	15.1	13.1	7.1	3.6	2.4	0.1	–	–	–	–	7.7
Oecusse	19.3	12.6	3.8	6.8	2.0	0.1	–	–	–	–	16.8
North Shore	85.6	76.9	35.1	16.3	10.5	2.7	6.2	3.3	0.5	2.3	249.1
South Shore	–	32.7	14.3	15.3	3.0	0.1	–	–	–	–	120.0
<b>Total</b>	<b>120.0</b>	<b>135.3</b>	<b>60.3</b>	<b>41.9</b>	<b>17.9</b>	<b>2.9</b>	<b>6.2</b>	<b>3.3</b>	<b>0.5</b>	<b>2.3</b>	<b>393.6</b>

km<sup>2</sup> = square kilometers

Note: 'Derived Bathymetry' and 'Benthic Habitat' are the areas mapped by region (km<sup>2</sup>). 'Unknown' is the area that could not be classified and is therefore excluded from the 'Benthic Habitat' area. The columns in light green show the benthic habitat characterized for each region (km<sup>2</sup>) that are included in the 'Benthic Habitat' area.

Benthic communities were assessed along a diverse range of physical, biological, and anthropogenic influences. Hard (scleractinian) coral cover ranged from 0.0 to 42.3% across sites, with an average of 15.6% (standard error (SE): 0.8). Notably, Lautem and Atauro exhibited the highest mean coral cover at 20.3% (SE 2.1) and 20.5% (SE 2.0), respectively. Baucau and Liquiça had the lowest at 10.4% (SE 1.8) and 10.7% (SE 1.6), respectively (**Figure 11.1** and **Table 11.2**) (PIFSC-NOAA, 2017).

<sup>8</sup> PIFSC-NOAA. 2017. Interdisciplinary baseline ecosystem assessment surveys to inform ecosystem-based management planning in Timor-Leste: Final Report. NOAA Pacific Islands Fisheries Science Center, PIFSC Special Publication, SP-17-02, 234p.

**Figure 11.1:** Mean Coral Cover at Sites Surveyed.

Source: <http://www.pifsc.noaa.gov/pubs/credpub.php>.

### 11.1.1 Mangroves/Wetland Forests

The total mangrove area has been reduced from 9,000 ha in 1940 to only 1,802 ha in 2008, equating to an 80% loss, and to only 290 ha in 2015. The reduction was mainly due to trees harvested for timber and fuelwood and the establishment of brackish water shrimp and/or fish ponds. Salt is also being extracted from mangrove fringes.

The information obtained from PIFSC-NOAA (2017) indicates that the cover area of mangrove in Timor-Leste remains at 2.9 km<sup>2</sup>. The largest stand is found in Metinaro region. In the Atauro Vila, there is a small mangrove habitat. The trees are few, widely-separated, and do not form a solid canopy. There are six species out of the 19 species known to be true mangrove species in Timor-Leste. So far, many of these mangroves have become extinct due to massive pressure from coastal communities. In order to sustainably manage these mangroves, it is necessary to organize local communities and local leaders to replant mangroves particularly for those species that are under threat or nearly extinct.

### 11.1.2 Coral Reefs/Benthic

The coral reefs are in good condition with 51% as hard and soft coral cover. The coral reef fish community is species-rich but overfished, with 23 species belonging to seven families found across the country. Although these are not the most valuable species (MAF, 2014).

Coral reefs in Timor-Leste are very important. The marine near shore zone is characterized by a narrow reef flat (often <60m wide but up to almost 1 km in length) and is dominated by seagrass in shallower water. The north coast of Timor has very few coral reefs, seagrass, and mangrove habitats. This imposes strong limitations on available marine resources and levels of harvest, particularly reef fisheries and mangroves (Uniquist, 2010).

In Lautem (Com), results of the research done by MAF with LIPI Indonesia<sup>9</sup> found 106 species of coral from 15 families of coral reefs (type of coral is fringing reef). The growth rate of the coral stone was very much impacted by two big rivers (Tamarau and Verukocho) plus other two small rivers, Tamaru and Lautem. Percentage cover of both biotic and abiotic was identified using the reef resource inventory (RRI) method, which was conducted along the coastal areas of Com and Lautem (**Table 11.2**).

**Table 11.2:** Percentage of Area Covered By Coral Reefs.

Location of Reef	Live Coral	Dead Coral	Algae	Other Fauna	Abiotic	Category
Com (in front of guesthouse SINA)	31.56	1.66	12.43	16.16	38.19	Average
Apile	26.90	5.70	13.00	35.4	19.00	Average
Wirasira	25.36	21.98	4.66	8.83	39.17	Average
Bunkerr Jepang	14.66	19.53	33.66	23.62	8.53	Bad
Euqisi 2	16.08	6.56	42.2	3.33	31.83	Bad

Source: MAF and LIPI; Hukom, et al., 2012.

The condition of coral reefs was also observed using the RRI method, which covered 11 locations in Com and Lautem coastal areas (**Table 11.3**). Morphology of the beach is white sand. The sea area is covered with growing seagrass of around 300 m. The coral reef area is covered with growing fringing reefs. The species of coral are dominated by *Heliopora Coerulea*, *Millepora dichotma*, and *Porites lutea*. The number of identified species is shown in **Table 11.4**.

**Table 11.3:** Category of Coral Conditions In Each Location Using RRI Method.

Percentage/ category	Condition	Location	Remarks
75%–100 % (4)	Very good	-	None
50%– 74.9% (3)	Good	Salaras	One location
24%– 49.9% (2)	Average/Sufficient	Leosun, Karasana, Euqisi, Sika dan Irakusu	Five locations
0– 23.9% (1)	Bad	Inakana, Dermaga Com, Kamatara, Kekerara, dan Raumaleo	Five locations

Source: MAF and LIPI; Hukom, et al., 2012.

<sup>9</sup> The Indonesian Institute of Sciences (*Lembaga Ilmu Pengetahuan Indonesia*, or LIPI) is the governmental authority for science and research in Indonesia.



**Table 11.4:** Biodiversity of Coral in Lautem.

Location of Reef	Position	Number of Species	Number of Genus	Number of Family
Com (in front of guesthouse SINA)	S.08° 21' 35.31 " E.127° 03' 41.04 "	93	42	15
Apile	S.08° 20' 31.09 " E.127° 02' 51.25 "	92	37	15
Wirasira	S.08° 20' 00.85 " E.126° 56' 37.82 "	74	37	15
Bunkerr Jepang	S.08° 21' 26.20 " E.126° 54' 24.96 "	44	25	14
Euqisi 2	S.08° 25' 01.30 " E.126° 46' 22.54 "	59	30	14

Source: MAF and LPI; Hukom, et al., 2012.

The condition of coral reefs was also observed based on percentage of cover area and components in each location on the northern coast of Timor-Leste using the Line Intercept Transect (LIT) method. The biotic and abiotic components are: hard coral 26.91%, soft coral 8.82%, sponges 0.64%, other fauna 5.45%, dead coral covered with algae 29.91%, sand 21.82%, and some rubbles.

### **Benthic habitat assessment (PIFSC-NOAA, 2017)**

The dataset developed by PIFSC-NOAA (2017) for the shallow coastal seafloor (0 m–20 m) covering 135.3 km<sup>2</sup> of nearshore habitats in Timor-Leste (excluding unknown areas) summarized 12 characterized habitat classes, which were classified into eight habitat types: (i) hard substrate, (ii) soft substrate, (iii) seagrass, (iv) mangrove, (v) macroalgae, (vi) intertidal, (vii) emergent rocks, and (viii) lagoon. The following are the key findings of the benthic habitat assessment:

- With respect to benthic cover, hard coral cover averaged 15.6% among the eight survey districts. Hard and soft corals as well as crustose coralline algae were more dominant than turf and macroalgae in Atauro, Liquiça, and Manatuto districts, favoring reef structure and integrity. In the remaining survey sectors, turf and macroalgae were more dominant than corals and crustose coralline algae.
- Live hard coral cover reached 40% within the recently designated Nino Konis Santana National Marine Park, and 38% in the Belio Barrier Reef complex, reflecting some of the highest quality reefs in the country.
- The average fish species richness for all sectors was extremely high in Timor-Leste (averaging 57 species per site) compared to any other Pacific region that NOAA-Coral Reef Ecosystem Program (CREP) surveys.
- Small-bodied fish biomass in Timor-Leste was similar to other remote, unpopulated areas in the Pacific islands, while medium- and large-bodied fish biomass (including species important as fishery targets) was comparable to values from other human-populated areas in the Pacific.

- Fish biomass was greatest in West Atauro comparable to other remote areas in the Pacific, suggesting that West Atauro fish assemblages are relatively unimpacted by human activities and/or this is an area of high productivity.
- The surgeonfish family had the highest biomass, accounting for 20% of the total fish biomass.
- A diverse number of crustaceans have been found in the biodiversity assessments conducted using autonomous reef monitoring structures (ARMS), including important fishery targets, such as shrimp, crab, and lobster, with the highest mean cryptobiota diversity at the Biaucou and Tutuala sites.

### Reef fish biomass

Geographic Region and Trophic Group for Timor-Leste estimated that the total reef fish biomass averaged at 41.1 g/m<sup>2</sup> [standard error (SE): 3.1], which is slightly higher than other populated areas in the Pacific [30.6 g/m<sup>2</sup> (SE: 2.1)], but more comparable to populated than remote areas [119.2 g/m<sup>2</sup> (SE: 11)]. Planktivores made up the majority of the overall fish biomass (50.3%), followed by primary consumers (22.3%), secondary consumers (18.8%), and piscivores (8.6%).

**Figure 11.2** shows the mean total fish biomass at each location.

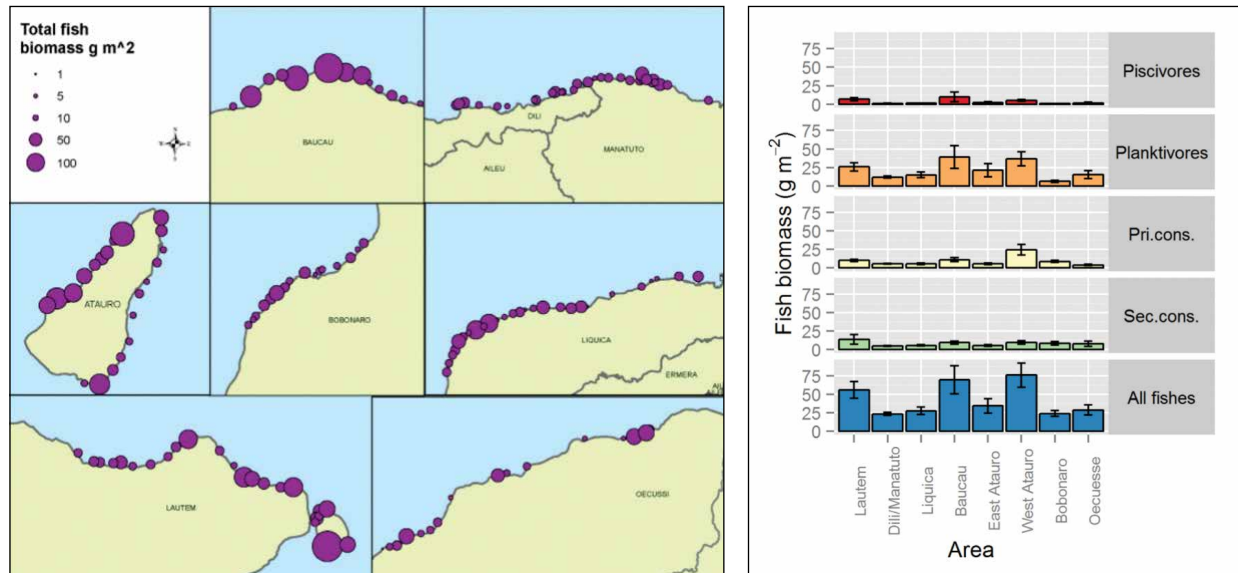
Reef fish biomass by trophic group is classified as:

- (i) 'Primary Consumers' – herbivores that eat marine plants and detritivores that eat detritus (largely comprised of surgeon fish and parrotfish);
- (ii) 'Secondary Consumers' – omnivores that eat marine plants and animals and insectivores that eat benthic invertebrate organisms (includes most wrasses, butterfly fish, triggerfish, and filefish);
- (iii) 'Planktivores' – eat drifting marine plants (phytoplankton) and animals (zooplankton) (includes several unicorn fishes, damselfishes, fusiliers, and several soldier fishes);
- (iv) 'Piscivores' – eat other fish (includes most jacks, groupers, emperors, barracudas, sharks, moray eels, and lizardfish).

Planktivores made up the majority of the overall fish biomass (50.3%), followed by primary consumers (22.3%), secondary consumers (18.8%), and piscivores (8.6%).

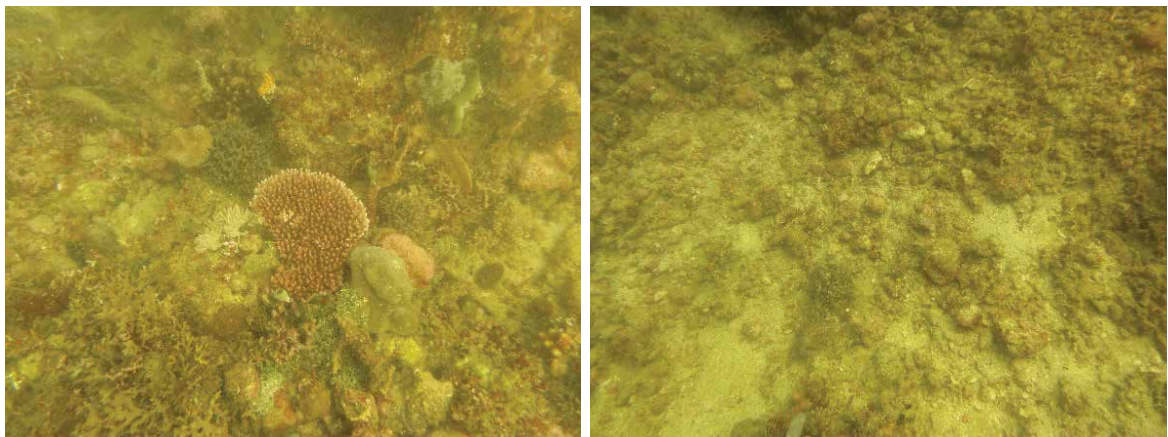
**Figure 11.2:** Mean Total Fish Biomass at Sites.

At each site, the fish assemblage was surveyed by underwater visual census and the benthic community of the reef was assessed.



Source: MAF-LPI; Hukom et al., 2012.

The west side of Atauro Island had the highest average fish biomass (75.9 g/m<sup>2</sup> [SE 12.90]), while Dili/Manatuto (23.4 g/m<sup>2</sup> [SE 2.0]) and Bobonaro (23.0 g m<sup>-2</sup> [SE 3.1]) had the lowest as can be seen in **Figure 11.3**. The high biomass in West Atauro may be related to the relatively high structural complexity of the reef, which was dominated by a steep wall.

**Figure 11.3:** Coral Reefs in Bobonaro.

Source: MAF

### 11.1.3 Seagrass

Seagrasses are recognized for their ability to help stabilize coastlines and provide shelter to an array of economically important marine organisms. Additionally, they are a critical habitat for a number of endangered marine species (*Dugong dugon* and *Cheloniemydas*), as well as support a rich and diverse fauna (Tomascik et al., 1997).

The narrow reef flats on the northern coast are dominated by seagrass beds in shallow waters (more than 2,200 hectares), but the distribution of seagrass to the southern coast of the island remains unknown. Seven genera are known to exist around Timor-Leste: *Halodule*, *Halophila*, *Enhalus*, *Cymodocea*, *Syringodium*, *Thalassia*, and *Thalassodendron*.

A total area of 17.9 km<sup>2</sup> is covered by seagrass along the coasts of Timor-Leste (PIFSC-NOAA, 2017).

In the Atauro Vila, there is an extensive seagrass cover that is in good condition throughout the length of the aquatic natural reserve. About four species were found out of the five known in Timor-Leste.

## 11.2 Major Risks and Threats

The environmental damages are complex and various from different magnitudes, starting from fires, landslides, erosion, flooding, inundation, and sea level rise. The impact is massive and greatly affects human life, such as houses, bridges, agricultural production, livestock, and water sources.

**Coastal erosion.** Coastal erosion largely occurs in the northern coast of Timor-Leste. This is because a majority of the population (66%) are living in the coastal areas and are relying heavily on coastal resources for survival, e.g., cutting mangrove trees for cash and canoe assembly, but in the end, this has a significant contribution to the destruction of fish habitats and ecosystems.

**Solid waste and marine debris.** Marine debris is one of the major problems in Timor-Leste (on the northern coast) recorded so far. Cruz (2015) describes that marine debris in Timor-Leste is getting greater and worst as a consequence of population growth. The marine debris provides significant negative impacts on coastal areas due to inefficient waste management found in the urban areas.

Laws and regulations exist, but these are not compatible with the socio-economic conditions of the coastal communities. Education and public awareness are necessary, but should not only target the communities and fishermen, but also the community leaders and local government staff who must prioritize conservation programs, law enforcement as well as allocation of more funds to safeguard marine and coastal resources.

**Climate change.** The PIFSC-NOAA (2017) study shows that the waters surrounding Timor-Leste support high fish diversity as well as areas of localized high coral cover. Yet, the seawater carbonate chemistry observed in the shallow water reef environments of Timor-Leste suggests an area of concern

and warrants continued long-term monitoring to assess whether low reef accretion rates are indeed an early indication of the effects of ocean acidification reducing reef growth and survival in the region. The baseline assessment for climate change has the following observations (PIFSC-NOAA, 2017):

- Net calcium carbonate accretion rates (used to track early responses to acidifying seawater conditions) were among the lowest recorded among NOAA-CREP's Pacific monitoring sites, and fell below predicted values based on water chemistry parameters.
- Recorded reef seawater temperatures from October 2012 to October 2014 exceeded the previously reported maximum for northern Timor-Leste from the NOAA Reynolds Optimal Interpolation Sea Surface Temperature (OISST) dataset.
- Timor-Leste's reefs have lower pH, aragonite saturation state, and net carbonate accretion values than many Pacific reefs monitored by NOAA-CREP. These low measurements suggest that ocean acidification impacts are part of a suite of threats currently facing growth of Timor-Leste's reefs.

### 11.3 Rare, Threatened and Endangered Species

Some of coastal heritage areas are protected by formal regulation, including that of the traditional law ('Tara Bandu'). Also, UNTAET Regulation 2000/19 is implemented in this Island, such as regulations on exporting and logging trees/timber.

There are 10 species of plants and animals in Timor-Leste, which are included in the IUCN Red List of Threatened Species (**Table 11.5**). There are three trees, four birds, two mammals and one insect in the list. Threatening activities or processes listed include habitat loss, fire, agriculture, logging, degradation, and extraction. Effective strategies and good management practices are needed to protect these species.

**Table 11.5:** Species of Animals Under Threat in Timor-Leste.

Common name/Scientific name	IUCN status	Threatening process
<b>BIRDS</b>		
Timor Green Pigeon ( <i>Treron psittaceus</i> )	EN (endangered)	Habitat loss, hunting, agriculture
Timor Imperial Pigeon ( <i>Ducula cineracea</i> )	EN	Habitat loss, hunting, agriculture
Wetar Ground-dove ( <i>Gallicolumba hoedtii</i> )	EN	Habitat loss, hunting, agriculture
Yellow-crested Cockatoo ( <i>Cacatua sulphurea</i> )	CR (critically endangered)	Habitat loss, harvest for pet trade, agriculture
<b>MAMMALS</b>		
Thin Shrew ( <i>Crocidura tenuis</i> )	VU (vulnerable)	Habitat loss, degradation, restricted range
Western Naked-backed Bat ( <i>Dobsonia peronii</i> )	VU	Habitat loss, extraction, restricted range
<b>INSECTS</b>		
Timor Yellow Tiger ( <i>Parantia timorica</i> )	EN	Severely fragmented population with ongoing decline

Source: Adapted from Trainor, 2010, as cited in Grantham, 2010.

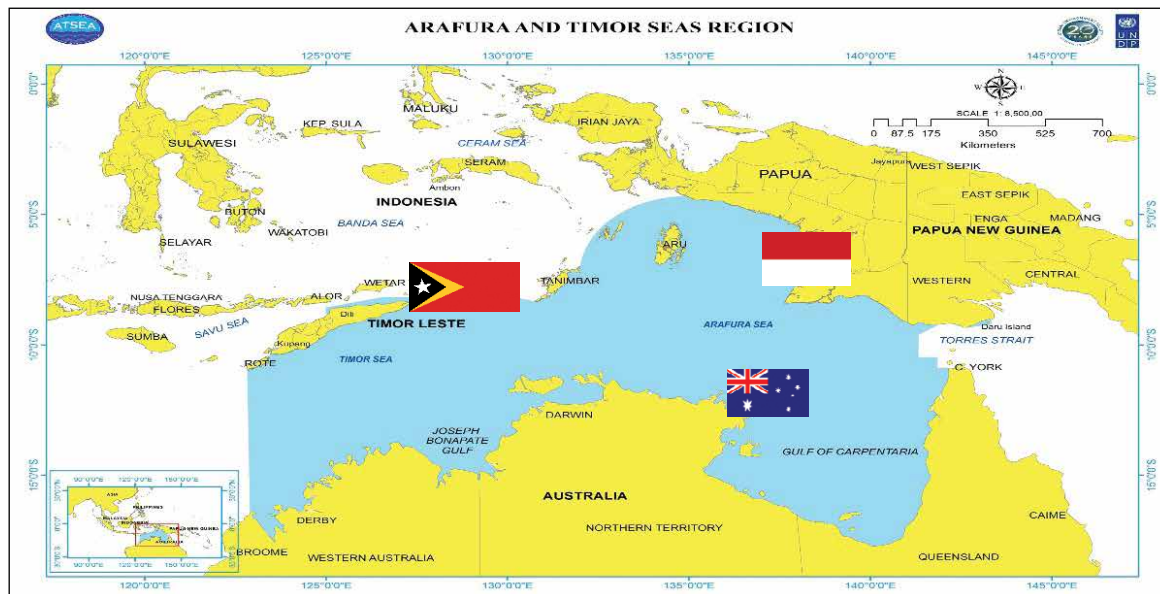
There are other species that are endangered and have been protected. These include mangroves and the *dugong*. The crocodile has been protected as well as it was considered as the grandfather of Timor-Leste's culture.

## 11.4 Large Marine Ecosystem: Arafura-Timor Seas (ATS)<sup>10</sup>

### 11.4.1 Location

The Arafura-Timor Seas (ATS) are bounded to the south by northern Australia, to the east by the Torres Strait, to the north by the southern coast of Papua and the eastern islands of East Nusa Tenggara and South-eastern Maluku. To the west, however, the ATS area connects to the eastern part of Indian Ocean (**Figure 11.4**).

**Figure 11.4:** Map of Arafura-Timor Seas (ATS).



Source: ATSEA

### 11.4.2 Bathymetry of the ATS Region

The Arafura Sea area is estimated to be 600,000 km<sup>2</sup>; while that of the Timor Sea is approximated at 615,000 km<sup>2</sup>. Bathymetry of the area covers the continental shelf and trough with various depths. Average depths of the Arafura sea range from 30 m to 90 m. To the east, however, the Torres Strait depths are less than 15 m at the shallowest part while depths are slightly deeper to the west in the Timor sea - ranging from 50 m to 120 m. However, there are small areas that are more than 1200 m in the deepest part, such as the Timor trough that run parallel to the island of

<sup>10</sup> This section is taken from Wirasantosa, et al., 2011 and Alongi, et al., 2011.

Timor, with depths reaching more than 3000 m. Bathymetry of the area is an important aspect of the natural condition since it affects the oceanography of the area. The shallow ridge in Torres Strait, for instance, is an impediment to a direct connectivity between the Indian and Pacific oceans, particularly for deep water connectivity. Therefore, deep ocean water from the two oceans is connected through the deeper routes, such as the straits of Makassar, Lombok, Lifamatola, Ombai, and through other deeper channels between islands of Nusa Tenggara (Wirasantosa, et al., 2011).

The shelf area indicates that it was dry land prior to 18,000 years ago, except in the trough with much greater depths. Marine transgression occurred during 8,000-11,000 years ago that flooded the area. According to Nontji (2002), the Arafura–Sahul continental shelf consists of the Arafura shelf (name was given by Krummel, 1897), which includes the shelf area from Van Diemen Cape in Australia to south of Papua; the Sahul shelf to the west of Van Diemen Cape to the Cape of Leveque; and the Rowley shelf to the west of Sahul shelf. The shelf area is a vast area with a total of 1.5 million km<sup>2</sup> that comprises of 930,000 km<sup>2</sup> of the Arafura shelf, 300,000 km<sup>2</sup> of the Sahul shelf, and about 300,000 km<sup>2</sup> of the Rowley shelf. Daizell and Pauly (1990), as quoted by ATSEF Book 1 (2006), indicates that the surface area of Arafura Sea is 599,000 km<sup>2</sup>, smaller than that of Nontji's figure of 930,000 km<sup>2</sup>. In the geodynamics of eastern Indonesia, Hall (1995) indicates that the shelf area is always attached to the Australia continent as well as to the southern part of Papua in the last 50 million years and has never been separated as blocks as is the case of the islands to the northwest. Freshwater input to the Arafura Sea mainly comes from the southwest flowing rivers in Papua and some rivers flowing to the Gulf of Carpentaria and northern Australia with continuing submerged tributaries in the shelf area. Few fresh water inputs flow from Aru, Yamdena and Kei islands. Freshwater input to the Timor Sea mainly comes from northward flowing rivers in the northern part of Australia and seasonally may come from the southward flowing tributaries in Timor Island, although total annual precipitations in Timor are in the range of 1,600 mm/yr–2,300 mm/yr. The total annual precipitation in the district of Belu, the district bordering with Timor-Leste, is the lowest with 1,060 mm/yr. Rivers and tributaries on the islands of Timor, Papua and the northern part of Australia are discharging sediments into the ATS area. Milliman et al. (1999) shows that the largest sediment input to the area comes from Papua (427 x 10<sup>6</sup> tonnes/yr); while sediment input from Timor is relatively small (59 tonnes/yr x 10<sup>6</sup> tonnes/yr) (Wirasantosa et al., 2011).

### 11.4.3 Biodiversity

#### Plankton

Plankton is important in terms of providing a crucial source of food to aquatic life. Plankton distribution and abundance are strongly dependent on ambient nutrients concentrations and the physical state of the water column. The ATS region is a plankton-rich region. Wijopriyono, et al. (2007) reported that plankton in the Arafura sea consists of 46 species of phytoplankton

representing four families: *Bacillariophyceae*, *Dinophyceae*, *Chrysophyceae*, and *Cyanophyceae*. The dominant one is the *Bacillariophyceae*, which is represented by 36 species.

Zooplankton in the Arafura Sea is represented by at least 55 species of eight families. The dominant species is represented by 35 species of crustacean. The other families that include *Urochordata*, *Ciliata*, *Sagittidea*, *Sarcondina*, *Ophisthobranchia*, *Holothuroidea*, and *Coelenterata*, are represented by one to six species.

### **Coral reefs**

The ATS area is located in the southern perimeter of a “Coral Triangle”, a recently defined area of rich biodiversity that encompasses six country territories: Indonesia, the Philippines, Papua New Guinea, Timor-Leste, Malaysia (Sabah), and the Solomon Islands. The Coral Triangle area consists of several eco-regions that covers reef areas of 75,000 km<sup>2</sup> with over 500 species of corals and over 3,000 species of fishes. The Coral Triangle covers the “core” of the Indo Pacific Global Centre of Coral Diversity with more than 70 genera of corals.

In the Timor Sea, coral reefs are found around the islands of Timor, Tikus, Burung, Kera, Semau, Kambing, Mera, and Rote and are commonly of the fringing type of reefs without lagoon. It was found that coral reefs in Timor Sea had 160 species of corals that formed a habitat for 350 species of reef fish (Wirasantosa et al., 2011).

### **Mangroves**

Distribution of the main mangrove species in this area, depends on the physical condition of the coastal area. *Rhizophora conjugata* and *Bruguiera parvifolia* are the main species to be found in this area. Generally, more than one species is found in the area parallel to the coastline up to the high tide mark. In waters with high salinity and sandy substrate, mangroves of the *Sonneratia alba* and *Bruguiera parvifolia* may be found. On muddy substrate, mangroves of *Rhizophora conjugata* and *Bruguiera* are more common; while in stagnant water with high salinity, *Rhizophora conjugata* and *Avicennia marina* are commonly seen. The other mangrove species found in the area are *Aegiceras corniculatum*, *Acanthus ilicifolius*, *Lumnitzera racemosa*, *Heritiera littoralis*, and *Acanthus ilicifolius* (Wirasantosa et al., 2011).

### **Seagrass**

The seagrass ecosystem is a shallow marine ecosystem that is normally found in the area between mangrove ecosystem and coral reefs. The seagrass ecosystem is known as a feeding ground



for marine mammals and sea turtles. This ecosystem has high organic productivity and provides suitable living environment for many marine organisms. In the Timor Sea, seagrass is found in lagoon areas with a sandy substrate, as well as in the other types of substrate that includes muddy bottoms to rocky shores. Wagey and Arifin (2008) reported that there are seven species of seagrass which are commonly found in the Timor Sea. These species include *Halodule uninervis*, *Halophila decipiens*, *Halophila ovalis*, *Enhalus acoroides*, *Syringodium isoetifolium*, *Thalassodendron ciliatum* and *Thalassia hemprichi* (Wirasantosa et al., 2011). Total area of seagrass in ATS is 23.78 km<sup>2</sup> with value of US\$959.05 per km<sup>2</sup> (PIFSC-NOAA, 2017).

### Sharks and rays

In the ATS region, sharks are found to have 15 families with 64 species, and rays are identified to have 11 families with 41 species, while there is only one family with 2 species of *Chimaera* that is known (Wagey and Arifin, 2008). Sharks and Rays have been identified only to the genus level.

Around two species of shark in the Australian northern waters are black-tip sharks (*Carcharhinus tilstoni* and *C. sorrah*). Hammerhead sharks (*Sphyrnidae*) also form a significant part of the catch in the area (Staples D., derek.staples@brs.gov.au).

Observations on the result of fish trawling survey in November 2006 (Wijipriono et al., 2007) in the Arafura Sea have identified the sharks and rays as listed in **Table 11.6**.

**Table 11.6:** Sharks and Rays Captured By Fish Trawling in the Arafura Sea.

Group	Family	Species
Rays	<i>Dasyatidae</i>	<i>Dasyatis sp.</i>
	<i>Gymnuridae</i>	<i>Gymnura sp.</i>
	<i>Myliobatidae</i>	<i>Aetomylius nichofii</i>
	<i>Narcinidae</i>	<i>Narcinidae sp.</i>
Sharks	<i>Rhinobatidae</i>	<i>Rhinobatidae</i>
	<i>Charcarinidae</i>	<i>Carcharinus sp.</i>
		<i>Gharcarinus sp.</i>
	<i>Spyrniae</i>	<i>Spyrna lewini</i>
	<i>Orectolobidae</i>	<i>Orectolobidae sp.</i>

Source: Wijipriono et al., 2007.

#### 11.4.4 Shared Resources and Socioeconomic Value

Arafura and Timor Seas (ATS) provide opportunities for regional cooperation – e.g. trans-boundary fish stock management, IUU fishing, oceanography, international water, etc.

There are approximately 4.1 million people living in the ATS region. The region is rich in marine and fisheries resources. However, inter-sectoral governance/ coordination for fish management is lacking. This area is also highly dominated by coastal communities with poverty and food insecurity being the major threats.

##### **Fisheries of Arafura Sea**

The Arafura Sea is one of the most productive fishing grounds for demersal fisheries including shrimp. Most of the illegal fishing happens in this region. Indonesia has imposed a fishing moratorium for foreign vessels, executed by the Indonesian Ministry of Marine Affairs and Fisheries. Timor-Leste needs to work more closely with Indonesia in order to combat illegal, unreported and unregulated (IUU) fishing.

##### **Fisheries of Timor Sea (South Coast of Timor-Leste)**

Trawlable area in the waters south of Timor (subareas Covalima and Lore in Lospalos) are very narrow with the water depth being less than 50 m, followed by deep seas contour (Timor trench). Artisanal fisheries are dominant. The Ministry of Agriculture and Fisheries (MAF) permits foreign vessels to be operated on the southern coast, whilst the northern coast are for local fishermen.

The composition of catch rates are as follows: demersal fish of 61.4 kg/hr (71.7% of total catch), followed by sea urchin of 20.8 kg/hr (23.3%), penaeid shrimp of 2.6 kg/hr (3.0%) and nonedible crab of 0.8 kg/hr (Sumiono, 2011).

##### **Other sectors**

Onshore mining (gold, nickel, and manganese), offshore petroleum and gas exploration, agricultural production, forestry (logging) and coastal development management, and conservation and marine tourism are also key sectors but have minimal impacts to the environment.

#### 11.4.5 Transboundary Issues

The major transboundary issues that need to be addressed by countries sharing resources in Arafura-Timor Seas are shown in **Table 11.7**.

**Table 11.7:** Priority Transboundary Issues in the Arafura-Timor Seas (ATS).

Priority Environmental Concerns	Key Causal Factors
1. Unsustainable fisheries and decline and loss of living coastal and marine resources	illegal, unreported, and regulated fishing; overexploitation; unsustainable practices; fisheries by-catch
2. Modification, degradation, and loss of coastal and marine habitats	coastal development, bottom trawling, fuelwood (mangroves), dynamite fishing, pollution (sediments)
3. Marine and land-based pollution (e.g. marine debris, sediments, oil spills)	coastal development (nutrients, sediments), mining (sediments, toxicants), land degradation (sediments), oil spills, marine debris, untreated wastewater (nutrients)
4. Decline and loss of biodiversity and key marine species	illegal harvesting, traditional indigenous harvest, fisheries by-catch (ghost nets, trawling, tuna long-lines), habitat loss
5. Impacts of climate change including ocean warming and ocean acidification	fossil fuel-based global energy consumption, land use, land use change and deforestation

### 11.4.6 ATSEA: Progress of Strategies and Action Plans

Transboundary issues require regional solutions. Implementation of the ATS Strategic Action Program will provide solutions to issues, such as marine biodiversity, climate change, and socio-economic challenges.

**ATSEA Phase 1 (2010 – 2014):** Arafura Timor Sea Ecosystem Action (ATSEA) research cruise in Timor-Leste Water.

ATSEA Cruise 1 – Baruna Jaya VIII, May 2010 (Indonesia and Timor-Leste waters); ATSEA Cruise 2 – RV Solander, July 2011 (Timor-Leste and Australia waters); Initial implementation of ATSEA focused on the Demo Project in Timor-Leste. The ATSEA programs also include mangrove rehabilitation and mud crab farming.



*Mud crab culture and mangrove rehabilitation in Beacou.*

Some relevant activities were done in different locations:

- a. Fish product processing in Beacou;
- b. Conduct of monitoring and evaluation (June and Nov 2013);
- c. Regional Demo Project #2: Second exchange visit to Rote Island, Indonesia;
- d. Timorese champions learned Catfish (freshwater) aquaculture in Ba'a;
- e. Timorese champions learned traditional salt production and milkfish aquaculture in Papela; and
- f. Signing of ATSEA Ministerial Declaration and SAP in Manado on 15 May 2014.

## ATSEA Phase 2 (2017 – 2022)

Project Objective: To enhance sustainable development of the Arafura-Timor Seas (ATS) region to protect biodiversity and improve the quality of life of its inhabitants through conservation and sustainable management of marine-coastal ecosystems.

- **Component 1:** Regional, national, and local governance for large marine ecosystem management.
- **Component 2:** Improving the carrying capacity to sustain provisioning, regulating and supporting ecosystem services through knowledge management (**Table 11.8**).
- **Component 3:** Knowledge Management

**Table 11.8:** Initiatives under ATSEA-2 Program.

Integrated Approach	Indonesia	Timor-Leste	Papua New Guinea
Ecosystem approach to fisheries management (EAFM)	2 sites: <ul style="list-style-type: none"> <li>• Aru District (red snapper)</li> <li>• Aru District (shrimp)</li> </ul>	1 site: <ul style="list-style-type: none"> <li>• Viqueque Municipality (mackerel)</li> </ul>	1 site: <ul style="list-style-type: none"> <li>• South Fly District</li> </ul>
Fisheries Improvement Project (FIP)	3 sites: <ul style="list-style-type: none"> <li>• Aru District (red snapper)</li> <li>• Aru District (shrimp)</li> <li>• Merauke District (barramundi)</li> </ul>		
Integrated Coastal Management (ICM)	1 site: <ul style="list-style-type: none"> <li>• Rote Ndao District, NTT</li> </ul>	1 site: <ul style="list-style-type: none"> <li>• Barique Sub-District, Manatuto</li> </ul>	
ICM-Climate Change Adaptation (ICM-CCA)		1 site: <ul style="list-style-type: none"> <li>• Barique Sub-District, Manatuto</li> </ul>	
Ecosystem-based Adaptation (EbA)	1 site: <ul style="list-style-type: none"> <li>• Rote Ndao, NTT</li> </ul>		
Marine Protected Area (MPA)	2 sites: <ul style="list-style-type: none"> <li>• Southeast Aru MPA Kolepon MPA (new)</li> </ul>	2 sites: <ul style="list-style-type: none"> <li>• Nino Konis Santana South Coast MPA</li> </ul>	
Pollution Reduction	3 sites: <ul style="list-style-type: none"> <li>• Aru Islands,</li> <li>• Maluku</li> <li>• Rote Ndao, NTT</li> </ul>	2 sites: <ul style="list-style-type: none"> <li>• Barique Sub-District, Manatuto</li> <li>• Suai, Cova Lima Municipality</li> </ul>	

Source: PEMSEA. 2017. *Proceedings of the Blue Economy Forum 2017*.

# 12 Pressures and Threats from Human Activities, Natural Hazards and Climate Change

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## 12.1 Human Activities and Environmental Damage

Human activities, such as using fire in the conversion of forest into plantations, and cutting trees for house construction, fuelwood and for cash, have resulted in environmental damages. The main causes of environmental damages are lack of awareness and economic pressure. For example, during the dry season, people in the remote areas burn small jungles on the hills to hunt wild animals (e.g., deer, pig, and cuscus) for cash and for domestic consumption. At the same time, they are also cutting trees for the construction of houses because they have insufficient money to buy building materials.

Clearance of coastal areas for human settlement and fish ponds (brackish water) have impacted the marine and coastal resources. Human settlements in the coastal areas have caused marine and coastal pollution due to lack of solid and liquid waste management systems. Pollution has greatly impacted coastal and marine water quality, and habitats, which in turn affected the tourism sector, and consequently reduced opportunities for job and income generation.

The main pressures in the coastal and marine areas include:

- Urbanization and unregulated development in coastal and marine areas;
- Conversion and destruction of habitats and loss of biodiversity;
- Illegal, unreported, and unregulated (IUU) fishing;
- Over-exploitation of resources and overfishing;
- Dumping of solid and hazardous wastes; and
- Discharges of untreated wastewater and storm water runoff.

The overall ocean health index (OHI) score of Timor-Leste is 59. Lower scores indicate that more needs to be done to protect ocean health in Timor-Leste, and ensure that that environmental, economic, and social benefits, which healthy oceans provide, continue into the future. The target is to get a score of 100.

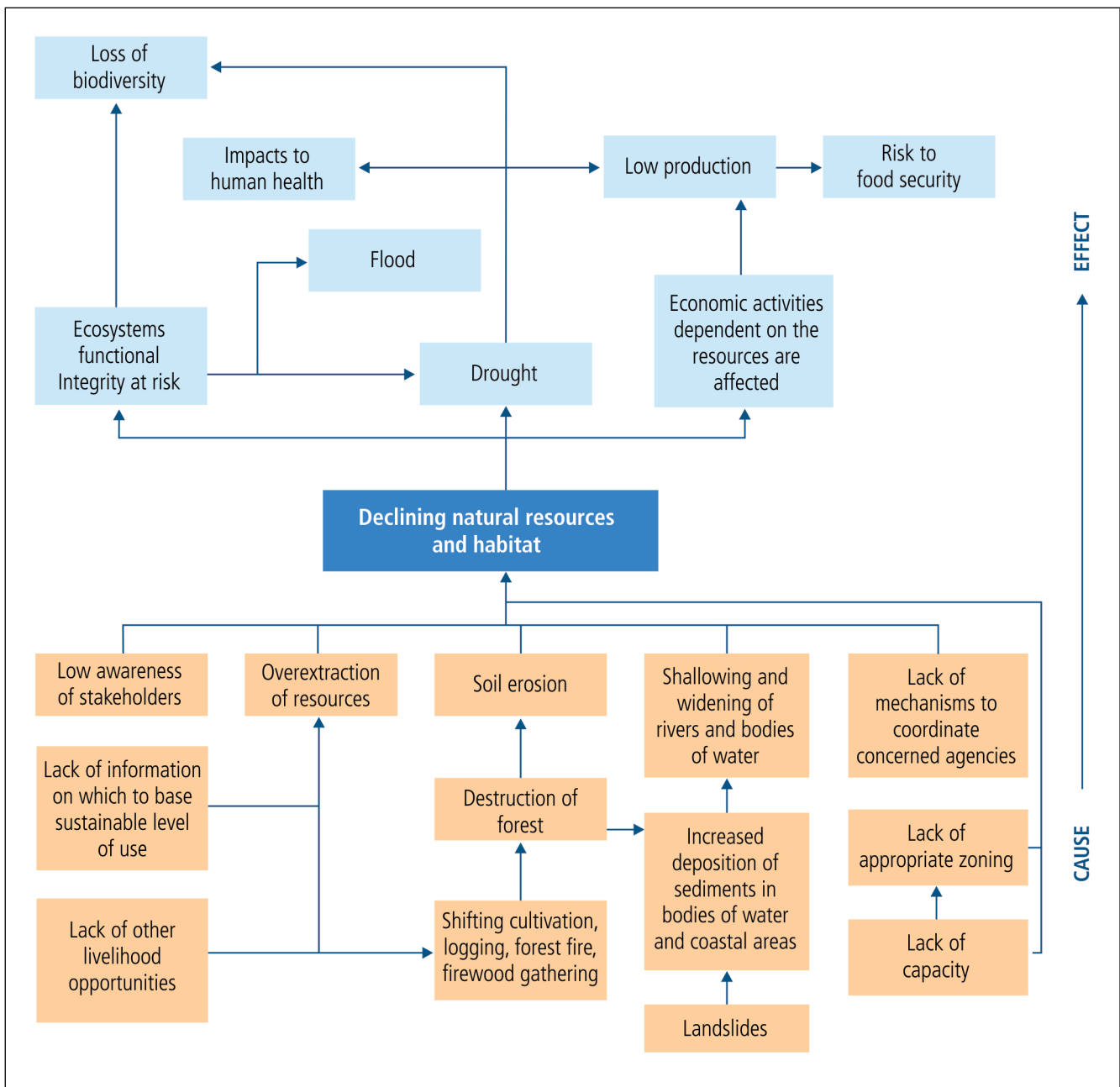
### 12.1.1 Habitat and Biodiversity Loss

Mangroves are being cut for house construction, building canoes, heating and cooking, as well as for cash. Historically, many mangroves species (~17 species) are growing on the northern coast

of Timor-Leste. But now, there are only a few species (around five species) growing in small scattered groups along the coast of Lautem, Baucau, Metinaro in Dili, Atauro, Liquiça, and Maliana.

Mangroves play an important role in preventing coastal abrasion and inundation, and providing nutrient supply for fish and non-fish species. Destruction of mangroves will heavily impact the income and protein intake of fisherfolk, as well as result in loss of shoreline protection and other ecosystem services provided by mangroves. **Figure 12.1** shows the problem tree analysis for habitat degradation.

**Figure 12.1:** Problem Tree Analysis for Habitat Degradation.



### 12.1.2 Erosion

Coastal erosion largely occurs on the northern coast of Timor-Leste. This is because most of the population (66%) are living on coastal areas. Coastal development has destroyed some habitats. Coastal communities also heavily rely on coastal resources for survival. Most of the mangroves have been gradually harvested by the people – an activity that results in coastal erosion, which in the end, has significant contribution to the destruction of fish habitat and marine ecosystem. Deforestation also contributes to soil erosion, and other negative consequences (**Box 2**).



Photo by M.Ebarvia

Laws and regulations already exist. However, these regulations should take into account the socio-economic conditions of the coastal communities. Education and public awareness are strongly required, not only targeting the communities and fisherfolk, but also community leaders and local government staff. More attention is needed on law enforcement and the allocation/investment of funds to safeguard marine and coastal resources.

#### Box 2. Impacts of Deforestation

**It is estimated that over 80% of the forests were destroyed between 1975 and 1999.**

In 1975, about half the land in Timor was primary and secondary forest. By 1989, areas of forest dropped to about 40%, and by 1999 less than 10% remained. Most of the deforestation was conducted under logging operations for teak, redwood, sandalwood, and mahogany for export. The use of wood as a primary fuel source has added to the problem of diminishing forests. Deforestation affects quality of drinking water due to soil erosion, increased contaminants, and water flow. During the rainy season, water quality deteriorates causing increased diseases and child mortality rates.

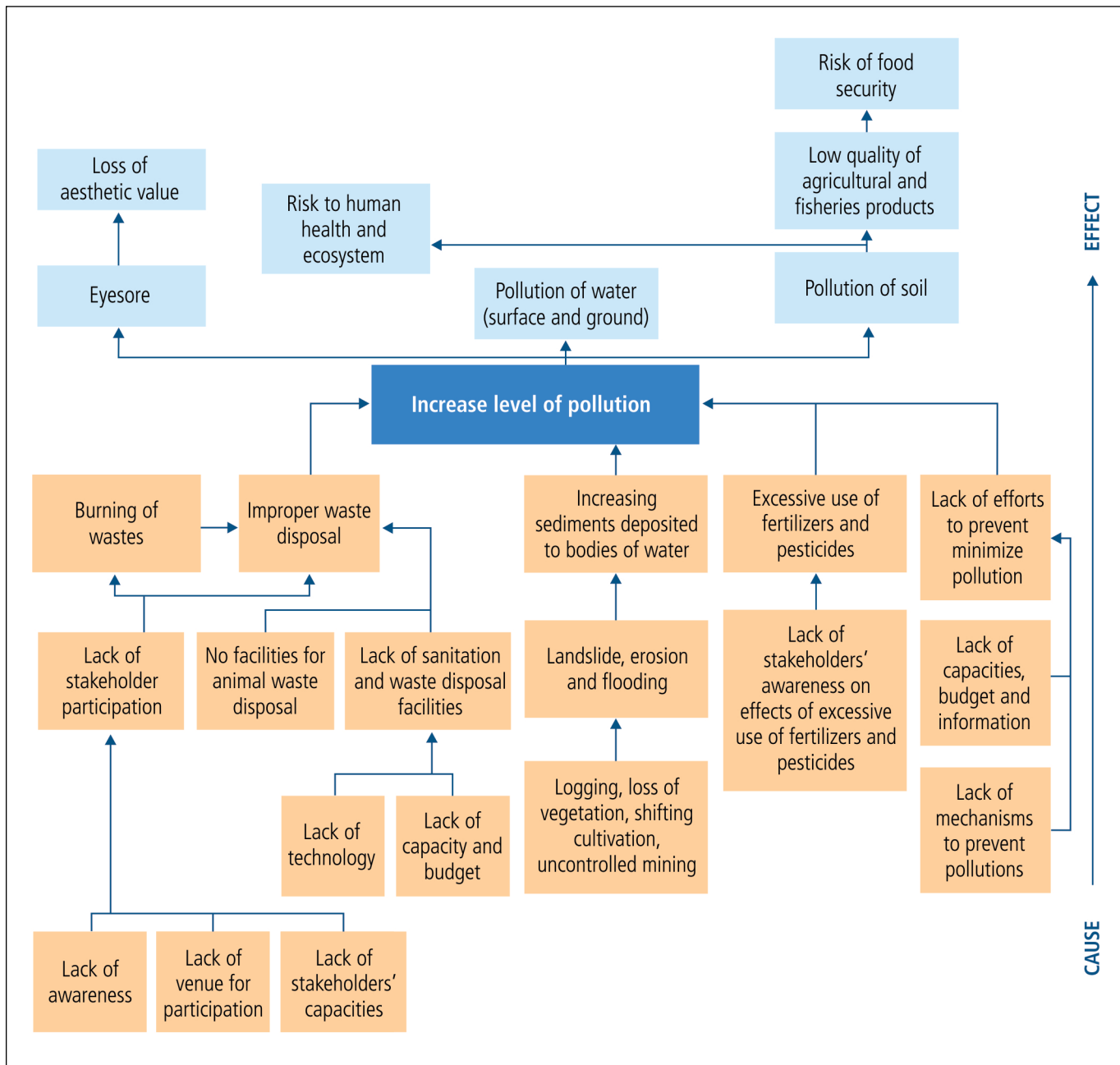
Of critical importance to the people of Timor-Leste is the implementation of strategies to restore landscapes to a sustainable position, maintain them on an ongoing basis and achieve a range of environmental, social and economic outcomes, particularly food security, improved water supply, and creation of employment and economic opportunity.

Source: [www.withoneplanet.org.au](http://www.withoneplanet.org.au).

### 12.1.3 Pollution

Pollution resulting from inadequate facilities for collection and treatment of wastewater, solid waste, and other types of waste has impacted water quality and ecosystems as well as human health and opportunities for recreation and tourism.

**Figure 12.2:** Problem Tree Analysis of Pollution in Manatuto Municipality.





### Lack of sanitation and wastewater management facilities

Sanitation facilities, and wastewater management systems are essential to reduce pollution loading into rivers and coasts, and protect the health of the oceans and the people. In terms of incidences of waterborne diseases, diarrhea is one of the top three diseases in children below five years old. Moreover, an environmental monitoring system should also be put in place to regularly assess the pollution loading, level of contamination, and water quality of groundwater, surface water (freshwater bodies), and coastal waters.

### Lack of solid waste management system

The efficient management of solid waste in urban areas in Timor-Leste is lacking. Inadequate intervention measures from the national and local governments, limited coordination, lack of facilities, and insufficient budget to design a proper collection, disposal and treatment system are major issues that need to be addressed.

In addition, the level of awareness of the people remains low. Many of the people still dispose solid waste improperly, and outside the disposal areas built by the local governments. Consequently, many types of solid waste are widespread, contaminating the ground and sea water.

The inadequate solid waste collection, transport and disposal system has resulted in garbage washed to rivers, and coastal and marine areas. **Table 12.1** shows the debris collected during the annual International Coastal Cleanup Day from 1989 to 2008. Cigarettes and cigarettes filters comprised 25% of the debris collected.

**Table 12.1:** Top Debris Items during International Coastal Clean-Up, 1989-2008.

No.	Debris Items	Percentage (%)
1	Cigarettes/cigarette filters	25.2
2	Caps, lids	9.2
3	Food wrappers/containers	9.0
4	Bags (paper and plastic)	7.0
5	Cups, plates, forks, knives, spoons	7.0
6	Beverage bottles (Glass)	4.8
7	Beverage cans	4.6
8	Straws, stirrers	4.5
9	Rope	2.1

Source: Ocean Conservancy

### Marine debris

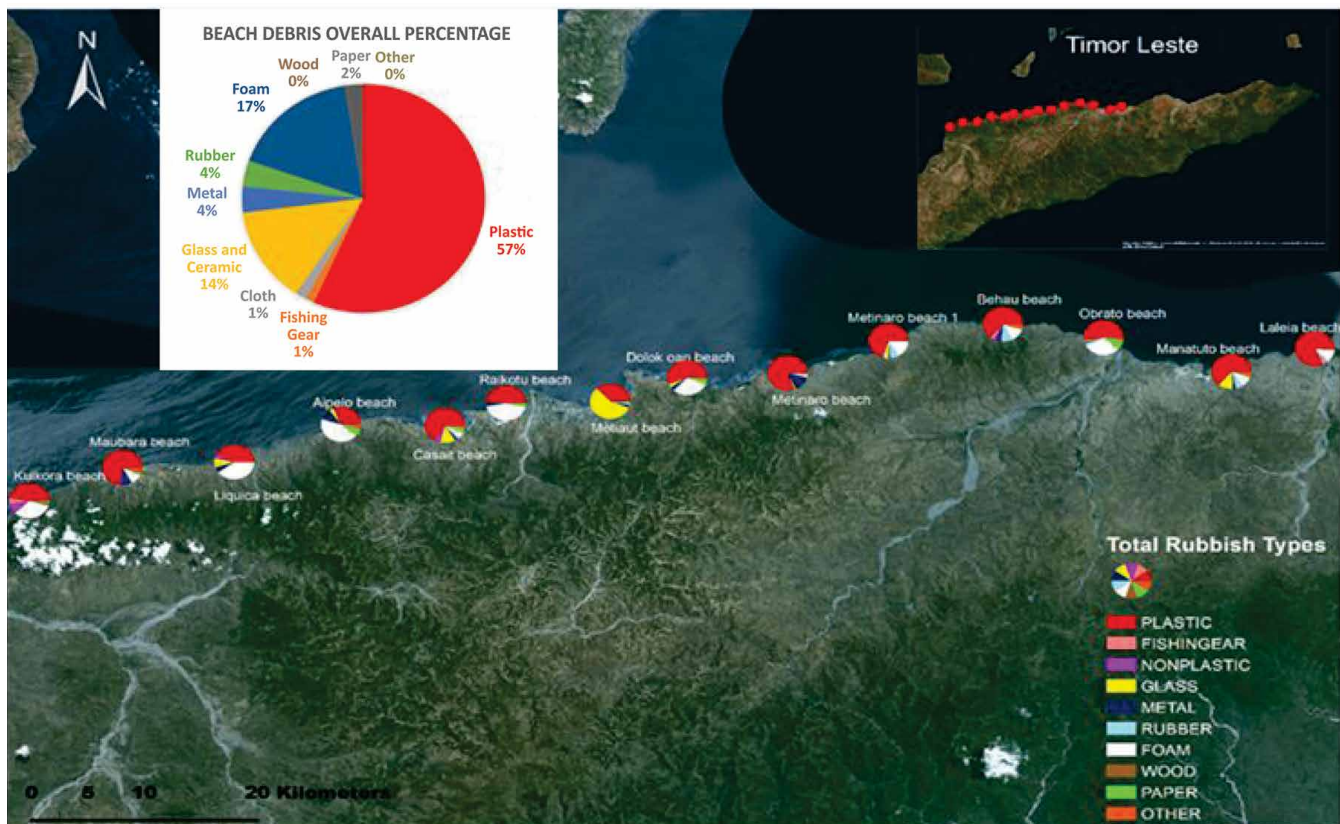
Marine debris is one of the main issues in Timor-Leste, especially on the northern coast. Cruz (2015) describes that marine debris in Timor-Leste is increasing and getting worse as a consequence of population growth and inappropriate waste management system typically in urban areas.

The study undertaken by Cruz (2015) quantifies the types, abundance, and sources of debris along the northern coast of Timor-Leste. The study predicts the anthropogenic and natural variables that contribute to areas of debris build up. The research was undertaken in 14 beaches, and five rivers in three municipalities (Manatuto, Dili and Liquiça). The research found a total of 2,166 items of debris in 14 beaches. In addition, the research found that debris density increased from upstream to downstream along the sampled rivers, and made an enormous impact on marine and coastal resources. Total and type of different debris can be seen in **Figure 12.3**.



Source: Cruz, A., 2015.

**Figure 12.3:** Type of Debris and Overall Percentage of Beach Debris Composition.



Note: Total debris in each beach located along the north coast of Timor-Leste. Inset represents the overall percentage of beach debris composition. Source: Cruz, 2015.

Marine debris has also affected marine and coastal habitat and biodiversity loss. Marine debris is one of the main direct causes of damage affecting marine and coastal biodiversity. For example, marine debris causes injuries and even kills large marine mammals, sea turtles, and seabirds through entanglement in nets, fishing line rope, plastics, and other materials that are often mistakenly eaten by large mammals. These materials pose threats to their stomachs due to ingestion.

### **e-Waste**

Electronic waste is also a concern in Timor-Leste. There are imports of some used electronic equipment, such as computers, TVs, radios, etc. Since 1999 and the UN transitional administration, there was a significant amount of e-waste but with no means of recycling or proper disposal. PDTOL is the only Australian company that has been working on the collection of e-wastes in Timor-Leste.

### **12.1.4 Illegal, Unreported, and Unregulated (IUU) Fishing and Transboundary Issues**

Illegal, unreported, and unregulated (IUU) fishing activities have negative impacts on transboundary fish stocks in the Arafura-Timor Sea and Indonesian Seas. Transboundary IUU fishing practices are widespread in these large marine ecosystems and surrounding areas. Timor-Leste has experiences of illegal fishing amounting to around US\$36,000 (estimated) per year. Most of the pelagic fish have been captured in the Arafura region and are traded outside the region.

The live reef fish have also been exploited illegally and traded, and this is also another transboundary issue.

### **12.1.5 Saltwater Intrusion**

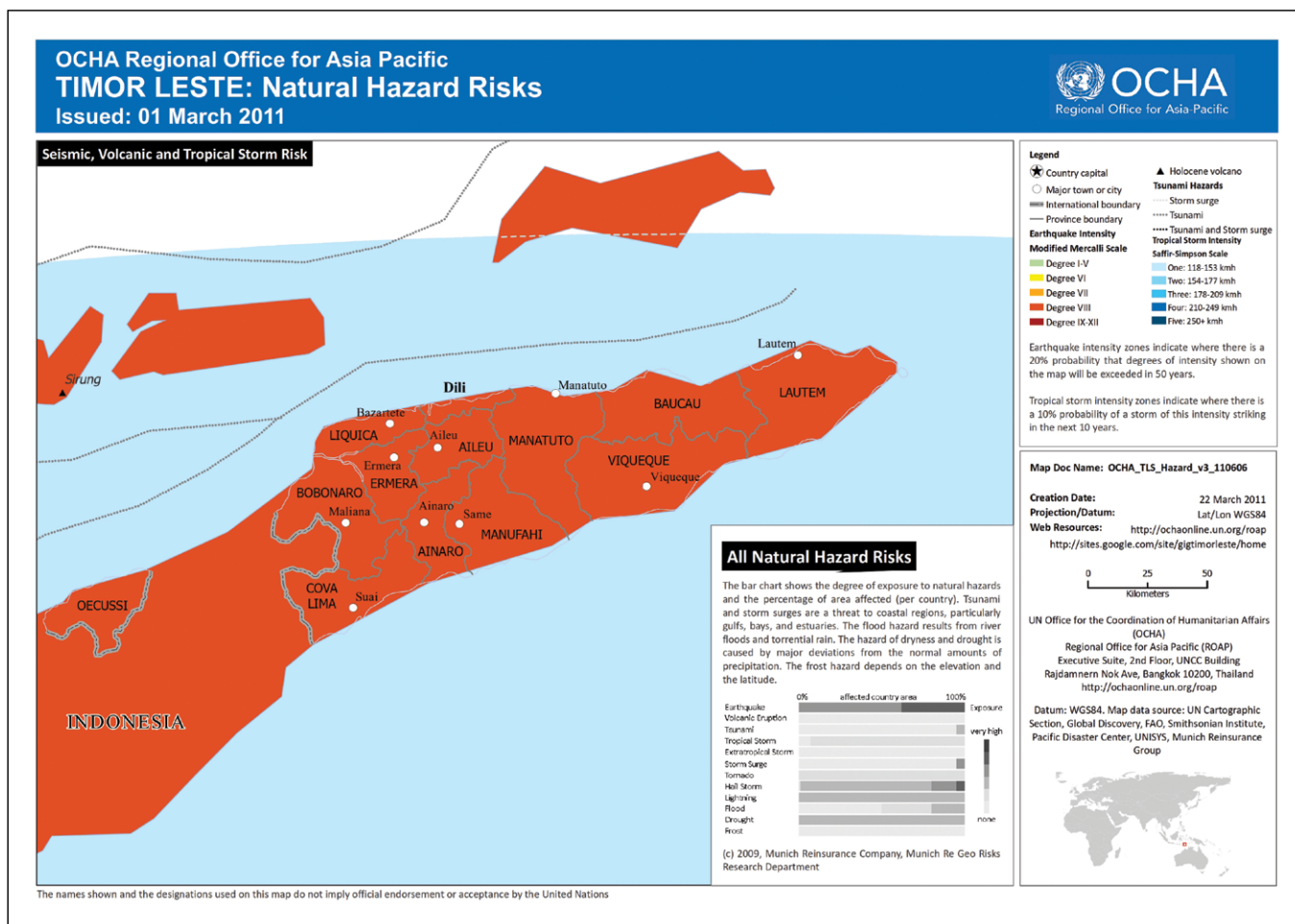
Inadequate and safe water supply still affects most rural areas. Groundwater is being used as an alternative due to lack of piped water connections. Saltwater intrusion has been observed in Tibar, Ulmera, Mota Ulun Lauahata, Maumeta, Vaviquinia, and sub-districts of Bazartete and Maubara.

## **12.2 Natural Hazards and Climate Change**

The country is very vulnerable to natural hazards, e.g., floods, landslides, drought, pests, earthquakes (**Figure 12.4**). Storm surges and tidal waves have already destroyed coastal properties (houses and infrastructures), and threaten human lives and other livestock in coastal areas. Additional disasters arising from climate change will further exacerbate and worsen the situation. All these natural hazards and climate change risks need to be addressed right now. Actions that need to be taken include vulnerability assessments, hazard mapping, and carrying out inventory of assets-at-risks and inventories for all hazardous areas. The protection of coastal assets, e.g., infrastructure and houses, should be undertaken as a matter of urgency.

Added risks from climate change may require further steps. This means that there is a need to consult with local communities and engage them further in the identification, planning, and implementing process of climate change risk management interventions. The local leaders, together with their communities, would need to undertake the most important and effective measures on the ground. For example, in Suai Loro, people have to elevate their houses by 80 cm without waiting for government's decision in order to avoid sea level rise/inundation. The local leaders can also provide information in relation to natural hazards as well as climate change and related risks. This way, communities can use the information as a basis for decision-making and action.

Figure 12.4: Natural Hazard Risks Map of Timor-Leste.



### 12.2.1 Meteorological and Climatic Processes

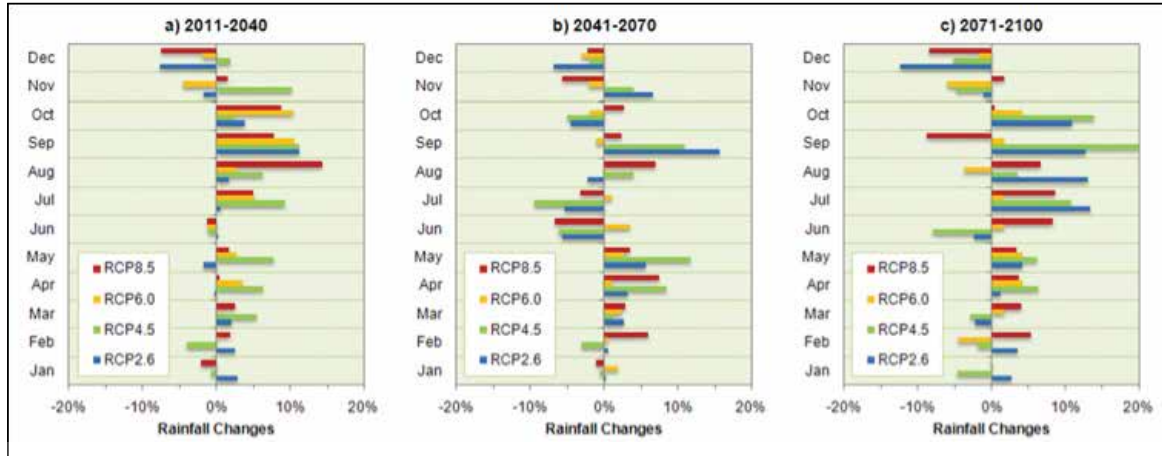
Timor-Leste has a tropical monsoon climate, with wet and dry seasons. There is relatively low rainfall on the northern coast (<1000 mm annual rainfall) and the duration of the wet season is between 4 to 5 months. Whilst on the southern coast, rainfall is relatively high, between 1,500 mm and 2,000 mm, with the duration of the wet season at around 7 months (Barnet and Jones, 2003; Kirono, 2010). The maximum diurnal temperature variation is around 13°C during the southeast monsoon period (between May and July); while the minimum diurnal temperature is 7°C–9°C in the northwest monsoon period, which falls from December to March (Australian Bureau of Meteorology and Commonwealth Scientific and Industrial Research Organization, 2011).

In 2011, a climate variability and climate change have been observed/studied by the Pacific-Australian Climate Change Science and Adaptation Planning (PACCSAP) in 14 Pacific Island countries, including Timor-Leste. The principal objective of the study was to identify climate variability and its process including other climate hazards and define the adaptation and mitigation measures based on local circumstances. Climate variability and changes projections in Timor-Leste are given by the PACCSAP program for three 20-year periods of 2020–2039, 2046–2065, and 2080–2099. The projections show that Timor-Leste is vulnerable to drought due to annual variability of rain events caused by exposure to high El-Niño Southern Oscillation (ENSO), flow patterns, resulting in heavy rainfall over short periods during the wet season and little rainfall during the dry season. **Table 12.2** shows the climate indicators and projected changes in years 2030, 2055 and 2090.

Rainfall forecast studies (Barnett et al., 2003; Katzfey et al., 2010; and Acil and KWK Consulting, 2010) found the following:

- Wet season rainfall in November–April is projected to slightly increase or decrease in 2030 ( $\pm$  8%), and will increase to 20% in 2070.
- This is in contrast with the rainfall change in May–July (the second rainy season for the southern part of Timor-Leste and the beginning of dry season in the north) that shows a significant decrease, reaching to 30% in 2030, and continue to decrease to 80% in 2070 (**Figure 12.5**).

Figure 12.5: Future Monthly Rainfall Change for Timor-Leste.

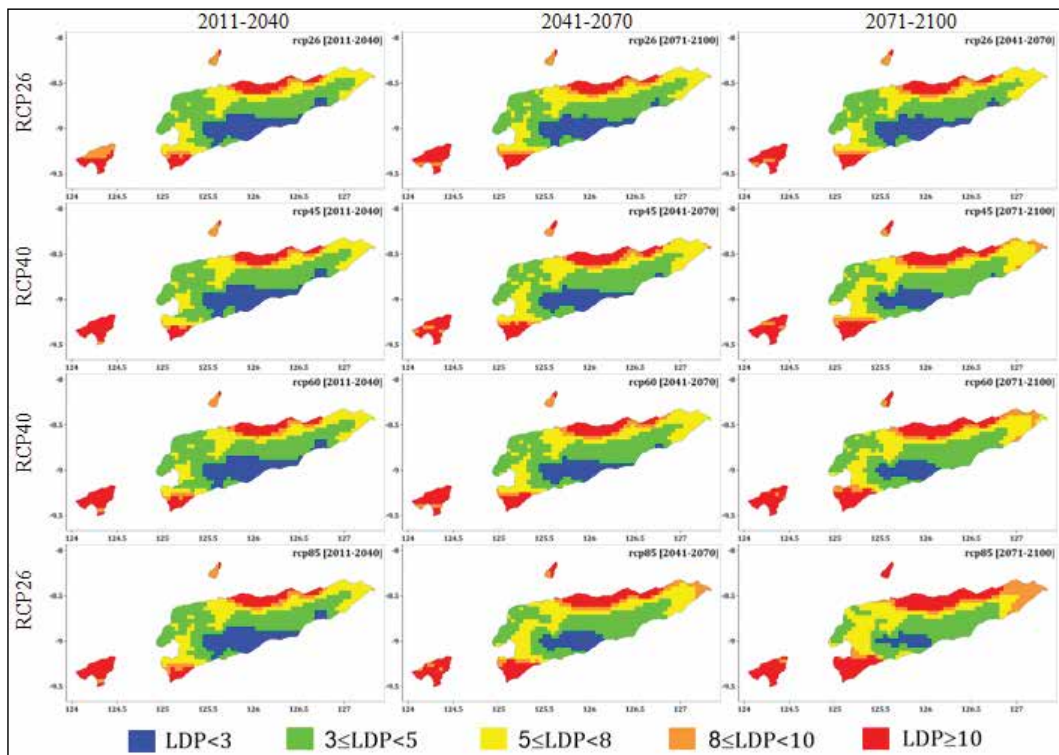


Source: MAF, 2014.

Kirono (2010) and PCCSP (2011) indicated that under climate change, Timor-Leste will experience:

- Increased rainfall with extreme rainfall events projected to become fewer but more intense ~ Decreasing numbers of tropical cyclones but the intensity get stronger).
- Inter-annual variability of the Asian monsoon is expected to increase.
- Increased and/or exacerbated hazard events, including flooding, landslides, storms, and drought (Figure 12.6).

Figure 12.6: Period of Water Deficit under Future Climate.



Source: MAF, 2014.

**Table 12.2:** Climate Indicators and Projected Changes for Timor-Leste.

Variable	Reference period	Projection for year 2030	Projection for year 2055	Projection for year 2090	Confidence
Surface temperature (°C)	Annual	+0.7 ±0.4 (1)	+1.1 ±0.6 (1)	+1.5 ±0.7 (1)	High
		+0.8 ±0.4 (2)	+1.5 ±0.6 (2)	+2.3 ±0.9 (2)	
		+0.7 ±0.3 (3)	+1.4 ±0.4 (3)	+2.8 ±0.7 (3)	
Maximum temperature (°C)	1-in-20-year event	N/A	+1.0 ±0.6 (1)	+1.4 ±0.8 (1)	Low
			+1.4 ±0.6 (2)	+2.2 ±1.1 (2)	
			+1.5 ±0.5 (3)	+2.8 ±1.5 (3)	
Minimum temperature (°C)	1-in-20-year event	N/A	+1.3 ±1.6 (1)	+1.7 ±1.6 (1)	Low
			+1.6 ±1.8 (2)	+2.2 ±1.8 (2)	
			+1.6 ±1.7 (3)	+2.5 ±1.8 (3)	
Total rainfall (%)	Annual	+1 ±9 (1)	0 ±15 (1)	0 ±13 (1)	Low
		+1 ±8 (2)	-1 ±18 (2)	0 ±19 (2)	
		+1 ±11 (3)	0 ±16 (3)	+1 ±23 (3)	
Wet season rainfall (%)	November - April	+1 ±9 (1)	0 ±15 (1)	0 ±13 (1)	Moderate
		+1 ±8 (2)	-1 ±18 (2)	0 ±19 (2)	
		+1 ±11 (3)	0 ±16 (3)	+1 ±23 (3)	
Dry season rainfall (%)	May - October	+1 ±20 (1)	-2 ±31 (1)	-4 ±28 (1)	Moderate
		+3 ±18 (2)	-4 ±35 (2)	-3 ±40 (2)	
		0 ±23 (3)	-3 ±31(3)	+4 ±51 (3)	
Sea-surface temperature (°C)	Annual	+0.6 ±0.4 (1)	+1.0 ±0.5 (1)	+1.4 ±0.7 (1)	High
		+0.7 ±0.4 (2)	+1.3 ±0.6 (2)	+2.1 ±0.8 (2)	
		+0.6 ±0.4 (3)	+1.2 ±0.4 (3)	+2.5 ±0.7 (3)	
Aragon saturation state (Ωar)	Annual maximum	+3.3 ±0.2 (1)	+3.0 ±0.2 (1)	+2.8 ±0.2 (1)	Moderate
		+3.2 ±0.1 (2)	+2.9 ±0.2 (2)	+2.5 ±0.2 (2)	
		+3.2 ±0.2 (3)	+2.8 ±0.2 (3)	+2.3 ±0.2 (3)	
Mean sea level (cm)	Annual	+10 (6-15) (1)	+18 (10-27) (1)	+32 (17-47) (1)	Moderate
		+11 (6-15) (2)	+21 (12-30) (2)	+40 (21-59) (2)	
		+10 (6-15) (3)	+20 (12-29) (3)	+42 (22-62) (3)	

Note: Emission scenarios used in this projection are B1 = low (1); A1B = Medium/moderate (2); A2 = High (3).

Source: Australian Bureau of Meteorology and the Commonwealth Scientific and Industrial Research Organisation (CSIRO), 2011.

### 12.2.2 Sea Level Rise, Coastal Flooding, Landslides, Forest Fire

Detailed observations of sea level changes during the twentieth century show that the high variability in the rates of sea level change observed over the past 20 years were not particularly unusual. The rate of sea level change was found to be larger in the early part of the last century ( $2.03 \pm 0.35$  mm/yr 1904–1953), in comparison with the latter part ( $1.45 \pm 0.34$  mm/yr 1954–2003). The highest decadal rate of rise occurred in the decade centred in 1980 ( $5.31$  mm/yr), with the lowest rate of rise occurring in the decade centred in 1964 ( $-1.49$  mm/yr). Over the entire century, the mean rate of change was  $1.74 \pm 0.16$  mm/yr (Wirasantosa, et al., 2011).

### 12.2.3 Declining Fish Stocks (due to *El Niño*)

During the *El-Niño* episode in November 2015–February 2016, many fishermen were unable to fish because many big fishes avoided the warm water caused by *El-Niño*. Also, many fishes and corals were stressed from changes in temperature (up to 2°C). Coral reacts to this shift in ocean temperature by expelling the symbiotic algae that lives within its tissues. Once the algae is expelled, the coral is bleached and becomes vulnerable to other harsh marine conditions (MAF, 2016). It was also noted that when the waters warmed during the *El-Niño* episodes, nutrient supply goes down, leading to progressively scrawnier plankton and microscopic-like creatures called copepods, the base species for the marine food chain. In this circumstance, many marine species are migrating to long distances to find fattier prey and better habitat. In some cases, many crabs are hiding in deeper water where it is colder and easier for them to survive. For that reason, some small-scale fishing industry in Timor-Leste are also failing in their business, including traditional fishermen particularly on the northern coast of Timor-Leste.

Fish pond aquaculture has also been negatively affected by the *El-Niño* episode. As recorded by MAF (2016), many fish ponds experienced dry areas. Many fish farmers in Ainaro, Manufahi, Dili, Ermera, Liquisa and Manatuto, Baucau and Viqueque cannot continue their fish aquaculture because of the *El-Niño* episode.

### 12.2.4 Effects of Hazards on Coastal Communities and Coastal and Marine Ecosystems

The effects of climate change in the long term (2030) were predicted by PACCSAP in 2011. The sea temperature will increase by 0.7°C under emission scenarios and under medium/moderate confidence. It means that the sea temperature will increase and will greatly impact on marine and coastal fisheries, particularly coral bleaching. If so, all coral fishes will collapse due to the interruption of the food chain and unavailability of plankton as a source of food for fish. In the end, small-scale fisheries, including artisanal fisherfolk, will lose their livelihood and protein source.

The concept of blue economy is to utilize marine and coastal resources in a responsible way in order to create job opportunities and attain improved wellbeing and human prosperity in the long term without harming the environment and coastal and marine ecosystems. Blue economy cannot be developed if climate change and related risks are getting worse. Therefore, tangible actions need to be planned with local leaders and communities in order to minimize climate change risks. For example, creation of green belt alongside coastal areas and enforcing all regulations to avoid depletion of marine and coastal resources. This is because climate-related risks will continue to place pressure on the marginalized coastal population.

The role of coastal and marine ecosystems in climate change mitigation, carbon sequestration, shoreline protection, and waste assimilation must be recognized. Thus, it is essential to maintaining the health and integrity of these important ecosystems.



### 12.2.5 Economic Loss due to Natural Hazards and Climate Change

Annual average number of households/people or houses impacted by the three main natural and climatic hazards in Timor-Leste (2001-2010) are as follows:

- Floods affecting almost 450 people and damaging about 180 houses.
- Strong winds affecting more than 250 people and about 220 houses
- Landslides affecting about 25 people.

### 12.2.6 Response Measures

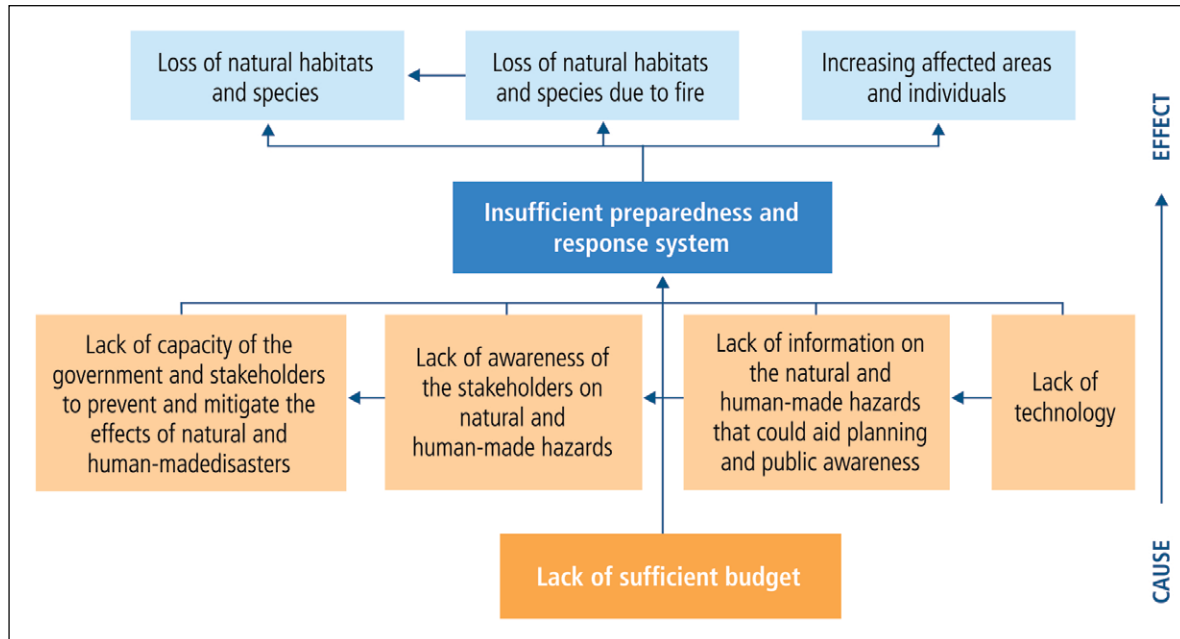
The environmental damage from natural hazards, such as fires, landslides, erosion, flooding, inundation, and sea level rise, are complex and have different magnitudes. The impacts are massive, and greatly affect human life, houses, roads, bridges, agricultural production, livestock, and water sources. To respond to these natural hazards and damages, the government has established a **Disaster Risk Committee** in all municipalities. The Disaster Risk Committee consists of key government agencies, such as the Ministry of Social Solidarity, Directorate of Environment, Ministry of Health, Ministry of Education, Ministry of State Administration and Territorial Management (Ministério da Administração Estatal), Ministry of Interior, Ministry of Defense, Ministry of Public Works, Ministry of Transportation and Communication and MAF. The principal role of the committee is to deliver services to all victims during and post-disaster by providing shelter, food, medicine, water, and other basic needs.

The Ministry of Social Solidarity is the main agency responsible for organizing all key government agencies to deal with natural disasters. However, most of these government agencies still lack the skills and appropriate knowledge. Most of them have limited budget making it more difficult to deal with the impacts of natural disasters. Therefore, strengthening the capacity of staff of the relevant government institutions is paramount and urgent. **Figure 12.7** presents the problem tree analysis of the major issues related to the lack of preparedness and response system.

#### Response to climate change

A project under the National Adaptation Program of Action (NAPA) called the Small Scale Rural Infrastructure is being implemented by the Ministry of State Administration in cooperation with UNDP. Financial support (US\$4.6 million) for this project is from the Global Environmental Facility (GEF).

Under the UNFCCC, RDTL-MCIE has formulated nine NAPA priorities: (1) food security and agriculture, (2) water resource management, (3) human health, (4) natural disasters, (5) forests, biodiversity and coastal ecosystem resilience, (6) livestock production, (7) physical infrastructure, (8) oil and gas infrastructure, and (9) capacity building.

**Figure 12.7:** Problem Tree Analysis for Inadequate Mitigation, Preparedness and Response System.

The following are the national climate change projects:

- National capacity self assessment was done in 2005–2007 under the Secretario Estado do Meio Ambiente (SEMA), with financial support of US\$200,000 from GEF, and facilitated by UNDP;
- NAPA Preparation was done from 2009–2011 with financial support of US\$200,000 from GEF and was led by the SEMA in cooperation with UNDP;
- NAPA implementation project on Food Security and Agriculture is now in place, implemented by MAF funded by the European Union (EU) / UN International Fund for Agricultural Development (IFAD) (US\$4 million);
- NAPA implementation project on Disaster Risk Reduction (Dili Ainaro Corridor) is now ongoing and is implemented by the Ministry of Social Solidarity. Financial support for this project is US\$5.25 million from GEF, and managed by UNDP;
- NAPA implementation project on road construction is going to start with financial support from the GEF/ADB (US\$4.5 million);
- Community-based adaptation project for NAPA implementation project is in place with financial support from AUSAID in the amount of US\$1.7 million. The project is implemented by OXFAM, CRS, and CARE under the leadership of CONSORSIUM;
- NAPA implementation project on community-based adaptation is now ongoing with financial support from the EU in the amount of US\$203,000. The project is implemented by the SEMA in Liquiça, Manatuto, and Baucau; and
- Initial National Communication was done by the SEMA and the report of the communication is now ready for approval by the council of ministers. The Project was funded by GEF/UNDP (US\$405,000) and implemented by the SEMA.
- There is also a GEF project (2016-2021) being implemented by UNDP in collaboration with MAF and various agencies and stakeholders. This is the Project on Building Shoreline Resilience of Timor-Leste to protect local communities and their livelihoods from disaster and climate change.

**PART 5**

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**GOVERNANCE STRUCTURE AND  
MECHANISMS SUPPORTING  
BLUE ECONOMY DEVELOPMENT**

# 13 Policies, Institutional Arrangements, And Governance

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## 13.1 Policies, Legal and Regulatory Framework, and Institutional Arrangements

The Democratic Republic of Timor-Leste restored its national independence on the 20 May 2002, after having been under the Transitional Administration of the United Nations, which began in late 1999, after 78.5% of the Timorese voted in favor of national independence.

Timor-Leste is a unitary, republican and democratic State with a semi-presidential system of Government. The administrative system follows the French type for the executive leadership.

### 13.1.1 National Strategic Development Plan

At the national level, the National Strategic Development Plan for 2011-2030 (RDTL, 2011), calls for a comprehensive action to attain the vision of the country, but the challenge is to implement them on the ground, with the active participation of the stakeholders. There is a need for an overall plan or strategy, both at the national and municipality level, to integrate the efforts of the government so that timely and appropriate actions can be provided.

### 13.1.2 Local Government Law (Decree/Law No. 3/2016)

With the approval of the National Strategic Development Plan, 2011-2030, the creation of local governments was recognized as a necessary precondition for the achievement of four strategic objectives:

1. Increasing and improving the public services rendered at the local level
2. Creation of new opportunities for democratic participation
3. Affirmation of the institutions of a strong State across the national territory
4. Development of the private sector in rural areas

However, to be able to drive the development process, the local governments will require time for the introduction of systems, processes and local public management procedures, as well as human capital development for the Local State Administration.

Thus, the Government approved the Decree-Law no. 3/2016 on 16 March 2016 to reform of State Local Administration's organization and defined a strategy for its development, strengthening and increased autonomy. According to this law, the creation of Local Governments will be made over three phases or stages:

A phase of administrative deconcentration, during which new local services will be created and enhanced their ability to work (provision of additional human resources and greater financial resources) and new systems and local democratic management processes to provide public services will be introduced.

A phase of institutional decentralization, during which will significantly increase the responsibilities of the local services in financial matters and in the definition of policy implementation strategies, gradually exercised with a greater degree of autonomy.

A phase of territorial decentralization, during which the local government will be completely autonomous from the central government in the definition of their public policies and its respective execution (This higher degree of autonomy from the central government arises from the fact that the government officials are locally elected and not appointed by the central government.)

Moreover, Decree-Law No. 3/2016:

- Identifies the services to be provided by the State's Local Administration
- Reformed the State Local Administration's organization according to the needs of the provision and delivery of the aforementioned services
- Created the necessary basis for the development of local administrative systems
- Created the necessary conditions for the training of human resources of the Local Government

The Timor-Leste Government considers that increasing the Local Government's responsibility in the provision of public services, with an intensive civic social control, it shall be possible to:

- Respond effectively to the real needs of local populations
- Improve the quality of the services provided, because the options and local development strategies are discussed and evaluated by the citizens and their representative organizations
- Develop the private sector in rural areas (initially induced by the public investment made within the context of the administrative reform and by the local infrastructure public programs) and later by the availability of access to public infrastructures, public facilities and services, to the present time mostly available only in the capital Díli;

- Affirm the institutions of a strong State across the national territory by strengthening the territorial cohesion of Timor-Leste (the elimination of development disparities between municipalities enhances the union of the Timorese with the State and with a national project).

According to the new law, the State Local Administration will be responsible for providing services in the following fields:

1. Education;
2. Health;
3. Water, Sanitation and Environment;
4. Agriculture;
5. Food Security;
6. Markets Management and Tourism;
7. Social Assistance;
8. Civil Protection;
9. Management of Natural Disasters;
10. Public Registries, Public Notaries and Cadastral Services;
11. Support to Non-Governmental Organizations and Community Organizations.

### 13.1.3 Policies and Laws on Environmental, Fisheries and Coastal Management

Some of the key laws that have been passed:

- Environmental Basic Law
- Environmental Licensing, EIA, Pollution control
- Fisheries Law, Forestry Law

The specific laws related to fisheries and coastal governance are shown in **Table 13.1**. **Table 13.2** shows the national laws, policies, and action plans related to coastal and ocean governance that have been adopted and are currently being implemented in Timor-Leste. Other laws and policies that are for consideration and adoption by the government are:

- Biodiversity Law (to be passed)
- National Oceans Policy (to be presented to the Council of Ministers for adoption)
- 5 Maritime laws related to the IMO Conventions (to be adopted)

With regard to environment and natural resources management in the country, the main agencies responsible are the Ministry of Agriculture and Fisheries (MAF), Ministry of Commerce, Industry and Environment (MCIE), and the Ministry of Petroleum and Mineral Resources..

Under MAF, there is a National Directorate of Fisheries and Aquaculture (NDFA), National Directorate of Agriculture and Horticulture (NDAH), and National Directorate of Forestry (NDF).

Under MCIE, there is a National Directorate of Environment, and National Directorate of International Environmental Affairs.

Various other agencies share responsibilities for environmental protection and natural resource management, especially those with mandate and functions in coastal and marine areas and ocean-related economic activities as shown in **Table 13.3**. Previously, an Inter-Ministerial Working Group for Environment and Natural Resources Management served as a coordinating body. This inter-ministerial working group needs to be re-established given the changes in the government structure, and considering that the ocean economy provides a significant share of the country's economy and natural capital.

An integrated coordination and management mechanism for the implementation of three regional/sub-regional projects on coastal and marine management (e.g., CTI, ATSEF, and SDS-SEA) was also established within MAF in order to facilitate the national implementation of the said projects, through a ministerial order (No. 8/24/GM/X/10) on October 2010.

Proposed Country Priorities are to be defended to the Council of Ministers.

**Table 13.1:** Laws Related to Fisheries and Coastal Management in Timor-Leste.

No.	Regulations/Laws	Title	Main objectives
1	Decree Law no.6/2004	Fisheries and Aquaculture	General basis of the legal regime for the management and regulation of fisheries and aquaculture
2	Decree Law no.3/2004	Port Authority of Timor-Leste (APORTIL)	Managing the port facilities and services
3	Government Decree No.3/2004	Fishing	General regulation on fishing
4	Law No.12/2004	Fishing-related offenses	Reducing impact to fisheries
5	Government Decree No.2/2005	Tariff in Fisheries	Regulating tariffs for fisheries license, inspection-related activities and services in fisheries
6	Ministerial Diploma 01/03/GM/2005	Definition of Fishing Zone	Define the term of fishing area and operation limitation
7	Ministerial Diploma 03/05/GM/2005	By Catch Fishing	Reducing by catch by regulate the percentage of by catch tolerated
8	Ministerial Diploma 04/115/GM/IV/2005	Protected aquatic species	Listing the aquatic species those are protected
9	Ministerial Diploma 05/116/GM/IV/2005	Minimum Fish Size can be caught	Regulate minimum size of fish that can be caught
10	Ministerial Diploma 06/42/GM/III/2005	Fisheries infringements	Penalties Fisheries infringements
11	Regulation 2000/19	Protected Wild Areas	Protecting area
12	Regulation 2000/17	Prohibition to Cutting and Export of Forest Product	Reducing deforestation

Source: Government of RDTL (2010).

**Table 13.2:** National Laws, Policies and Plans, and International Agreements for Coastal and Ocean Governance.

Sustainable Development	Ocean and coastal area management	Climate Change	Natural Hazards and Risks	Pollution	Water resources	Ecosystems and Biodiversity	Fisheries, Food Security	Ports and Shipping	Coastal and Marine Tourism
<b>National laws</b>	Government Resolution No. 8/2007 on Protection of marine and terrestrial areas (2007)			Decree-Law 26/2012 - Framework Environmental Law	Ministerial Order 1/2004 on Fees and Charges for Water Supply (2004)	Government Resolution No. 8/2007 – Establishing the Nino Konis Santana National Park (2007)	Government Decree No. 5/2004 on General Regulation on Fishing, amended through Government Decree No. 3/2005 (2005)	Government Decree-Law No. 3/2004: APORTIL – Managing the Port Facilities and Services (2004)	
	Law No. 07-2002 on Maritime Borders of the Territory of the Democratic Republic of Timor-Leste (2002)			Law No. 05/2011 on Environmental licensing	Law No. 04/2004 on Water Supply for Public Consumption (2004)	Government Resolution No. 9/2007 on National Policy and Strategy for Forestry (2007)	Government Decree No. 2/2005 on tariffs for fisheries, licenses, related activities and services of fisheries (2005)	Law No. 3 -2003 on the establishment of the Port Authority and on the approval of the bylaws (2003)	
				Law No. 33/2008 on Hygiene and Public Health (2008)	Law No. 05/2009 on Licensing, commercialization and quality of drinking water (2009)	Ministerial Diploma No. 04/115/GM/IV/2005 on the list of protected aquatic species (2005)	Ministerial Diploma No. 01/03/GM/2005 on the definition of fishing zones (2005)	Decree Law 19-2003 - Regulation of Port Fees and Charges	
				Government Decree-Law No. 10/2004 on Health System (2004)		Government Regulation No. 17-2000 on Prohibition of Logging Operations (2000)	Ministerial Diploma No. 03/05/GM/ 2005 on allowed percentage of bycatch (2005)		



Table 13.2: National Laws, Policies and Plans, and International Agreements for Coastal and Ocean Governance. (cont.)

Sustainable Development	Ocean and coastal area management	Climate Change	Natural Hazards and Risks	Pollution	Water resources	Ecosystems and Biodiversity	Fisheries, Food Security	Ports and Shipping	Coastal and Marine Tourism
				Government Resolution approving the assignment for the construction of the Waste Treatment Factory of Tibar to the company Shun Hsin Constructions & Development, Ltd.		Government Regulation No. 19-2000 on Protected Places (2000)	Law No. 06/2005 on the General Basis of the Legal Regime for the management and regulation of fisheries and aquaculture (2005)		
							Law No. 12/2004 on Criminal actions related to fisheries (2004)		
<b>National policies and plans</b>									
Timor-Leste Strategic Development Plan 2011-2030	National Plan of Action for the Coral Triangle Initiative	National Adaptation Program of Action on Climate Change (2010)	National Disaster Risk Management Policy (2008)	National Action Program to Combat Land Degradation		National Biodiversity Strategy and Action Plan 2011-2020	National Fisheries Strategy (2015)		Timor-Leste National Tourism Policy: Growing Tourism to 2030 – Enhancing a National Identity (2017)
Human Resource Development Plan			National Disaster Risk Management Plan (2005)				National Aquaculture Development Strategy 2012-2030		Timor-Leste Strategic Development Plan 2011 – 2030
			National Contingency Plan for Flooding (2006)						
			Operational Guide for the Social Restoration Program on Assistance to the Victims of Natural Disaster						

Table 13.2: National Laws, Policies and Plans, and International Agreements for Coastal and Ocean Governance. (cont.)

Sustainable Development	Ocean and coastal area management	Climate Change	Natural Hazards and Risks	Pollution	Water resources	Ecosystems and Biodiversity	Fisheries, Food Security	Ports and Shipping	Coastal and Marine Tourism
<b>Institutional arrangements</b>									
Decree-Law on the Commission for Interministerial Coordination and the Interministerial Technical Work Group for Local Development (2012)									
<b>International conventions and agreements</b>									
	UNCLOS (a – 2013)	UNFCCC 92 (a – 2006)	Hyogo Framework for Action (ad – 2005)		UNCCD 94 (2003)	Biodiversity 92 (2006)			
		Kyoto Protocol 97 (2008)							
		Montreal Protocol (a -2009)							
		Vienna Convention - Ozone Layer (a – 2009)							

Source: PEMSEA. 2015. *Regional Review: Implementation of the Sustainable Development Strategy for the Seas of East Asia 2003-2015*.

**Table 13.3:** Institutions Related to Coastal and Ocean Governance in Timor-Leste.

No.	Institution	Principal Mandate	Relation with Coastal and Ocean Governance
1	Ministry of Agriculture and Fisheries	Responsible for development of sustainable use of agricultural resources, forestry, livestock and fisheries.	
	National Directorate of Fisheries and Aquaculture	Responsible for development and management of fisheries and aquaculture resources management in Timor-Leste	Fisheries development and marine resources policy - marine resources conservation Policy on coastal community welfare development
	National Directorate of Agriculture and Horticulture	Managing and securing food supply especially those which related to agricultural and livestock management	Coastal agriculture, Food security
	National Directorate of Forestry	Managing forest resources for the national prosperity	River basin management, marine protected area and mangrove forest conservation
2	Ministry of Commerce, Industry and Environment		
	National Directorate of Environment	Manage the environmental protection and reduce environmental damage throughout the entire national territory.	Habitat protection, marine and coastal environmental impact assesment, waste and pollution
	National Directorate of International Environmental Affairs	Responsible to manage and participate on international forum relating with environmental issues, the international agreement, international funding and institution.	Environmental issues in coastal and marine area
3	Ministry of Tourism		
	National Directorate of Tourism	Responsible for tourism activities in Timor-Leste	To create the environment and incentives for the orderly operations of marine and coastal tourism in Timor-Leste
4	Ministry of Education, Arts and Culture	Responsible for the conception, execution, coordination and development of policy, as approved by the Council of Ministers in the areas of Education, science and technology.	Designing curriculum related to the coastal and marine issues.
5	Ministry of Health	Designing, regulation, executing, coordinating and evaluating health and pharmaceutical policy and activities	Health problem related to and in coastal area
6	Ministry of Public Works		
	National Directorate of water resources and sanitation	Responsible for planning, execution, coordination and evaluation of policy in relation to the supply of water	Water Supply in coastal area to the community and others function
7	Ministry of Social Solidarity		
	National Directorate of Natural Disaster Management	Responsible for the development and implementation of policies in the areas of social security, social assistance and responses to natural disasters	Social security and natural disaster management in coastal area

**Table 13.3:** Institutions Related to Coastal and Ocean Governance in Timor-Leste. (cont.)

No.	Institution	Principal Mandate	Relation with Coastal and Ocean Governance
8	Ministry of Public Works	Responsible for planning, execution, coordination and evaluation of policy in relation to the areas of public works, urbanisation, the supply of water and electricity, national transportation networks including roads and bridges, international transport facilities including seaports and airports, telecommunications systems, radio, meteorology and information systems	Infrastructure, public work, electricity, water supply, transportation and communication in coastal area
9	Ministry of Petroleum and Mineral Resources	Responsible for oil and gas, and mineral resource utilization	Coastal and marine natural resources (non-living)
10	Timor-Leste Port Authority/APORTIL	To ensure that the ports are developed and managed to ensure they provide an efficient service to the population and to importers and exporters.	Sea Transportation and port management, pollution management on the port area

## 13.2 Meeting International Commitments

The international conventions and agreements that have been signed by the country are also shown in **Table 13.2**. About five IMO Conventions are being considered for adoption by the country, and corresponding national laws to implement those conventions are being drafted. (as of 2017).

## 13.3 Ecosystem and Biodiversity Conservation to Ensure Blue Economy Development

### 13.3.1 Mangrove and Coral Reef Restoration and MPAs

The Government of Timor-Leste is investing in mangrove and coral reef conservation, and working together with stakeholders. Local and international NGOs have executed conservation projects in Ulmera-Liquiça municipality and in Hera-Metinara post administrative area. Mangrove planting is also one of the ICM activities.

### 13.3.2 Seagrass and Dugong Protection

There are substantial knowledge gaps regarding the distribution and abundance of dugongs in Timor-Leste. Population size and characteristics remain unknown; while recent sightings have been made on the north coast, there is no information on the presence or distribution of dugongs on the southern side of Timor-Leste. Little is known about the location of the main feeding habitats for the species.

Threats to dugongs and their seagrass habitat in Timor-Leste include deforestation, over-fishing (both targeted and accidental by-catch), and destructive development activities. Dugong mortality

has not been reported in Timor-Leste in recent years, but the use of gillnets in near shore waters by coastal fishers is increasing, which poses a growing threat to the species.

Dugongs are protected under the *Marine Protected Species Act*, and reference to their endangered status is made in the *National Biodiversity Strategy and Action Plan (NBSAP)*. The NBSAP describes the importance of seagrass ecosystems not only as the primary habitat for dugongs and many fish and shellfish species, but also as a protective barrier for coral reefs against sedimentation. Seagrass also contribute to carbon sequestration and climate change mitigation. However, the people of Timor-Leste, including decision-makers, are largely unaware of dugongs, their status, and the importance of seagrass ecosystems to the coastal environment and climate.

### **GEF Dugong and Seagrass Conservation Project**

TL1: Under the GEF Dugong and Seagrass Conservation Project, national-level partners in Timor-Leste will be trained in seagrass and dugong research techniques to overcome existing knowledge barriers regarding the distribution, status and ecology of seagrass ecosystems and dugong populations (TL1), and priority sites for dugong and seagrass conservation efforts will be identified.

TL2: A model for marine conservation ecotourism will be developed to incentivize local engagement in dugong and seagrass conservation (TL2). This project component will pioneer a model to diversify livelihoods among target coastal communities, generating a sustained source of income for the target population to encourage community-based natural resource management (CBNRM) activities for priority seagrass ecosystems and small-scale fisheries.

TL3: This component aims to strengthen and operationalize an inter-ministerial mechanism to ensure a coordinated approach to national-level coastal zone planning and decision-making, which effectively addresses dugong and seagrass conservation.

TL4: This component involves designing a “Tool Box” of materials and media to illustrate the importance of dugong and seagrass habitats, explain their benefits to local people, outline options for their protection, and communicate dugong and seagrass related laws and regulations to target groups. Community festival events will also be used to generate awareness.

TL5: A National Facilitating Committee (NFC) will be established to assist national capacity-building and mobilize decision-maker support for dugong and seagrass conservation (TL5), and to work with project partners, sharing their data, lessons learned, and experience of dugong and seagrass ecosystem conservation.

The project will strengthen national-level understanding of the importance of seagrass areas by linking their health to the economic value of fisheries and the potential for eco-tourism opportunities related to dugongs. It also aims to enable adaptable management planning and active ownership over the use of natural resources by local communities.

### 13.3.3 Marine Protected Areas

There are seven MPAs in Timor-Leste: (a) Atauro Vila, with an area of 50.51 ha in Dili municipality; (b) Batugade, with an area of 1,100 has in Bobonaro municipality; (c) Lore, with an area of 1,487 ha; (d) Hilapuna, 303 ha; (e) Perebenu, 231 ha; (f) Jone, 409 ha; and (g) Com, 228 ha. About five latest MPAs are in the National Park of Nino Konis Santana in Lautem Municipality. Total area of MPAs in Timor-Leste is 2,808.51 ha (MAF, 2016).

In addition, Manatuto has established a locally managed marine area (LMMAs).

Four communities, namely: Com, Lore, Tutuala, and Atauro, also established MPAs in Timor-Leste with the support of USAID's Coral Triangle Support Partnership (CTSP). Although they face different challenges, they see similar needs for enforcement.

The town of Com, on the north-eastern coast of the island, benefits from the small size and convenient location of its MPA. The core and buffer zones, totaling just over 100 ha, are within site of the town, and the fishermen of Com pass by it whenever they head out to fish that, making separate patrolling unnecessary. There were hiccups on the way to acceptance of the MPA, however. Edmundo da Cruz, port officer for Com, told this story:

*"One fisherman tested the system by herding fish out of the 'no take' zone with the intention of catching them once outside of it. He was apprehended, tried, and sanctioned by the suku (town government)." The local sanction required him to provide food for a community gathering where he was held to account for his actions. The district officials also confiscated his boat and motor, a very serious consequence. "Now the MPA gets the full respect of the fishermen."*

In Lore, across the island on the southeast coast, the MPA is about 270 ha, and it protects the spawning sites, juvenile habitat, and feeding grounds, but these are far from the nearest village. For now, fishing regulations are enforced only by villagers going to the vicinity of the MPA for their normal work. Regular patrols of 2-3 fishermen are under discussion. In the long run, local officials say that government help with enforcement is crucial (USAID-CTSP, n.d.).

In Tutuala, at the eastern tip of Timor, the community's approach to patrolling its 1,600-hectare MPA: "A minimum of two and usually more fishermen stay by the core zones at all times, with members of the fishermen's organization rotating on and off duty," said Antonio da Fonseca the chefe of Tutuala's village (USAID-CTSP, n.d.). He sees the problem not as one of local enforcement, but of the nation's inability to prevent foreign trawlers from fishing offshore waters and scooping up the fish spilling out of the MPAs. The three communities, which created the MPAs, agree that they can manage local problems themselves, but poaching by armed commercial fishermen requires

marine police and national government action. MPA communities and government representatives are currently discussing this issue as part of their work adopting co-management guidelines for natural resource management. Conservation International is the lead partner for CTSP in Timor-Leste.

The biggest difference in Tutuala is “the change in the way we perceive our resources, from something to use up, to a bank account we can manage, taking out our interest when needed.” CTSP was the catalyst for this process, holding community trainings on marine resources, supporting biological surveys of the waters, and involving district representatives from DNPA in a planning process that resulted in the expansion of Tutuala’s protected areas to a 1680-hectare core and buffer zone with close to 20,000 ha of biologically significant area under improved management. The fishermen’s association expanded its existing patrolling from the two traditional areas and assigns fishermen in rotation to patrol the MPA. (USAID-CTSP, n.d.)

### 13.3.4 Other Protected Areas

Found in Liquiça, Mount Fatumasin and the surrounding forests, with an area of 4,000 ha, is one of the 15 ‘protected wild areas of the country’. Mt. Guguleur, which is found in the western part of Liquiça, is also being evaluated to be included in the list of protected areas. Historical heritage sites are also located along the coast of the district, such as the ruins of the Dutch fort and the Epelu Jail during the Portuguese colonization. In addition, there are old buildings like the residence of the district and sub-district officers, as well as the Portuguese government administration office, chapel, hospital, and church. The terrestrial protected areas are around 13.06% of total land area (World Bank 2018).

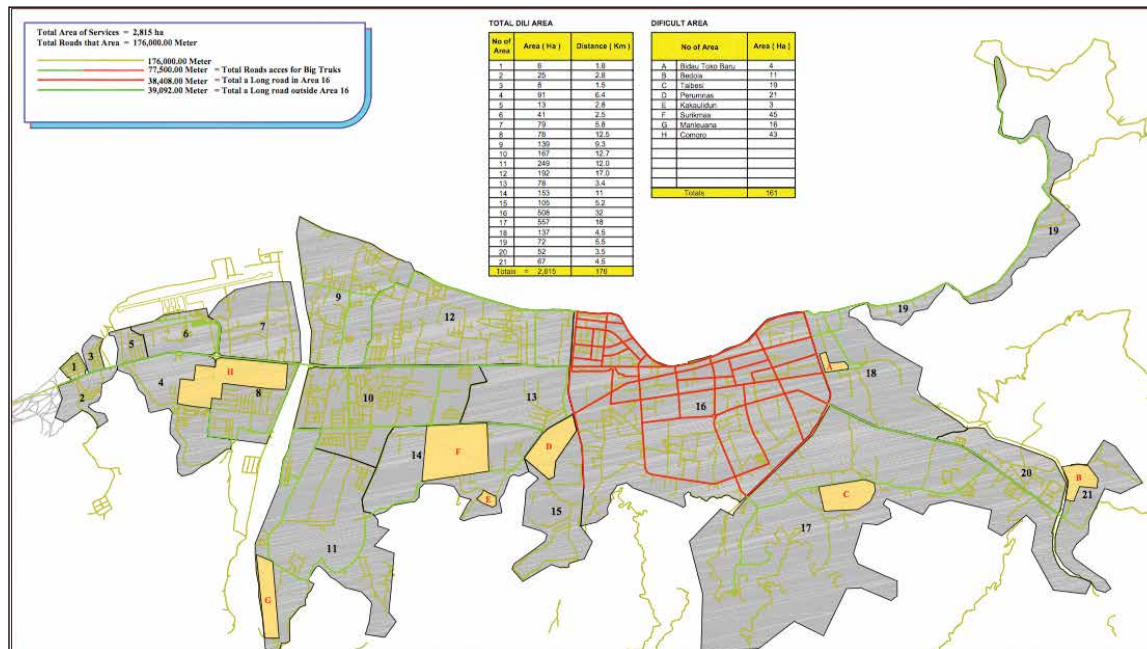
## 13.4 Pollution Reduction and Management of Solid Waste and Wastewater to Protect Ocean Health and Ensure Blue Economy

### 13.4.1 Solid Waste Management

Solid waste is being collected around Dili and transported to Tibar landfill by a private company as management contractors of Dili Administrative. The Tibar landfill site is located in the western part of Dili, about 13 km, and is managed by the Ministry of Infrastructure. Constructed under the Indonesian rule, it is the only remaining site that is used as final disposal of solid waste. The Tibar landfill also accepts hospital waste (medical waste) that is categorized as nonhazardous waste and medical waste. However, open dumping still occurs. The Directorate of Water and Sanitation operates two compactor machines, and maintains the operator house, access road, warehouse for the compact machines, and other materials.

Total area that is covered by solid waste management service in Dili is 161 ha, with a distance of 176 km as shown in **Figure 13.1** below.

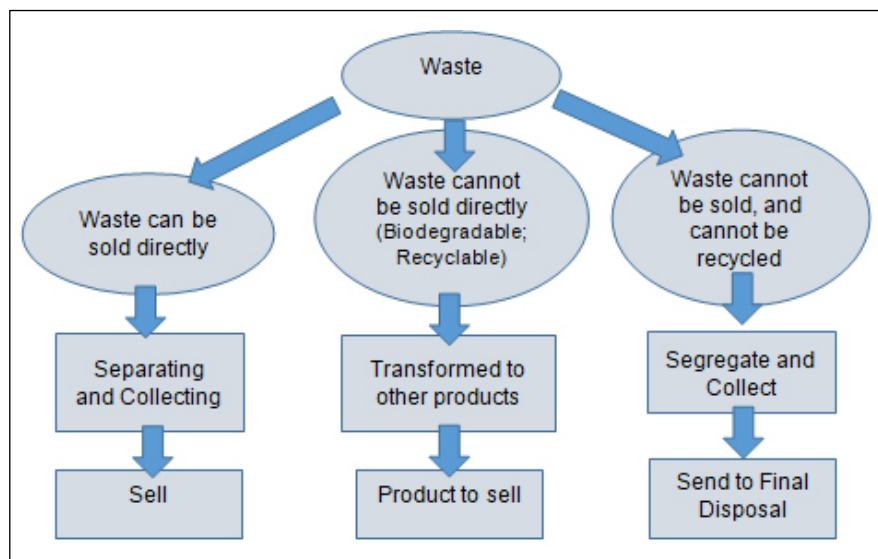
**Figure 13.1:** Location of Solid Waste Management Services in Dili Municipality.



Some places in the urban areas in Timor-Leste have been abiding by the proper management of solid waste, which is classified into three categories:

- Waste, which one can sell directly, e.g., paper, cardboard box, plastics, iron, steel, tin cans, etc.
- Waste, which one cannot sell directly, e.g., cover of food/drinks, styrofoam, cloth, organic material, etc.
- Waste, which one cannot sell and recycle, e.g., diaper, etc.

**Figure 13.2:** Principles of Solid Waste Management.





### 13.4.2 Used Oil Management

Used oil is a big problem in Timor-Leste because it contaminates groundwater, and eventually can also damage other terrestrial and aquatic living micro-organisms. Examples of improper disposal are illustrated in **Figures 13.3** and **13.4**.



**Figure 13.3:** Depositing Used Oil in Drums – Common Habits of Small Shops.

Source: Carlos Ximenes, 2016.



**Figure 13.4:** Underground Storage of Used Oil.

Source: Carlos Ximenes, 2016.

#### Adaptive government program for used oil management

- Through the Secretariat of State of Environment, they constructed a storage facility for used oil across the country, each with five tanks with the capacity of 100,000 liters each, plus one collection truck that is ready to do the work every day
- There is a plan for future recycling process for this used oil stored in those tanks.
- The following picture shows the used tanks at Tibar Village (**Figure 13.5**)

**Figure 13.5:** Oil Tanks Prepared by the Government.



Source: Carlos Ximenes, 2016.

### 13.4.3 Wastewater Treatment

Wastewater management is under the Directorate of Water Supply and Sanitation (Ministry of Public Works) and the Directorate of Environment (Ministry of Economy and Development). The final disposal of wastewater is located in Tasitolu in the western part of Dili.

**Tasitolu wastewater treatment system:** The waste stabilization pond system consists of three treatment ponds as shown in **Figure 13.6**: facultative pond; and maturation ponds 1 and 2. The first pond is connected to a hauling tanker hose. Each of the second and third pond is installed with an overflow pipe at the end. These ponds are filled with sediments, then scum and sludge are floating around, and then each overflow pipe has a part of sludge flowing through the channels.

**Figure 13.6:** Wastewater Treatment Ponds in Tasitolu.



Source: Carlos Ximenes, 2016.

## 13.5 Sustainable Development Actions in ICM Sites

Development and implementation of ICM system is being demonstrated in the municipalities of Dili, Liquiça and Manatuto, covering around 30.49% of the national coastline, with support from PEMSEA. There are initiatives on habitat restoration, sustainable fisheries and aquaculture, ecotourism, waste management and disaster risk management to ensure the sustainable development and resiliency in the coastal areas and help protect the coastal and marine ecosystems.

### 13.5.1 Natural and Man-made Hazards Management

The country has developed the *National Disaster Risk Management Plan* (2005) and the *National Disaster Risk Management Policy* (2008) in response to dealing with natural and man-made hazards. An inter-Ministerial Commission for Disaster Response/Management has also been established. Disaster response has been integrated in the Constitutional Government Program 2007-2012. Countrywide response is centrally managed through the National Disaster Management Directorate. There were 23 programs or initiatives related to prevention and management of hazards implemented in 2004-2010; and 29 programs were implemented in 2011-2015.

**Dili.** The communities in Dili have been experiencing long dry season, and shorter rainy season resulting in drought. During rainy season, flooding has been experienced in areas near the rivers. Although man-made hazards, such as oil spills and forest fires also occur, natural hazards like flooding and landslides cause more adverse effects like loss of property, food and sources of livelihood. The lack of or insufficient preparedness and response system in times of disaster is the main challenge of the municipality in terms of disaster management. Issues include constraints on: 1) capacity of government and stakeholders; 2) budget; 3) awareness of communities; and 4) technology to generate information on natural and man-made hazards.

The municipality has an emergency response plan covering floods, landslides, oil spills and forest fires. A disaster management committee had been established in the municipality comprising of the agriculture, health services, education, social services and disaster management agencies, the National Police of Timor-Leste (PNTL),

**Manatuto.** Manatuto is frequently affected by many natural and climate change hazards like landslides, fire, floods, inundation and drought. Flash flooding, inundation/sea level rise and drought are more pronounced along the northern coast, while fires and landslides in the middle (mountains) of the municipality have very high risk and magnitude. To respond and prevent natural hazards, the local government of Manatuto has established a Disaster Management Committee under the Municipality Authority, comprised of different ministries. The main role of the committee is to provide assistance and support victims during and after disaster incidences. In addition, the committee is also responsible for providing information and GIS maps on areas vulnerable to natural hazards, delivery

of emergency support in the event of disaster, conduct natural and climate change hazard and related risk assessment, and provide tangible or appropriate adaptation options and measures in order to lessen the natural disaster.

**Liquiça.** Similar to Dili, Liquiça has been experiencing long dry season, and shorter rainy season resulting in drought. Flooding has been experienced in areas near the rivers during the rainy season. The district has an emergency response plan covering floods, landslides, oil spills and forest fires. A disaster management committee had been established in the district comprising of the agriculture, health services, education, social services and disaster management agencies, the National Police of Timor-Leste (PNTL), Red Cross, environmental agencies, civil security, and fire department. The committee is headed by the District Administrator.

### 13.5.2 Habitat Protection, Restoration and Management

The country is in the process of developing policies, action plans and strategies for the management of its environmental resources. These include the: Draft National Biodiversity Strategic Action Plan, Preparation of Program of Work on Protected Areas, Draft National Action Plan to Combat Desertification, Draft Community Forestry Policy and the National Forestry Legislation. There were about 30 projects/programs on habitat management implemented in 2000-2010, and about 67 projects/programs implemented in 2011-2015.

In August 2007, the Nino Konis Santana National Park (NMSNP) was established, covering an area of 123,600 ha; about 55,600 ha of it is part the 'Coral Triangle'. About five new MPAs are located in the National Park of Nino Konis Santana in Lautem municipality.

There are seven marine protected areas (MPAs) in Timor-Leste: Atauro Vila with a cover area of 50.51 ha in Dili municipality, Batugade with 1100 ha in Bobonaro municipality, Lore 1 (487 ha), Hilapuna (303 ha), Perebenu (231 ha), Jone (409 ha), and Com (228 ha). Total area of MPAs in Timor-Leste is 2,808.51 ha.

**Dili.** Among the coastal resources and habitats that are found in the municipality are mangroves, coral reefs, seagrass beds and beaches. There are also sightings of turtles and wild birds along the coasts. Decline of the coastal resources, including forests and rivers, however, is occurring in Dili. This could have been due to unsustainable human practices, such as over-extraction and overexploitation of resources, limited capacity of government and stakeholders in habitat protection and management, high dependence on resources for livelihood, and low awareness of stakeholders on the importance and management of resources. In terms of reclamation, total reclaimed area in Dili municipality covers 25 ha in about 3.2 km of the coastline.

There is a program on habitat protection and resource conservation in the municipality. As part of the ICM program in Dili, mangrove rehabilitation is being undertaken in collaboration with various agencies and coastal communities.

However, adequate protection has not been carried out due to limited financial resources. There is also a need for more comprehensive assessment on the status and coverage of coastal habitats in the municipality.

**Manatuto.** A locally Managed Marine Area (LMMA) was established in Manatuto to protect marine and coastal resources, and sustain fishers' income and other livelihoods. Some of the coastal communities have already taken part in the LMMA processes. The management of the LMMA is considered as part of the ICM program of the municipality.

**Liquiça.** In terms of protected areas, Mount Fatumasin and the surrounding forests is one of the 15 'protected wild areas of the country'. Mt. Guguleur, which is found in the western part of Liquica, is also being evaluated to be included in the list of protected areas. Historical heritage sites and old buildings are also located along the coast of the district, such as the ruins of the Dutch fort, Epelu Jail during the Portuguese colonization, Portuguese government administration office, chapel, hospital, and church.

### 13.5.3 Water Use and Supply Management

The country has a number of governing laws and policies on water use and supply management. These include the following.

- Decree-Law 04/2004 on Water Supply for Public Consumption
- Ministerial Order 1/2004 on Fees and Charges for Water Supply
- Rural Water and Sanitation and Hygiene Sector Strategy (2008)
- Decree Law 05/2009 on Regulation of the Licensing, Commercialization and Quality of the Drinking water

**Dili.** In 2015, about 70% of the population in Dili has access to safe water (NDS and UNFPA 2015). Urban areas in the municipality, such as the sub-municipality of Dili, have better access with piped connections directly to the households compared to rural areas where water is still supplied from water tanks. In terms of incidences of waterborne diseases, diarrhea is one of the top three diseases in children below five years old. Among the strategies identified for water use and supply management during the consultation workshops in Dili include:

- o Reforestation of upland areas and denuded forests;
- o Improvement of water distribution system;
- o Establishment of water impounding dams and reservoirs;
- o Establishment of wastewater management system; and
- o Capacity development of water and sanitation agency and forestry personnel.

There were 22 projects, amounting to US\$1.662 million for 2010-2011 for the provision of clean water in the urban and rural areas.

**Manatuto.** Water supply and water management program has been established under the Water and Sanitation Department in Manatuto. Almost everyone in Manatuto have access to clean water (tap water). However, some of them still use groundwater. To date, some people still struggle with water quantity, especially in the coastal areas. This is caused by the long dry season and limited capacity and efforts to conserve water in the wet season. The strategic plan for long-term management of water resources is already in place, but the implementation is constrained by lack of human skills and budget allocation.

### 13.5.4 Sustainable Fisheries, Food Security and Livelihood

The National Directorate of Fisheries and Aquaculture governs the management of fishery resources and aquaculture in all municipalities in Timor-Leste. Among the country's strategies, policies and laws in relation to fisheries management include the *National Fisheries Strategy (2015)*, *National Aquaculture Development Strategy (2012-2030)*, *Fish for Sustainability (2006-2012)*, and eight other Decree laws and Ministerial Diploma on Fisheries. The Government Decree-Law No. 6/2004, *General Bases of the Legal Regime for the Management and Regulation of Fisheries and Aquaculture* stipulates the fishing area for various vessels, such as:

1. 200 meters from the coastline for small-scale fishing vessels;
2. 3 miles from the coastline for artisanal fishing vessels; and
3. 12 miles from the coastline, for industrial fishing vessels.

There are about 42 programs and projects on food security, including fisheries and livelihoods management, that were implemented in 2005-2010, and additional projects and programs implemented in 2011-2015.

**Dili.** Livelihood programs that are currently being conducted in the municipality includes: seaweed cultivation, handicrafts, boneca (doll)-making, and livestock raising. It is essential for the municipality to explore other potential livelihood opportunities, establish and improve livelihood-relevant facilities, and provide livelihood skills training to the communities.

**Manatuto.** The local government has made great effort to conserve and protect marine and coastal resources by using existing laws and regulations, and through cooperation with development partners, local NGOs, and community leaders. The fishing efforts are subsistence and small scale. Fish production is small, with very few of the products can be sold in the local market. The local fishermen have limited capacity (budget and fishing equipment) to carry out commercial fishing. However, aquaculture is being developed, such as farming of seaweeds and milkfish. Considering the low employment rate in Manatuto, the local government is looking for alternative livelihood opportunities. Some initiatives that are being started are salt distillation and tourism to diversify people's incomes. However, the tourism industry is also limited because of lack of supporting facilities.

### 13.5.5 Pollution Reduction and Waste Management

**Dili.** There is a solid waste management system, with sanitary landfill, in place in Dili. Moreover, there is also a wastewater treatment system. Expansion of coverage of solid waste and wastewater management systems are needed as well as more efficient and innovative systems, with consideration of reuse and recycling.

**Manatuto.** Budget allocation for waste management is needed considering that Manatuto has the second largest quantity of beach debris in Timor-Leste (Cruz, 2015). No annual monitoring system, which deals with waste management, is in place. The local government is encouraged to develop their solid waste and wastewater management facilities in conjunction with the ICM program.

## 13.6 Capacity Development, Technology Transfer, and Knowledge Sharing

The following activities for capacity development are being undertaken by the government together with partner NGOs and universities:

- The Ministry of Agriculture and Fisheries (MAF) organizes annual training for various agencies and other sectors focusing on different aspects of environmental and coastal management. MAF also incorporates public awareness activities into its various programs.
- Development of the National Oceans Policy: for consideration by Council of Ministers (with PEMSEA support).
- WorldFish has been assisting the Fisheries Department of MAF with its research on stock assessment of fishes in the north and south seas of the Island of Timor-Leste to prepare a strategic plan on fisheries, with the following underlying principles:
  - Food security
  - Human rights
  - Precautionary principle in fisheries management
  - Ecosystem based approaches
- Establishment of PEMSEA ICM Learning Centers in UNITAL and UNTL to provide technical and capacity building support to local governments developing and implementing ICM programs.
- Universidade Oriental de Timor Lorosa'e (UNITAL) has been teaching 70 students in fisheries aquaculture since 2013. UNITAL also provides assistance to the community (HASEKO group with 32 members) to implement blue economy activities through fish culture (milkfish and

tilapia) integrated with poultry and tourism activities in Vatuvou-Liquiça since October 2016, with funding support from the MECAE.

- A number of international NGOs are active in the country and conducts environment-related activities. These include CARE International, WWF, CI, TNC, UNDESA (Japan), Oxfam, OISCA, JICA, USAID, AusAID, CRS, Caritas, CIDA (Canada).

## 13.7 Innovative Tools for Monitoring, Evaluation, and Enforcement

Innovative monitoring, evaluation and enforcement tools have been introduced for the fisheries assessment (e.g., tablet app to assess fish landings) were used for the fish stock assessment, survey of fisherfolk, etc. (WorldFish, 2016). Regular monitoring of marine water quality, coastal and marine ecosystems, and MPAs is critical for more effective governance.

## 13.8 Public Awareness and Participation Mechanisms

*Tara bandu* is a traditional Timorese custom that enforces peace and reconciliation through the power of public agreement. *Tara bandu* involves the hanging of a culturally significant item from a wooden shaft to place a ban on certain activities within the area of concern. Given that there could be multiple resource-use conflicts in the coastal areas, *tara bandu* codes of behavior would be useful in addressing existing conflicts or in preventing outbreak of potential conflicts.

Community education and awareness activities are regularly undertaken by government agencies and NGOs (e.g., Haburas Foundation). Public awareness and education include information on fisheries regulations, marine reserves, and on the importance of marine habitats, such as mangroves, coral reef, seagrass and internationally protected species.

Haburas Foundation has engaged in participatory action research with local peoples, documenting local cultural traditions and rituals specifically in relation to environmental management. They carry out initiatives in sectors, such as forest management, coastal area protection, ethical tourism, energy management and environmental education. Haburas advocates, where appropriate, the recognition of customary governance structures (*tara bandu*) particularly in area of resource management. Haburas has been involved in research and evaluation of prospective sustainable tourism sites for the Department of Tourism, and assisted with the construction of one of the first ecotourism village at Valou Beach, within the NKSMP.

WorldFish is also engaged in participatory research with local communities, use of *tara bandu* approach, and promoting Locally Managed Marine Areas (LMMAs) or community-based Marine Protected Areas (MPAs) (WorldFish 2017).



Conservation International (CI) is working with coastal fisheries to empower ocean-dependent communities to secure and access this nutrient-rich food source. CI is also involved in raising awareness and demonstrating the importance of ecosystem-based approaches to address the impacts of climate change, including the use of coastal ecosystems to better protect communities from extreme weather.

Another locally active NGO is Roman Luan on Ataúro Island. It is involved in the Bikeli Marine Management Project that helped to establish two community-based MPAs in the Bikeli region of Ataúro Island. In response to declining fish catches, the fishing communities in cooperation with Roman Luan, established the two MPAs for which a set of regulations have been drafted. The NGO is also running an eco-lodge on Vila Beach and has developed a set of guidelines for sustainable eco-tourism. All regulations and guidelines were developed through a consultation process that brought together key stakeholders, such as village heads, fishermen's cooperatives, and Dili-based dive tour operators. Other activities are concerned with sustainable fisheries and include a survey of fisheries operations and community workshops on safe fishing practices, and coastal re-vegetation.<sup>11</sup>

Co-management arrangements is being applied in the MPAs developed with support of the Coral Triangle Support Partnership (CTSP). "Communities develop a sense of ownership from co-management," said Fernando da Silva, head of the Fish Management and Aquatic Research division of DNPA. "Multi-sector engagement allows outside expertise to be brought into the process, strengthening DNPA and local knowledge." (USAID-CTSP, n.d.)

Existing means of communication in the three ICM sites include: internet access in some areas, radio, and television. Information and public awareness in coastal communities are carried out through radio broadcasts, brochures, audio-visual materials, billboards, and posters, including the establishment of a marine and coastal conservation group involving the public and coastal communities.

Despite the public awareness campaigns being conducted, the level of awareness of local governments and other sectors on the objectives and processes of the ICM program still need to be enhanced. There is a need to strengthen information and education on the ICM program, as well as on other aspects related to the coastal and marine environment, through formal and non-formal education. There is also limitation in terms of human and financial allocations for information and public awareness programs.<sup>12</sup>

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<sup>11</sup> MAF. 2011. Timor-Leste Program of Work on Protected Areas: Capacity Development Action Plan for the Department of Protected Areas and National Parks.

<sup>12</sup> Local SOC Report of Dili.

## 13.9 Partnerships in Ocean Stewardship

The following are the key partners of Timor-Leste in coastal and ocean management:

- PEMSEA (2000-ongoing)
- Arafura and Timor Seas Ecosystem Action Program or ATSEA (2010-ongoing)
- Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security or CTI-CFF (2007-ongoing)
- Coral Triangle Support Partnership (2008-2013)
- CTI-Pacific: Strengthening Coastal and Marine Resources Management in the Coral Triangle of the Pacific (ADB CTI-Pacific)
- FAO – Regional Fisheries Livelihood Program for South and Southeast Asia (RFLP)
- WorldFish
- Conservation International
- Haburas Foundation
- UNDP
- USAID
- AUSAID
- SEAFDEC

A number of other NGOs are also active in environmental management and sustainable development, working with various stakeholders: Asia Foundation, AECID, Child Fund, and Care International. In addition, there are also some local NGOs like LODA, Moris Foun, Rede Feto, Rai Maran, SOL, Fundasaun Hader, Taha, Goreti, Tuba Rai Metin, Moris Rasik, Peace Commission and Justice, and Aplimentec Foundation. Tuba Rai Metin and Moris Rasik are local NGOs engaged in micro-credit.



**PART 6**

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**CONCLUSION AND  
RECOMMENDATIONS**

# 14 Summary and Conclusion

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## 14.1 Ocean Economy: Where Are We Now?

### 14.1.1 Ocean Economy

The entire ocean economy is measured as the sum of: (a) the economic activities with dependence on the ocean and coastal and marine resources, and (b) natural assets, goods and services of marine ecosystems upon which these industries depend on, and people rely on for food, income, livelihood, recreation, shoreline protection, etc. (OECD 2016).

Total gross value added (GVA) of ocean industry is US\$1,966,648,447.38, with 87% contribution to GDP. The key ocean economic activities in Timor-Leste are gas and oil industries, shipping and port, tourism, and fisheries. Offshore oil and gas industry is the sector that has the highest economic contribution (66%) in Timor-Leste. The total number of people employed in the ocean industry is around 16,077 persons, and indirect jobs amount to 26,500 persons for two baseline oil and gas projects (Tasi mane Suai and Beaço-Viqueque).

The estimated value of coastal and marine ecosystems in Timor-Leste is US\$5.25 billion. This is much higher than the value of the ocean-based economic activities as this estimate includes nonmarket values like the regulating, supporting and cultural services being provided by ecosystems.

### 14.1.2 Fisheries and Aquaculture

From 2000 to 2016, the annual average growth rate of capture fisheries production was -0.8% (World Bank 2017). As can be gleaned from Table 5.1 and Figure 5.2, production declined from 2004 to 2007, and has not changed from 2009 to 2016 at 3,200 tonnes.

A report from the Government of Timor-Leste (2015) stated that there were 62 fishing centers, 4,723 fisherfolks, and 3,009 fishing boats. Approximately 95% of the boats are small-scale. Around 36.3% of fisherfolk do not have their own fishing boats.

There was a huge increase in production from 2006 to 2009, and then it tapered off in 2011 to 2015 at 1,556 tonnes. In 2016, aquaculture production slightly increased to 1,560 tonnes. There is increasing promotion of aquaculture, which is attracting many people in rural areas to raise tilapia, milkfish, and golden fish. Moreover, areas for brackishwater and marine water ponds have

been identified. There is also potential for seaweed farming. In 2016, Timor-Leste produced 1,500 tonnes of seaweeds, with a value of US\$113,000 (FAO 2018).

Gross value added (GVA) of fish and other fish products in 2015 is US\$0.007 billion (DNSS of MoF Timor-Leste, 2017).

Given the small share of the fisheries sector to the national economy, it could be difficult to give high priority for this sector. However, the adoption of strategies, action plans, and innovative technologies for the sustainable development of fisheries and aquaculture could contribute to poverty alleviation, income and livelihood diversification, and food security. Seafood processing industry could also offer job opportunities and potential products for domestic use and exports.

### 14.1.3 Coastal and Marine Tourism

The following are key heritage sites and marine parks:

- Area Branca, Cristo Rei, Largo de Lecidere, Tasi Tolu and Joao Paulo Segundo in Dili;
- Akrema Beach and Atauro Island in Dili Municipality;
- One-dollar Beach in Manatuto Municipality;
- Illi kere-kere and Jaco Island in Tutuala Village Lautem Municipality;
- Beach in Liquiça Municipality;
- Vemase Beach in Baucau;
- Lifau Beach in Oecussi special region.

Around 56% of total tourists is part of marine tourism (e.g., 31% snorkeling, 13% fishing, 12% scuba diving) (Asia Foundation, 2014). The GVA of the coastal and marine tourism sector in 2015 was US\$19,600,000, where it contributed 1% to the GDP. The direct benefit was estimated to be US\$7.84 million (56% of US\$14 million) (calculated based on research of Asia Foundation, 2014 and Timor-Leste National Tourism Policy, 2015).

In 2015, Timor-Leste's tourism sector directly employed approximately 4,300 people, with jobs in the accommodation, restaurant, and other tourism-related services. Employment in tourism industry is expected to exceed and reach 15,000 by 2020.

### 14.1.4 Ports and Shipping

Contribution of ports and shipping to the economy of the country is only 3% of the country's GDP. The major services of the port in Dili are cargo loading and unloading. Another service is passenger transport to visit Atauro Island and Oecusse-Ambeno SAR. The share of ports and shipping is expected to increase with the construction of the new port in Tibar, and expansion of the passenger terminal in Dili port.

### 14.1.5 Offshore Oil and Gas

The oil and gas industry has the biggest share and contribution to the economy of Timor-Leste. However, development of downstream industries, e.g., Suai Supply Base, oil refineries, petrochemicals, and LNG plant will diversify the economy, create jobs, and reduce reliance on purely extractive activity.

## 14.2 Ocean health

### 14.2.1 Ocean Health Index<sup>13</sup>

The Ocean Health Index (OHI) is a way to measure how healthy oceans are. The overall score is 59, with an overall ranking of 187 out of 221 exclusive economic zones (EEZs) (CI, 2016). More actions are needed to improve the OHI score and ranking of Timor-Leste. The target is to get a score of 100. Target setting makes clearer whether management actions are enabling progress toward the sustainable development of oceans and achieving the range of environmental, social, and economic benefits and services that healthy oceans provide to people. Timor-Leste got high scores for coastal protection (87), but low scores for food provision (25), and coastal livelihoods and economies (28).

### 14.2.2 Coastal and Marine Ecosystems

- **Mangroves:** The total mangrove area has been reduced from 9,000 ha in 1940 to only 1,802 ha in 2008, equating to an 80% loss, and 290 ha in 2015. Mainly due to trees being harvested for timber and fuel wood, and the establishment of brackish water shrimp and/or fish ponds. Salt is also being extracted from mangrove fringes.
- **Coral reefs:** Fringing coral reefs form an almost continuous strip along the coastal waters, west of Timor-Leste.
- **Fisheries:** Timor-Leste has abundant fish stocks, yet almost all fishing is subsistence or semi-subsistence.

The environmental problems are complex and varied with different magnitudes. Drought, fires, landslides, erosion, flooding, inundation, and sea level rise greatly affect human life, houses, bridges, agricultural production, livestock, and water sources. The damage or impact could be massive.

Coastal erosion largely occurs in the northern coast of Timor-Leste. This is because most of the population (66%) are living on coastal areas and rely heavily on coastal resources for survival, e.g., cutting mangrove

<sup>13</sup> The Ocean Health Index establishes reference points for achieving socio-ecological goals and scores for 220 countries & territories, Antarctica and 15 High Seas regions on how successfully they are achieved. The 10 goals are: (1) food provision; (2) artisanal fishing opportunities; (3) natural products; (4) carbon storage; (5) coastal protection; (6) tourism and recreation; (7) coastal livelihoods and economies; (8) sense of place; (9) clean waters; (10) biodiversity. Each goal is calculated with a variety of components: status, trend, pressure and resilience. A goal is given a score of 100 if its maximum sustainable benefits are gained in ways that do not compromise the ocean's ability to deliver those benefits in the future. Lower scores indicate that more benefits could be gained or that current methods are harming the delivery of future benefits.

trees for cash and canoes construction, which in the end has a significant contribution to the destruction of fish habitat and ecosystem.

Marine debris is one of the main issues in Timor-Leste (on the northern coast) recorded so far. Cruz (2015) describes that marine debris in Timor-Leste is getting greater and worse because of population growth. Marine debris creates major impact on coastal areas due to inappropriate and inefficient waste management system typically found in urban areas.

Laws and regulations already exist, but these regulations are not always compatible with the socio-economic conditions of the coastal communities. Education and public awareness are strongly required not only in targeting the community and fishermen, but also community leaders and local government staff to give more attention to law enforcement and to allocate/invest more money for safeguarding marine and coastal resources and climate resiliency.

### 14.1.3 Marine Environmental Quality

The following are the findings for the key seawater quality parameters (Refer to Section 10 for more details.):

- Dissolved oxygen (DO): rating is Good (75%–97% of water bodies partially comply with the water quality standards);
- Nitrates and phosphates: very low to undetectable near the surface; increasing concentration with depth
- pH and heavy metals: rating is Good
- Total suspended solids (TSS): rating is Fair (50%–74% of water bodies partially comply with the water quality standards).

## 14.3 Policies and Blue Economy Initiatives

- **National Oceans Policy (NOP).** The NOP has been drafted (with support from PEMSEA) and undergone stakeholder consultations. It is now subject for approval and adoption by the Council of Ministers.
- **Integrated coastal management.** The three municipalities of Dili, Liquiça and Mantuto, covering or around 30.49% of coastline, are implementing ICM. The government should look into extending the ICM program to all coastal municipalities.
- **Fisheries and aquaculture.** Strategies for sustainable development of fisheries and aquaculture have been recently developed. Potential areas for aquaculture development have also been identified. However, new technologies and practices are essential to support this industry. Alternative livelihood programs are also needed to reduce fishing pressures, together with conservation of coastal and marine ecosystems.
- **Sustainable tourism.** The Ministry of Tourism is implementing the *National Tourism Policy 2011-2030*, considering the Timor-Leste Strategic Development Plan 2011–2030, traditional law (*Tara*

*bandu*), and laws/decrees related to other sectors (e.g., environment, agriculture and fisheries, land and property, etc.). The Tourism Policy is a pledge by the Government of Timor-Leste to develop a unified and holistic tourism sector that places emphasis on sustainability, community, quality, and business competitiveness. Sustainable community-based tourism and ecotourism with habitat and biodiversity conservation are key initiatives contributing to the blue economy transformation.

- **Port development.** The government invested in the new Tibar Port, which is a greenfield port. The PPP contract includes the construction of green-building features. Measures are needed to reduce the impacts on ecosystems that will be affected by the construction and eventual operations of the port.
- **Marine protected areas (MPA).** There are seven MPAs in Timor-Leste, such as Atauro Vila covering an area of 50.51 ha in Dili municipality; Batugade, 1100 ha in Bobonaro Municipality; Lore, 1,487 ha; Hilapuna, 303 ha; Perebenu, 231 ha; Jone, 409 ha; and, Com, 228 ha. Five new MPAs are in the National Park of Nino Konis Santana in Lautem Municipality. Total area of MPAs in Timor-Leste is 1.37% of territorial waters. Manatuto also established a LMMA to protect marine and coastal resources in their municipality, and sustain fishers' income and other livelihoods. Raising awareness among the local communities has helped in getting their support for the establishment and maintenance of the MPAs, and compliance with the regulations. MPAs in tandem with community-based ecotourism and sustainable fisheries would transform the traditional tourism into a more sustainable and inclusive industry.
- **Habitat restoration and protection.** There are on-going projects and programs on mangrove restoration, seagrass and dugong conservation, and fisheries management with coral reef protection in some areas of the country.
- **Pollution reduction.** Existing facilities for solid waste and wastewater management need to be expanded to cover more areas, households and establishments. This would require access to financing and technologies, institutional capacity, technical support services, accountability, performance monitoring, user fee system and other incentives to support operations and maintenance, and sustain services.
- **Natural hazard management and climate change response.** The country has developed the National Disaster Risk Management Plan (2005) and the National Disaster Risk Management Policy (2008) in response to dealing with natural and man-made hazards. An inter-Ministerial Commission for Disaster Response/Management has also been established. A project under the National Adaptation Program of Action (NAPA) called the Small Scale Rural Infrastructure is being implemented by the Ministry of State Administration

## 14.4 Outlook for Blue Economy

The need to diversify the economy, and move beyond the oil sector offers opportunities for the country to look at alternative paths for economic growth. Blue economy and harnessing the oceans in a sustainable way presents potential investment areas for Timor-Leste, such as:

- Sustainable fisheries and mariculture (ongoing and projects in the pipeline)
- Marine and coastal ecotourism (initiated in some areas)



- Fish/seafood processing, food security and livelihood projects (initiated in some areas)
- Port development (expansion of Dili port and construction of new Tibar port is ongoing, but need to ensure that these ports are green and sustainable, and impacts on coastal habitats are minimized)
- Marine bioprospecting (proposed, but needs human and financial capital)
- Downstream industries of the oil/petroleum sector
  - New businesses and locals can compete to supply services and goods for LNG, pipeline and tanker operations worth over US\$1.5 billion (25 years). It is assumed that this will not be generated without the project. Such services include maintenance, engineering, small fabrications, repairing, specialized welding, specialized equipment cleaning, transport, gardening, cleaning, security guard services, chemical supplies, LNG tanker business, tug boats, electricity usage, offices and accommodation, hotels and entertainment, food, fruit and vegetable supplies, etc. All these sectors could generate thousands of indirect jobs, stimulate economic activities around Beaçó and Timor-Leste in general, and contribute to tax revenues and GDP growth. With this project, Timor-Leste can be more active in world trade and be known as an LNG supplier.

Such investments for short- and long-term development will require supporting policy instruments, clear regulations, strategies for implementation of blue economy, strong collaboration among ministries; financing arrangements (from government and development partners); and indicators for monitoring and evaluation (M&E).

## 14.5 Conclusion and Recommendations

Blue economy is a new concept in Timor-Leste. Blue economy involves the utilization of marine and coastal resources in a sustainable way, and needs careful and integrated management to ensure the flow of ecosystem services and goods which people rely on for food, livelihood, amenities, shoreline protection, well-being and other benefits. Although still underdeveloped, fisheries and aquaculture have great potential to contribute to food security and protein intake, especially for those people who are living in the coastal areas. The development of the blue economy will contribute to the acceleration of activities to achieve the UN Sustainable Development Goals (SDGs).

The coastal and marine resources are under threat in face of climate change and related hazards (floods, inundation, sea level rise, and erosion) as well as unsustainable human activities, which result in pollution, erosion and sedimentation, and habitat and biodiversity loss.

The development of this report was done in close coordination and consultation with key government agencies, NGOs, academe, and development partners. There were focus group discussion and workshops conducted in Dili from 2016 to 2017.

The ocean economy is currently not getting much attention from the government as shown by the lack of allocated state budget and political will. For example, new port development in Tibar is delayed due to a lack of money.

Marine and coastal tourism is partially done in some districts, but it requires further action and investments from the government in terms of proper facilities, water for drinking, security and roads. This is very important because all of these marine and coastal ecotourism initiatives provide job opportunity and income generation for local people. Marine and coastal tourism needs to be managed in proper way, because so far there are many marine debris, and solid and liquid wastes have greatly contaminated and affected marine and coastal areas, including marine protected areas.

Limited knowledge on fisheries management and innovative technologies in aquaculture has hampered the implementation of blue economy concept and activities in the fisheries sector.

The majority of government staff also has limited knowledge on how to mainstream blue economy concept into climate change issues in coherent manner.

There are ongoing ocean economy-related developments (e.g., Tasi Mane project) in the southern coasts, providing many job opportunities and income for local people. But skills and knowledge of the local workers have to be enhanced, and environmental impacts assessed and addressed properly.

Management of marine and coastal resources (including marine protected areas) and nature-based disaster- and climate-resiliency in the context of blue economy development should also consider community participation and involvement of stakeholders in decision-making. This approach will enable all players to implement the blue economy activities/concept as well as existing government policies and strategies to promote sustainable development.

A technical working group is recommended to be established to assess the needs and work on finding solution options to ensure that ocean health is protected for blue economy development.

The key actions needed are:

- Adopt the National Ocean Policy, and prepare its Implementation Plan, including blue economy initiatives
- Formulate strategies and action plan for blue economy
- Strengthen coordination among line ministries with active involvement of decision-makers
- Scale up the ICM program and increase ICM sites; Include blue economy initiatives in the coastal strategies and ICM plans
- Develop capacity-building activities for the ministries involved in implementing projects related to blue economy development (e.g., MCIE, MAF, tourism, port administration, oil and gas, infrastructure, education, climate resiliency etc.)
- Involve the statistics agency for the development of ocean accounts for the country. The ocean accounts will show the contribution of the ocean economy to the national economy as well as ensure that the ecosystem services, biodiversity values, and environmental damage

are accounted for and integrated into national and local planning, development processes, and poverty reduction strategies (This is also in line with SDG 17).

- Implement marine spatial planning to reduce multiple resource-use conflicts and ensure responsible use of Timor-Leste's near-shore habitats and resources
- Continue the monitoring and assessment of mangroves, seagrass, coral reefs, fish, biodiversity, seawater chemistry, and reef processes
- Evaluate the effectiveness of actions being undertaken for developing and sustainably managing coastal fisheries and aquaculture, and enhancing climate resiliency
- Develop projects on water supply, sanitation, wastewater and solid waste management to protect freshwater and marine waters, fisheries, and ecosystems from pollution as well as ensure the health and wellbeing of the people.
- Involve the communities and key stakeholders, increase their awareness, and develop their skills so they can be partners in economic development, and co-managers and stewards of the environment and the oceans.
- Link blue economy initiatives with the UN Sustainable Development Goals, and Strategic Development Plan, 2011-2030..

There is a need to operationalize and strengthen an inter-ministerial mechanism to ensure a coordinated and integrated approach for blue economy development. Blue economy offers opportunities for emerging industries, economic growth, innovations, livelihood, and poverty reduction while enhancing food security, climate resiliency, and conservation of coastal and marine resources. It is important for the government and communities to recognize that blue economy is not just the role of the fisheries, environment, and coastal management sectors. Everyone would benefit from sustainable and inclusive blue economy development. Timor-Leste relies heavily on the resources from the oceans. However, everyone will also be affected by the oceans -- by human activities affecting the health of oceans, and by the impacts of sea level rise, ocean acidification, rising sea water temperature, increasing frequency and intensity of extreme weather events, and loss of habitats, fisheries and biodiversity. Thus, blue economy should be incorporated and highlighted into the economic and development planning and strategies of the country, taking into consideration the changing environment and climate.

**Table 14.1:** State of Ocean Economy and Health, Issues and Challenges, and Response.

Indicator	Status / Trend	Major Issues and Challenges	Response	
	INCREASING (↑) / DECREASING (↓) / NO CHANGE (–)	Top 3 issues	(a) key policies/ laws; (b) national action plan	Best practice or blue economy initiative
<b>State of ocean economy</b>				
<b>Ocean economy</b>	↑			
<b>Fisheries and aquaculture</b>	Fisheries: ↑ Aquaculture: ↑	<ol style="list-style-type: none"> <li>1. Lack of adequate fishing boats and gears (90% of boats are small.);</li> <li>2. Lack of capacity - knowledge and skills - and funds for sustainable fisheries and aquaculture</li> <li>3. Low demand for fish; high price of fish</li> <li>4. Lack of fish landing centers or fish ports, and storage facilities</li> </ol>	<ol style="list-style-type: none"> <li>1. Law No. 12/2004 “Fishing-Related Offences”</li> <li>2. Decree-Law No. 6/2004 of 21 April 2004: General Bases of the Legal Regime for the Management and Regulation of Fisheries and Aquaculture</li> <li>3. Decree-Law No. 4/2005 of 20 July 2005: Amending Decree-Law No. 6/2004 Of 21 April 2004</li> <li>4. Government Decree No. 5/2004: General Regulation on Fishing</li> <li>5. Decree- Law No. 21/2008, of the 25 June 2008: Implementation of Satellite System for Monitoring Fishing Vessels</li> <li>6. Policy and strategy for development of fisheries in Timor-Leste (draft)</li> <li>7. Aquaculture: Strategy for aquaculture</li> </ol>	<ul style="list-style-type: none"> <li>• Integrated farming system</li> <li>• 10 municipality support to youth for aquaculture of Tilapia sp.</li> </ul>

Table 14.1: State of Ocean Economy and Health, Issues and Challenges, and Response. (cont.)

Indicator	Status / Trend	Major Issues and Challenges	Response	
	INCREASING (↑) / DECREASING (↓) / NO CHANGE (-)	Top 3 issues	(a) key policies/ laws; (b) national action plan	Best practice or blue economy initiative
<b>State of ocean economy</b>				
<b>Tourism</b>	↑	1. High cost of traveling (both air access and land costs) compared to neighbor destinations; 2. Limited freshwater availability; 3. Potential risk of crocodile attacks.	1. National Tourism Policy, 2011-2030 2. Traditional law ( <i>Tara bandu</i> ) to support sustainable ecotourism and community-based tourism initiatives	Ecotourism and MPAs; ecotourism and seagrass and dugong conservation; community-based tourism
<b>Ports and shipping</b> • Passenger volume • Cargo and container throughput volume • GVA	↑		• Decree-Law No. 3 /2003 of 10 March: On the Establishment of the Port Authority (APORTIL) and on the Approval of the Bylaws Thereof • No. 7/2002: Maritime Borders and the Territory of RDTL	A new port in Tibar bay is under construction, with standard facility and services; including application of green building features, international rules and private sector participation.
<b>Offshore oil and gas</b> • Output; GVA	↓			Regular monitoring of water quality and sediments (in the Joint Petroleum Development Area)
<b>Employment in ocean economy</b>	↑			
<b>State of ocean health</b>				
<b>Fish stocks</b>	↑	IUU fishing; intrusion of foreign fishing vessels		
<b>Catch per unit effort</b>	NA			
<b>Mangroves</b> • area; cover • condition	↓	Cutting trees	Regulation No. 2000/19: Protected Places	Mangroves rehabilitation
<b>Coral reefs</b> • area; cover • condition	↑		Regulation No. 2000/19: Protected Places	MPAs; LMMA

Table 14.1: State of Ocean Economy and Health, Issues and Challenges, and Response. (cont.)

Indicator	Status / Trend	Major Issues and Challenges	Response	
			(a) key policies/ laws; (b) national action plan	Best practice or blue economy initiative
	<b>INCREASING (↑) / DECREASING (↓) / NO CHANGE (–)</b>	<b>Top 3 issues</b>		
<b>Seagrass beds</b> • area; cover • condition	↑			MPAs
<b>Beach</b>	↑		Regulation No. 2000/19: Protected Places	
<b>Tidal swamps, mudflats</b>	–			
<b>Extinction of known threatened species</b>	↑			Public awareness
<b>Marine water quality</b>	DO: Good TSS: Fair Heavy metals: Good N, P: Inadequate data	Lack of wastewater treatment facilities		
<b>Marine protected areas (% of territorial waters)</b>	1.37% ↑	Effective management	Regulation No. 2000/19: Protected Places	Seven MPAs in Timor-Leste: (a) Atauro Vila, with an area of 50.51 ha in Dili municipality; (b) Batugade, with an area of 1,100 has in Bobonaro municipality; (c) Lore, with an area of 1,487 ha; (d) Hilapuna, 303 ha; (e) Perebenu, 231 ha; (f) Jone, 409 ha; and (g) Com, 228 ha. Five new MPAs were established in the Nino Konis Santana National Park in Lautem Municipality. One LMMA was established in Manatuto. Total area of MPAs is 1.37% of territorial waters.
<b>Mainstreaming of valuation of ecosystem services; natural capital accounting</b>	none	Need capacity development and data management system to support resource valuation and ocean economy-environment accounting		

Table 14.1: State of Ocean Economy and Health, Issues and Challenges, and Response. (cont.)

Indicator	Status / Trend	Major Issues and Challenges	Response	
	INCREASING (↑) / DECREASING (↓) / NO CHANGE (–)	Top 3 issues	(a) key policies/ laws; (b) national action plan	Best practice or blue economy initiative
<b>Pressures and threats</b>				
Population growth in the coastal areas	↑			
IUU fishing	No data	Remains one of the most damaging problems in Arafura and Timor Seas – strong political will is required		Coordination with Indonesia, ASEAN, CTI-CFF, etc. on monitoring IUU fishing
Coastal erosion and sedimentation	↑	Lack of Oil Spill Contingency Plan		Forest/mangroves rehabilitation
Untreated wastewater discharge	↑			
Solid waste generation	↑			
Plastic waste generation and marine debris	↑			Recycle plastic bottle, and reused (e.g., flower, chair, and border of garden)
Oil spills	–		Regulation No. 2000/19: Protected Places	
Greenhouse gas emissions	–			
Population with access to sanitation and wastewater management systems	↑ sanitation	<ol style="list-style-type: none"> <li>1. Need to increase access to safely managed sanitation services</li> <li>2. Only Dili has access to wastewater management system, and the facility has to be improved and expanded. Additional wastewater management systems are needed to serve other municipalities.</li> <li>3. Wastewater management systems are also needed in tourism and commercial establishments and industries.</li> </ol>		Majority uses toilet

**Table 14.1:** State of Ocean Economy and Health, Issues and Challenges, and Response. (cont.)

Indicator	Status / Trend	Major Issues and Challenges	Response	
	INCREASING (↑) / DECREASING (↓) / NO CHANGE (–)	Top 3 issues	(a) key policies/ laws; (b) national action plan	Best practice or blue economy initiative
<b>Population covered by solid waste management services</b>	–	<ol style="list-style-type: none"> <li>1. Increased public awareness on waste segregation, waste reduction, reuse and recycling, proper collection and disposal is needed.</li> <li>2. Only Dili is served by the solid waste management system and landfill, and the facility has to be improved and expanded.</li> <li>3. Additional solid waste management systems (regular garbage collection; recycling or materials recovery facilities; sanitary landfills) are needed to serve other municipalities.</li> </ol>		There are vehicles collecting solid waste everyday in urban area, and then transported to the Tibar for treatment by Shun Hsin Company.
<b>Tourist establishments with habitat, solid waste and wastewater management</b>	–			An example in Atauro is treatment of sludge (toilet waste), and then used as soil conditioner for plants.
<b>Ports and ships with environmental management systems</b>	–	Adoption of key IMO Conventions and corresponding national laws is needed.	<ul style="list-style-type: none"> <li>• Decree-Law 26/2012 - Framework Environmental Law;</li> <li>• Decree-Law 5/2011 - Environmental Licensing System; and</li> <li>• UNTAET Regulation No. 2000/19 - Protected Areas.</li> </ul>	



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