



A review of intergovernmental collaboration in ecosystem-based governance of the large marine ecosystems of East Asia



Aimee T. Gonzales^{a,*}, Emma Kelley^b, Stella Regina Q. Bernad^a

^a PEMSEA, DENR Compound, Visayas Avenue, Quezon City 1165, Philippines

^b ECS Tech, Contractor to NOAA-NMFS, Office of Science and Technology, Silver Spring, MD, USA

ARTICLE INFO

Keywords:

Large marine ecosystems
East Asia
PEMSEA
Governance
Integrated coastal management
Ecosystem-based management

ABSTRACT

East Asia encompasses six large marine ecosystems (LME): the South China Sea, the Gulf of Thailand, the East China Sea, the Yellow Sea, the Sulu-Celebes Sea, and the Indonesian Sea. Despite occupying only 3 percent of the world's ocean surface, portions of this area are considered to be the global center of marine biodiversity. Since the early 1990s, Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) has refined the Integrated Coastal Management (ICM) methodology and fostered a collaborative, partnership approach in the region to implement sustainable coastal and ocean development of these LMEs. ICM provided the foundational delivery system promoting interdisciplinary approaches and cooperation among users and beneficiaries to address complex development issues. While addressing marine pollution at the beginning, it became obvious that it had to be tackled in the context of the whole marine environment and sustainable development. PEMSEA developed and adopted the Sustainable Development Strategy for the Seas of East Asia (SDS-SEA) as the regional policy instrument from which countries of the region and other partners, individually or in groups, could apply the action programmes relevant to them. This in-depth review article describes the evolution of PEMSEA from a regional marine pollution project to an international organization, highlighting key developments, such as the SDS-SEA, the ICM Code, and the Ocean Investment Service, as well the advancement of ICM throughout the East Asian region and the adoption of the State of Oceans and Coasts reporting system to track progress. Looking forward, we summarize a United Nations Environment and IOC-UNESCO assessment of the current baseline status of these East Asian LMEs to examine future key areas for intervention by PEMSEA.

1. Introduction

The Seas of East Asia encompass six Large Marine Ecosystems: the South China Sea, the Gulf of Thailand, the East China Sea, the Yellow Sea, the Sulu-Celebes Sea, and the Indonesian Sea. Collectively, they occupy a total sea area of 7 million km² and 235,000 km of coastline, with an estimated population of 1.5 billion people living within 100 km of the region's coasts (Whisnant and Reyes, 2015; PEMSEA, 2011). They are surrounded by 14 countries: Brunei Darussalam, Cambodia, PR China, DPR Korea, Indonesia, Japan, Lao PDR, Malaysia, the Philippines, RO Korea, Singapore, Thailand, Timor-Leste and Vietnam (Fig. 1). The value of ecosystem services in these countries is estimated to be in the hundreds of billions of US dollars (Table 1). The East Asian seas countries have global economic significance, as they serve as a conduit for 90 percent of world trade through shipping, produce 80 percent of global aquaculture output and 40 percent of capture fisheries, and receive 26 percent of the world's tourists (PEMSEA, 2018c).

The world's second and third largest economies (China and Japan) are located in this region (International Monetary Fund, 2018). Table 2 provides some statistics on the coastal resources of the 13 LME border countries. A fourteenth country, Lao PDR, while landlocked, is in the watershed of the Mekong River, which drains into the South China Sea. These countries depend on the resources of these Large Marine Ecosystems to varying degrees, but all rely to some extent on the services provisioned by their coastal and marine areas (see Table 3).

Despite occupying only 3 percent of the world's ocean surface, portions of this region are considered to be the global center of marine biodiversity. They are home to 31 percent of the world's mangroves and 33 percent of both seagrass beds and coral reefs (PEMSEA, 2018c). Threats in the form of pollution, loss of biodiversity and challenges including poverty alleviation, food, water and energy security and climate change are being addressed within the spatial domains of the LMEs, through country-to-country partnerships. Using the results of the United Nations Environment Programme's Transboundary Waters

* Corresponding author.

E-mail address: agonzales@pemsea.org (A.T. Gonzales).

<https://doi.org/10.1016/j.dsr2.2019.05.014>

Received 20 April 2019; Received in revised form 29 May 2019; Accepted 29 May 2019

Available online 06 June 2019

0967-0645/ © 2019 Elsevier Ltd. All rights reserved.

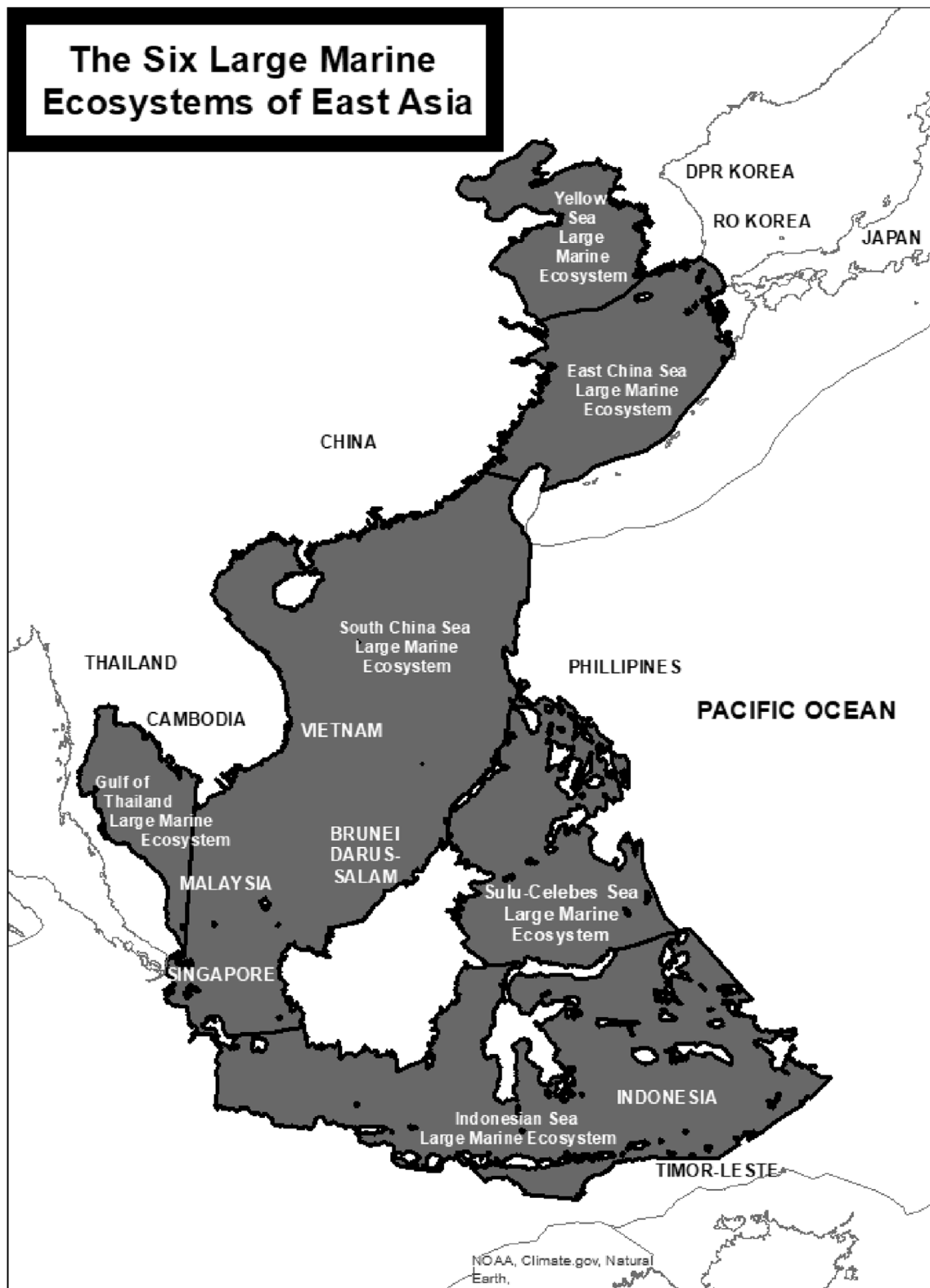


Fig. 1. LMEs of East Asia Map.

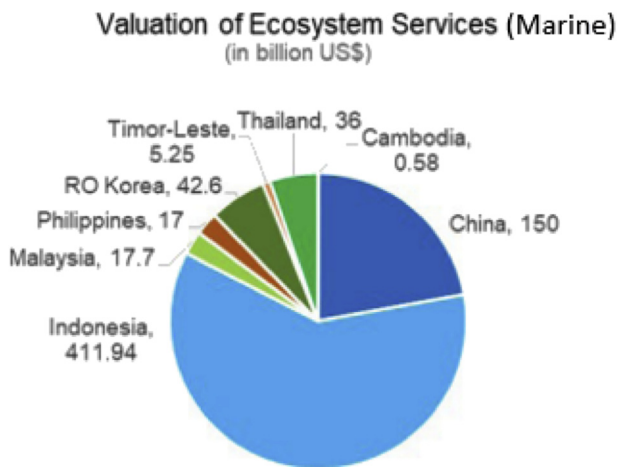
Assessment Programme, this article follows on the review of the progress made through PEMSEA with an examination of the current status of these six LMEs. The results of this assessment were then compared across the six East Asian LMEs. Our overview describes the current key stress mitigation challenges in the LMEs of East Asia and the continued importance of the collaborative, partnership approach to sustainable

coastal and ocean development undertaken by PEMSEA in addressing these challenges.

2. A partnership based on regional organization

Partnerships in Environmental Management for the Seas of East Asia

Table 1
Value of Marine Ecosystem Services (US\$) (PEMSEA, 2018).



(PEMSEA) began as the project “Regional Programme for the Prevention and Management of Marine Pollution Project in the Seas of East Asia” established by the Global Environment Facility (GEF), United Nations Development Programme (UNDP) and the International Maritime Organization (IMO) in 1993. Eleven countries, namely Brunei Darussalam, Cambodia, China, DPR Korea, Indonesia, Malaysia, Philippines, RO Korea, Singapore, Thailand and Vietnam initially joined the programme. The programme examined how local governments could effectively implement a governance approach in the region, called “Integrated Coastal Management” (ICM), to address marine pollution, the most pressing issue in the Seas of East Asia at that time. Activities were undertaken in demonstration sites in Xiamen, China; Batangas Bay in the Philippines; and the Malacca Strait. Demonstration sites were chosen on the basis of possessing similar biogeographical features and pollution management challenges to those found in other parts of the East Asian region.

Several lessons were learned from the demonstration sites. First, marine pollution is only one of the major threats to the region’s environmental and economic sustainability. To protect ecosystems and their services over the long term, the countries would need to address the cumulative impacts of pollution with other threats, such as fisheries depletion and habitat destruction, in a holistic and integrated manner. Second, the East Asian region needed a common vision and mission to set a clear direction and set of goals to achieve sustainable coastal and ocean development. Finally, cooperation is important at many levels: between sectors, between government agencies, among local governments, among countries, and with civil society actors in countries and in the region.

These lessons learned from the demonstration site projects were used to improve and refine the ICM methodology. In 1999, these experiences also helped transform the initial project into a GEF/UNDP/IMO Regional Programme on Building Partnerships in Environmental Management for the Seas of East Asia, from which the name PEMSEA was derived. As the name indicates, the collaborative approach to activities built during the first phase became the operating modality among the participating countries and other programme partners. ICM demonstration sites were added and expanded. The programmatic approach evolved from pollution management to a more holistic sustainable coastal and ocean development, which mirrored the global movement resulting in the World Summit on Sustainable Development (WSSD), Rio + 20, and the Millennium Development Goals (MDGs). In 2002, Japan joined PEMSEA, bringing the number of participating countries to 12.

In 2003, the Sustainable Development Strategy for the Seas of East Asia (SDS-SEA) was adopted at the first East Asian Seas Congress and

Table 2
Updated statistics on coastal resources of PEMSEA countries (p. 524, Routledge Handbook) (World Bank, 2017).

	Brunei Darussalam	Cambodia	China	Indonesia	Japan	Korea, DPRK	RO Korea	Malaysia	Philippines	Singapore	Thailand	Timor Leste	Viet Nam	WORLD
Total fisheries ('000 m.t.)	3.9	745	76,149	20,884	4,773	734	3,305	1,989	4,692	6.4	2,904	4.8	6,331	195,784
Capture fisheries growth (avg. annual %, 2000–2014)	1.8	5.8	1.1	3.3	-2.3	0.4	-0.4	0.9	1.5	-9	-3.7	-0.9	4.3	0.0
Aquaculture growth (avg. annual %, 2000–2014)	14.0	16.3	5.3	21	-1.7	0.6	6.3	8.4	5.5	-0.2	1.7	3.8	14.5	6.5
Marine protected areas (% of territorial waters)	1.5	0.5	2.3	5.8	5.1	0.1	4.3	2.3	2.5	1.5	5.2	1.5	1.8	12.2
Coral reef area (sq.km.)	210	< 50	1,510	51,020	2,900	-	-	3,600	25,060	< 100	2,130	3.8	1,270	284,300
Mangrove area (sq.km.)	173	728	208	31,894	7.4	-	-	7,097	2,565	4.6	2,484	18	1,056	150,398

Table 3

PEMSEA: 25 years of promoting Healthy Oceans, People and Economies (adapted from graphic available at www.pemsea.org).

Year	Activity
1993	<ul style="list-style-type: none"> ● GEF/UNDP/IMO Project on Marine Pollution Prevention in the East Asian Seas (MPP-EAS) signed by representatives from IMO, UNDP, Cambodia, China, Philippines, Thailand, and Vietnam, 13 November 1993, Xiamen, China. Participating Countries: Brunei, Indonesia, Cambodia, China, DPR, Korea, Philippines, Singapore, RO Korea, Thailand, and Vietnam.
1994	<ul style="list-style-type: none"> ● Regional Programme office officially opens 3 June 1994; attended by national delegates, UNDP New York and Manila, IMO, London and officials and staff of the Department of Environmental and Natural Resources of the Philippines. ● Xiamen (China) and Batangas (Philippines) established the first National ICM Demonstration Projects.
1995	<ul style="list-style-type: none"> ● First Regional Training Course on the Application of ICM System in Marine Pollution Prevention and Management held in Philippines, China and Singapore. ● Batangas Coastal Resource Management Foundation (BCRMF) established in support of Batangas Bay ICM Demonstration Project.
1996	<ul style="list-style-type: none"> ● Environment and Natural Resources Office (ENRO), established by the Batangas Provincial Government. ● Batangas Bay Environmental Protection Council established by Provincial Ordinance.
1997	<ul style="list-style-type: none"> ● Sea use zoning plan adopted by the Municipal Government of Xiamen. ● Agreement between littoral countries (Thailand, Malaysia, Indonesia, Singapore) to implement the Malacca Straits Demonstration Project.
2000	<ul style="list-style-type: none"> ● 2nd Phase of PEMSEA funded by the Global Environment Facility, implemented by UNDP and executed by the IMP; Participating countries: Brunei, Indonesia, Cambodia, China, DPR Korea, Philippines, Singapore, RO Korea, Thailand and Vietnam. ● National ICM demonstration sites established: Cambodia (Sihanoukville), DPR Korea (Nampho), Thailand (Chonburi), Vietnam (Danang) in addition to existing sites in China (Xiamen) and the Philippines (Batangas).
2001	<ul style="list-style-type: none"> ● Manila Bay Coastal Strategy/Declaration signed, October 2001, Manila, Philippines. ● Regional Network of Local Governments Implementing ICM (RNLG) established, March 2001, Seoul, RO Korea.
2002	<ul style="list-style-type: none"> ● Japan joins PEMSEA.
2003	<ul style="list-style-type: none"> ● Inaugural East Asian Seas Congress (8–12 December, Putrajaya, Malaysia); hosted by the Ministry of Science, Technology and the Environment of Malaysia with assistance from the Department of Environment Malaysia and Selangor State Government. ● 1st Ministerial Forum adopts Putrajaya Declaration of Regional Cooperation for the Sustainable Development of the Seas of East Asia, signed by Brunei, Cambodia, China, DPR Korea, Indonesia, Japan, Malaysia, Philippines, RO Korea, Singapore, Thailand, Vietnam. ● Sustainable Development Strategy for the Seas of East Asia (SDS-SEA) approved and initiated.
2005	<ul style="list-style-type: none"> ● Xiamen International Forum for Coastal Cities (XIFCC) organized and conducted; adopted the “Xiamen Declaration on Coastal Cities – Global Cooperation for Sustainable Development,” hosted by Xiamen Municipal Development, together with UNDP, State Oceanic Administration of China and PEMSEA; later transformed into the Xiamen World Ocean Week (XWOW).
2006	<ul style="list-style-type: none"> ● EAS Congress 2006, 12–16 December, Haikou City, China, hosted by the Haikou City Government, Hainan Province of China and the State Oceanic Administration of China. ● LAO PDR and Timor-Leste join PEMSEA as Country Partners and agree to implement the SDS-SEA. ● PEMSEA Network of Local Governments for Sustainable Coastal Development (PNLG) Charter signed by 18 local governments.
2007	<ul style="list-style-type: none"> ● 1st EAS Partnership Council Meeting, July 2007, Manado, Indonesia; hosted by the Ministry of Environment of Indonesia and the Provincial Government of North Sulawesi. ● International Ocean Institute, IUCN Asia Regional Office, Northwest Pacific Action Plan and Swedish Environment Secretariat for Asia joins PEMSEA as Non-Country Partners and sign agreement with PEMSEA supporting SDS-SEA implementation.
2008	<ul style="list-style-type: none"> ● 1st State of the Coasts Report published (Batangas Province, Philippines). ● Centre for Marine Environmental Research and Innovative Technology (MERIT) Hong Kong designated as the first PEMSEA Center of Excellence. ● Philippine Supreme Court Decision issued requiring 14 agencies in the Philippines to implement the Operational Plan for the Manila Bay Coastal Strategy (OPMBCS).
2009	<ul style="list-style-type: none"> ● 3rd EAS Congress, November 2009, Manila, Philippines, hosted by the Department of Environment and Natural Resources Philippines. ● 3rd Ministerial Forum adopts the Manila Declaration on Strengthening the Implementation of Integrated Coastal Management for Sustainable Development and Climate Change Adaptation in the Seas of East Asia Region, November 2009, Manila, Philippines). ● Agreement Recognizing the International Legal Personality of PEMSEA signed by Cambodia, China, DPR Korea, Indonesia, Lao PDR, Philippines, RO Korea, and Timor-Leste. ● World Bank signs MOU with PEMSEA as sponsoring agency, covering support for initiatives related to land-based pollution reduction, ICOM/governance, climate change adaptation and public-private partnership, 25 November 2009, Manila, Philippines.
2010	<ul style="list-style-type: none"> ● Global Environment Facility recognizes PEMSEA and SDS-SEA as a regional governance mechanism and framework for sustainable management of the Seas of East Asia at GEF stocktaking meeting, October 2010, Manila, Philippines. Attending regional programmes and organizations include ADB, FAP, UNEP, World Bank, UNDP, and UNIDO, along with Country Partners.
2011	<ul style="list-style-type: none"> ● Dongying Declaration in Building a Blue Economy through ICM adopted during the 10th PNLG Forum, July 2011, Dongying, China.
2012	<ul style="list-style-type: none"> ● 4th EAS Congress, July 2012, Changwon City, RO Korea, hosted by the City Government of Changwon and Ministry of Land, Transportation and Maritime Affairs of RO Korea. ● Port Safety, Health, and Environmental Management (PSHEM) Code and Recognition System launched at the Yeosu Expo, July 2012. ● Headquarters Agreement signed between the Department of Foreign Affairs of the Philippines and PEMSEA, 31 July 2012, Manila, Philippines.
2013	<ul style="list-style-type: none"> ● Ratification of the Headquarters Agreement by the Philippines.
2014	<ul style="list-style-type: none"> ● Initiated GEF/World Bank project on development of a regional platform for knowledge management and facilitating investment in blue economy.
2015	<ul style="list-style-type: none"> ● Establishment of China-PEMSEA Sustainable Coastal Management Cooperation Center. ● 5th EAS Congress, November, Danang, Vietnam, launching the PEMSEA Network of Learning Centers, SDS-SEA 2015 and signing of the Danang Compact at the 5th Ministerial Forum.
2016	<ul style="list-style-type: none"> ● PNLG Forum, November 2016, Ansan City RO Korea adopts PNLG Strategic Action Plan 2016–2021.
2017	<ul style="list-style-type: none"> ● PEMSEA participated in UN Ocean Conference for implementation of Sustainable Development Goal 14 (SDG 14), 5–9 June 2017, New York, USA.
2018	<ul style="list-style-type: none"> ● The East Asian Seas Congress 2018

Ministerial Forum held in Putrajaya, Malaysia. The SDS-SEA included an action programme to implement the Sustainable Development Strategy, “a package of applicable principles, relevant existing regional and international action programmes, agreements, and instruments, as well as implementation approaches, for achieving sustainable development of the Seas of East Asia” (SDS-SEA, 2015). The partnership-based mechanism came to full realization at the next East Asian Seas Congress in Haikou, China in 2006, where countries adopted the Partnership Agreement and, together with other non-country partners, approved the Partnership Operating Arrangements. These provided for

formal institutional arrangements with the components shown in [Box 1 \(Chua and Bernad, 2015\)](#). Lao PDR and Timor-Leste joined PEMSEA at this time, signing the Partnership Agreement. (A total of 11 country representatives signed the Partnership Agreement; Brunei Darussalam and Malaysia did not participate. Thailand was not represented by a Minister but had observers. The Minister of Thailand signed the Partnership Agreement two years later). Thereafter, PEMSEA became a recognized international organization with headquarters in the Philippines when eight of the countries signed an agreement to that effect during the 2009 Ministerial Forum in Manila. The document is titled

Box 1

Institutional arrangements for the implementation of the SDS-SEA.

COMPONENTS OF THE PEMSEA INSTITUTIONAL ARRANGEMENTS

1. The *East Asian Seas (EAS) Partnership Council* is the governing body. The Council is conducted in two sessions. A Technical Session is attended by government representatives, as well as concerned stakeholder partners, and focuses on technical matters relating to the implementation of the SDS-SEA. The Intergovernmental Session is limited to government representatives; this session is responsible for policy matters and adoption of the recommendations of the Technical Session. Each session elects its own chair. The Council chair is elected under a joint session.
2. The *PEMSEA Resource Facility (PRF)* is made up of two functional units: Secretariat Services and Technical Services. The PRF Secretariat Services acts as the Secretariat to the Partnership Council and the Executive Committee. It organizes the Partnership Council and Executive Committee meetings, coordinates SDS-SEA implementation at the national level, coordinates various networks set up by PEMSEA, facilitates information dissemination and capacity building, and prepares the triennial EAS Congress, Ministerial Forum, and other major workshops. The PRF Technical Services implements projects and programmes, conducts training courses, and provides technical assistance to interested countries and other technical supports.
3. The *Regional Partnership Fund (RPF)* is a trust fund built up from donor contributions and other income arising from the sale of goods (publications, software) and services from the PRF Technical Services. The Fund is used for specific activities toward attaining the goals and objectives of PEMSEA. By operationalizing the RPF, PEMSEA hopes to gradually shift from being fully dependent on the GEF to future reliance on multiple sources of financial income. The SDS-SEA and the Programme of Activities can provide a framework through which donor communities can identify the projects and activities that they want to support.
4. The *EAS Congress* takes place every three years, bringing together stakeholders, experts, regional partners, and other actors from around the world to evaluate progress in the implementation of the regional strategy, and to share their experience and exchange information or ideas in different areas of concern on the sustainable development of coasts and oceans. The event includes an international conference, a Ministerial Forum, exhibits, and other side events. A total of more than 4,700 participants have taken part in the last four congresses.
5. The *Ministerial Forum* is held to be an integral part of the EAS Congress and is attended by ocean-related ministers from the participating countries of PEMSEA. The Forum allows ministers to review the status of implementation of the SDS-SEA, renew commitments, and set new policy directions.

“Agreement Recognizing the International Legal Personality of the Partnerships in Environmental Management for the Seas of East Asia”, signed on 26 November 2009 in Manila by the representatives of Cambodia, China, DPR Korea, Indonesia, Lao PDR, Philippines, RO Korea and Timor-Leste. The Headquarters Agreement between PEMSEA and the Philippines was entered into in 2012 and ratified by the Philippine Senate in 2015.

2.1. The rationale for the partnership approach

PEMSEA chose the partnership approach over a regional convention because of the flexibility it affords in a region where capacities are widely disparate between countries. Furthermore, the management challenges of caring for the coastal and marine environment and pursuing sustainable development cut across sectors and at different levels. The partnership approach, together with the adoption of the SDS-SEA as described below, render PEMSEA governed by “soft law” rather than by binding rights and obligations that would have been created by multilateral treaty.

This Partnership approach strengthens principles-based governance and serves as the implementation mechanism for principles-based governance in the region. It is inclusive, as it is open to participation to any stakeholder at any level, from regional to local. It has a multiplier effect, bringing in stakeholder partners and leveraging funds through successful demonstration of projects. It allows for stepwise, incremental processes partners can implement projects and programs at their own pace, widening scope and coverage at each step, and applying lessons learned from the preceding steps. It facilitates simultaneous top-to-bottom and bottom-to-top approaches to coastal and ocean governance, because while national governments can impose policies and programs on their components, local governments and projects can influence higher level governance through delivering globally relevant examples of sustainable use (Chua et al., 2008).

2.2. PEMSEA’s operating modality

The PEMSEA partnership extends beyond the national and regional levels of implementation. At the local level, partnership could not be

better demonstrated than by ICM, due to its multisectoral and collaborative nature. Furthermore, the PEMSEA Network of Local Governments for Sustainable Coastal Development (PNLG), which is a collaborative network among the local governments implementing ICM in the region, allows the sharing and exchange of ideas and experiences. PNLG also conducts joint activities among and between local government units (LGUs). Other partnerships include the twinning arrangements between local governments for collaborative action on pollution hotspots, the regional Network of Learning Centers (Box 2) and professional networks of scientists and policy/legal specialists.

3. Regional strategy

Building on the pilot phase, and realizing the continued need for a holistic, integrative and partnership-based approach in addressing the complex management barriers in the region, the next UNDP-GEF project focused on the development of a regional strategy and building a mechanism for its implementation.

3.1. Adoption of the SDS-SEA

The Sustainable Development Strategy for the Seas of East Asia (SDS-SEA or the Strategy) was conceived as a document in which all the prescriptions of international and regional instruments relating to sustainable development, as well as lessons learned from relevant experiences in the region, would be put together in one coherent plan. This would help the countries and local government partners see how their actions fit into the bigger picture, and help them address gaps and overlaps in their policies and programs. The SDS-SEA became the regional platform for the implementation of the WSSD, Rio+20, Millennium Development Goals and eventually the Sustainable Development Goals (SDGs). It was also seen as a way for the partners to formulate programs and projects based on discrete action programmes in the Strategy. Box 3 shows the main components of the SDS-SEA, as captured in the Strategic Action Statement. The country partners approved the Strategy as the basis of a working Partnership and adopted it during the first PEMSEA Ministerial Forum in December 2003 in Putrajaya, Malaysia.

Box 2

Network of Learning Centers.

PEMSEA currently has fifteen ICM Learning Centers established in eight PEMSEA Country Partners.

- Royal University of Phnom Penh (RUPP), Cambodia
- Coastal and Ocean Management Institute (COMI), Xiamen University, PR China
- Kim Il Sung University, DPR Korea
- Center for Coastal and Marine Resource Studies, IPB University (Bogor Agricultural University), Indonesia
- Xavier University-Ateneo de Cagayan, Philippines
- De La Salle University-Lipa, Philippines
- University of the Philippines Visayas, Philippines
- University of Danang, Vietnam
- Burapha University, Thailand
- Prince of Songkla University, Thailand
- National University of Timor Leste, Timor Leste
- Oriental University of Timor Leste, Timor Leste
- Ocean College of Zhejiang University, PR China
- [Diponegoro University, Indonesia](#)
- Udayana University, Indonesia

3.2. Implementation

Since then, the SDS-SEA has been implemented in a step-wise and evolutionary manner (Chua et al., 2008; Chua and Bernad, 2015). Partners prioritize action programmes to implement from the SDS-SEA according to their respective needs and capacity, individually or with partners.

At the succeeding Ministerial Fora, held every three years, PEMSEA Country Partners committed to the implementation of the SDS-SEA with expanded goals and targets. The 2006 Haikou Declaration set regional priority goals, which included the implementation of ICM in at least 20 percent of the region's coasts by 2015, national coastal policies and action plans in at least 70 percent of participating countries by 2015, a rolling ten-year partnership programme, and published state of the coasts reports by 2009.

The 2009 Manila Declaration expressed the formal adoption of ICM and the agreement to undertake specific actions to address climate change and to mitigate disasters. The 2012 Changwon Declaration contained the commitment of the countries to use the new SDS-SEA Implementation Plan (2012–2016) to implement Rio+20 and other relevant commitments.

The 2015 Da Nang Compact reconfirmed their commitment to the SDS-SEA and adopted an updated version, the SDS-SEA 2015 “as a common platform for regional cooperation, and as a framework for policy and programme development and implementation, at the national and local level, on a voluntary basis, where deemed appropriate by each concerned individual state within the East Asian region, without imposing legal obligations or prohibitions.” The Compact also adopted ambitious “Post-2015 Strategic Targets” as follows:

Box 3

SDS-SEA 2015 Strategic Action Statement

Sustainable Development Strategy for the seas of East Asia

Strategic Action Statement

The East Asian Countries shall:

Ensure **SUSTAIN**able use of coastal and marine resources.

PRESERVE species and areas of the coastal and marine environment that are pristine or are of ecological, social or cultural significance.

PROTECT ecosystems, human health and society from risks occurring as a consequence of human activities.

Undertake steps to improve the capability to **ADAPT** to the adverse impacts of climate change and other man-made and natural hazards.

DEVELOP economic activities in the coastal and marine environment that contribute to economic prosperity and social well-being while safeguarding ecological values.

IMPLEMENT international instruments relevant to the management of the coastal and marine environment.

COMMUNICATE with stakeholders to raise public awareness, strengthen multisectoral participation and obtain scientific support for the sustainable development of the coastal and marine environment.

- a self-sustaining PEMSEA Resource Facility by 2017;
- a regional State of Oceans and Coasts reporting system to monitor progress, impacts and benefits by 2018;
- set up functional national coastal and ocean policies and supporting legislation and institutional arrangements in 100 percent of PEMSEA Partner Countries by 2021; and
- establish ICM programs for sustainable development of coastal and marine areas covering at least 25 percent of the region's coastline and contiguous watershed areas, supporting national priorities and international commitments by 2021.

Country partners agreed to formulate mutually supportive SDS-SEA implementation plans at both regional and national levels, and called for an expanded Partnership, acknowledging the invaluable help of Non-Country Partners. (Cash- and in-kind contributions are provided by six of the countries for the Secretariat services. Cash contributions from China, Japan, RO Korea for Secretariat operations and implementation of the SDS-SEA since 2007, from Singapore since 2014; from Timor Leste since 2009 earmarked for their activities; in kind from the Philippines in the form of the headquarters from 2017 (PEMSEA, 2015).) The GEF and UNDP primarily provide funding through the project on Scaling up SDS-SEA implementation. The above commitments were further affirmed and the SDS-SEA Implementation Plan 2018–2020 formally endorsed during the Ministerial Forum in Iloilo City on November 2018.

4. Integrated coastal management

4.1. ICM as the delivery system

PEMSEA applies ICM through a systematic, procedural and iterative cycle. This approach has been developed and refined through years of experience and has helped inform policy and institutional reforms not only at the local level, but at the national level as well (Chua and Bernad, 2015).

4.2. Scaling up of ICM, 2015–2019

From the first demonstration sites, the application of ICM spread by sharing the examples and experiences. During the previously described GEF/UNDP/IMO Regional Programme on Building Partnerships in Environmental Management for the Seas of East Asia, parallel demonstration sites were set up in Cambodia, DPR Korea, Indonesia, Malaysia, RO Korea, Thailand, Vietnam, China and the Philippines. By 2016, the 60 sites covered about 17 percent of the region's coastlines, which facilitated more expansion and replication by the countries to more or wider localities (PEMSEA, 2018a.). Today, many of these sites are now self-funded. These sites also included different combinations of coastal resources, human uses, government level, area size, and objectives. Singapore even applied ICM principles adapted to its highly urbanized context, through Integrated Urban Coastal Management (IUCM).

As of late 2018, PEMSEA has conducted a total of 178 training and workshop activities in ICM and related/support courses to over 5,000 participants, thereby building a critical mass of ICM practitioners to successfully implement ICM. As an approach, ICM is an important highlight in the SDS-SEA, signifying regional-level adoption. Several countries passed ICM legislation and made institutional arrangements for ICM. As of early 2019, nine countries have set up national inter-agency coordinating mechanisms and a number of them have developed specific ICM legislations.

PEMSEA has demonstrated ICM to be a flexible management tool that can be scaled up by geographical extension, applied to any ecosystem, and operationalized at the local level to the national and regional levels, capturing interrelated coastal and marine objectives of pollution reduction and waste management, food security and livelihood management, water use and supply management, habitat protection, restoration and management, natural and man-made hazard prevention and management, and more (PEMSEA, 2017a).

4.3. Products

PEMSEA has developed many products that would be useful to any entity wishing to apply ICM. These include ICM Courses, ICM Training Manuals and related manuals. After the success of the programs in the demonstration and parallel sites, PEMSEA distilled these experiences into additional tools for ICM.

An ICM Code was developed to provide a systematic approach to implementing ICM. The primary objective of this code is to provide assistance to local governments for planning, developing, implementing and improving an ICM system, while at the same time strengthening environmental and quality management systems consistent with two international standards: ISO 14001:2004 and ISO 9001:2000. Two supplementary objectives of the Code are: (a) to enable self-assessment of progress and quality in ICM efforts; and (b) to provide a set of measurable indicators covering governance, stress reduction and impact/benefits (social, economic and ecological), which can be used by a third party to recognize/certify the local government's conformance to the Code (PEMSEA, 2011). In tandem with this, PEMSEA is equipped with an ICM System Certification designed for local governments seeking validation of their ICM system and recognition for excellence and continuous improvement. In addition, the ICM Professional certification program confers recognition to professionals who can

demonstrate competencies on ecosystem-based sustainability and leadership frameworks; and who are willing to undergo professional growth towards integrative, collaborative coastal and ocean governance (PEMSEA, 2018b.).

PEMSEA shares its experiences through 47 published case studies on ICM in the East Asian Seas, spanning 25 years (Chua et al., 2018). The Seas of East Asia (SEA) Knowledge Bank was also developed to serve as a knowledge platform for policymakers, planners, managers, investors and other stakeholders to scale up ICM and investment in sustainable development of coasts and oceans across East Asia. This online platform provides access to a collection of case studies, manuals, technical reports and other resources, along with opportunities for engaging and collaborating with peers and experts and guidance for jumpstarting coastal management programs, or taking them to the next level. The platform also supports local governments and other stakeholders in identifying and developing projects that could attract investment, including a series of rapid assessments and the ability to submit a project for further evaluation.

5. The reporting system: State of Oceans and Coasts

As previously described, PEMSEA adopted the State of the Coasts reporting system, emphasizing the importance of delivering a transparent, inclusive process- and results-oriented organization. This reporting system was devised as an operational tool for providing baseline information on management, and thereafter to monitor, evaluate and report on efforts, particularly ICM programs for PEMSEA Partners. Developed in consultation with experts, to date the reporting system includes a set of 35 core indicators across a range of issues that must be managed as part of an ICM program. For ICM sites, it serves as a report card, showing the current environmental conditions and how progress has been made in addressing priority environmental concerns. (SEA Knowledge Bank, 2018; PEMSEA, 2008.)

In 2018, State of the Coasts reports had been produced by 11 local governments including: Preah Sihanouk (Cambodia); Dongying and Xiamen (China); Bali (Indonesia); Sedone River (Lao PDR); Batangas and Guimaras Provinces (Philippines); Changwon City (RO Korea); Chonburi (Thailand); Liquica and Manatuto Districts (Timor-Leste); and Da Nang (Vietnam) (PEMSEA, 2018c).

5.1. Measuring progress and impacts

In the 2012 Changwon Declaration, the country partners expressed concern that threats to coastal and marine areas continued, noting that the existing economic models needed to change to continue enjoying coastal and ocean resources and services. They committed to redoubling efforts through specific PEMSEA programmes, and the pursuit of an ocean-based blue economy. They stated:

“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.”

The preceding year, in July 2011, the PNLG adopted the Dongying Declaration on Building a “Blue Economy” through the ICM approach. The Declaration committed the Network to apply the State of the Coasts reporting system to 100 percent of its members by 2015, to identify and validate social, economic, and environmental status and changes in coastal and marine areas, and measure progress and impacts of ICM implementation among local governments of the region (PEMSEA, 2011). It states:

“Recognizing the need to preserve the ecological, economic and

cultural values and benefits of the coasts and oceans, a blue economy encourages the pursuit of ecosystem conservation and environmental protection programs – such as the consideration of “blue carbon”, marine protected areas, innovative wastewater treatment and recycling – and business ventures that make use of and enhance coastal and marine services, such as ecotourism, green ports, ocean energy, desalination, wastewater treatment, and marine biotechnology.”

5.2. The reporting system

Now titled the State of Oceans and Coasts (SOC) report (modified to signify comprehensiveness), the report begins with the baseline information, including a valuation of the coastal and marine resources and services within the local/regional and/or national level. The articulation in concrete terms of that value and the contribution to GDP helps to communicate the importance of the preservation and/or growth of that value through sustainable management and economic activities. Sustainable management programmes, projects and actions are also reported, as are economic, cultural and any ecosystem service (s) that preserve or add to that value. (See the PEMSEA brochure on State of Oceans and Coasts: Monitoring the SDGs, Promoting Blue Economy (PEMSEA 2017) for a more thorough description.)

The SOC reports are an important tool to advance good governance, scientific support and partnerships for blue economy, to promote the development of synergies among the various sectors, and to support evidence-based policy- and decision-making aimed at ensuring sustainable oceans and coasts for all. For local governments, and perhaps for all levels of governance, the benefits include the provision of an integrated and comprehensive evaluation process for ICM implementation serving as basis for reviewing and improving the management program, documentation, systematic monitoring of sustainable development targets, and standardization of the monitoring process to allow comparison across ICM sites. (PEMSEA Knowledge Bank 2018).

In November 2017, the first regional Blue Economy Forum was held, where productive discussions among decision-makers and experts described principles in support of blue economy (PEMSEA, 2018). The Forum found that the SOC reporting process provides a systematic and comprehensive approach to planning, monitoring and evaluating individual country, sub-regional and regional contributions to the ocean agenda, and that these will continue to evolve over time with regular updates, as national ocean economy-environment accounting systems and methodologies are strengthened and harmonized.

The Forum concluded that “business as usual is no longer an option in the face of changing environment and climate” and that “there is a need to prioritize critical challenges and recognize economic growth and healthy oceans as compatible propositions. Interesting actions, innovations, and partnerships taking place in the region demonstrate the huge potential for blue economy, and workable solutions towards achieving sustainable oceans and coasts for all” (PEMSEA, 2018).

Ten national and four subregional SOC reports were presented at the Forum. These reports provided the figures on just how much the ocean economy contributes to the GDP of each country (Fig. 2) and to employment (Fig. 3). As reported by eight countries in their draft SOC reports, the ocean economy was worth a total of \$1.5 trillion in value added. Table 4 shows a summary of the kinds of programs, activities and policies reported in these SOC reports. Updated national reports and a regional SOC report were presented at the EAS Congress in 2018.

6. Financial and operational sustainability

To sustain the implementation of the SDS-SEA, PEMSEA has been working to improve its self-sustainability and examining ways to diversify its funding options. As a regional programme, PEMSEA has been able to leverage and mobilize outside funding by virtue of the strength of its activities.

6.1. Effect of partnership: leveraging of funds

Certain country partners contribute to PEMSEA’s sustainability by supporting PEMSEA’s Secretariat operations and the implementation of the SDS-SEA through regular voluntary contributions. Other country partners contribute by hosting events such as the triennial EAS Congress and Ministerial Forum, PNLG Conference, and PEMSEA meetings (PEMSEA, 2015). Non-country partners contribute through technical assistance in projects, and by co-convening meetings and sessions during the EAS Congress (PEMSEA, 2013).

At its sixth meeting in June 2014, the EAS Partnership Council approved the Strategy and Implementation Plan to Achieving a Self-Sustained PEMSEA, which “reorients PEMSEA’s sustainability by delivering products and services that are geared toward addressing the needs of Country Partners, local governments, private sector and international organizations” (PEMSEA, 2018c). The products that PEMSEA has developed to meet this charge include advising on implementing the ICM Code and ICM System Certification, and the ICM Professional Certification, discussed earlier.

PEMSEA has also developed the Port Safety, Health and Environmental Management System (PSHEMS), which is an integrated management system for ports, compliant with the requirements of ISO 9001 (Quality Management), ISO 14001 (Environmental Management), and OHSAS 18001 (Occupational Health and Safety). (PEMSEA n.d.) This system is a tool for ports to assess the quality, safety, health and environmental impacts of their operations and activities.

The East Asian region is replete with rich experiences and solutions in addressing critical marine and coastal issues, however, PEMSEA is increasingly aware of the need to market itself and needs to improve communication of solutions to these shared regional and global problems. It is becoming more proactive in sharing its more local stories, lessons and knowledge with other programmes in the region and beyond the East Asian Seas. The IW:LEARN programme of the GEF supports these efforts by convening knowledge sharing workshops, building capacity and supporting twinning programmes with other projects and initiatives all over the world.

6.2. Ocean Investment Service and ICM projects

The Intergovernmental Session of the 9th EAS Partnership Council supported the proposal by the PEMSEA Resource Facility (PRF) to establish a new and innovative financing mechanism to support and accelerate SDS-SEA implementation. Referred to as an Ocean Investment Service, the primary purpose of the mechanism is to develop and promote projects that can attract capital (particularly private capital) for investment in infrastructure, technologies, systems, etc. in support of SDS-SEA implementation. One of the key activities of the investment service is to help build the capacity of local governments on the use of tools and services for developing investments in the ICM sites.

Key to this innovative approach is the establishment of strategic partnerships with several organizations to help develop a pipeline of pilot investments with potential investors across several sectors, including wastewater recovery, protected area and sustainable marine tourism, solid waste recycling and ocean plastics and sustainable fisheries and aquaculture. Each of these partnerships provide an opportunity to jumpstart the process of establishing investments and provide valuable learning for PEMSEA as it continues to build capacity. The interest by these sectors in collaborating with PEMSEA affirms of the value that PEMSEA provides as a project developer for sourcing investments for SDS-SEA implementation.

As projects move through the investment process, and as PEMSEA strengthens its capacity and efficiency in building a sustainable investment pipeline, project development costs have the potential to decrease, resulting in an increased return on investment. A report on the initial activities undertaken by PEMSEA’s investment service and lessons was shared at the November EAS Congress 2018 and more

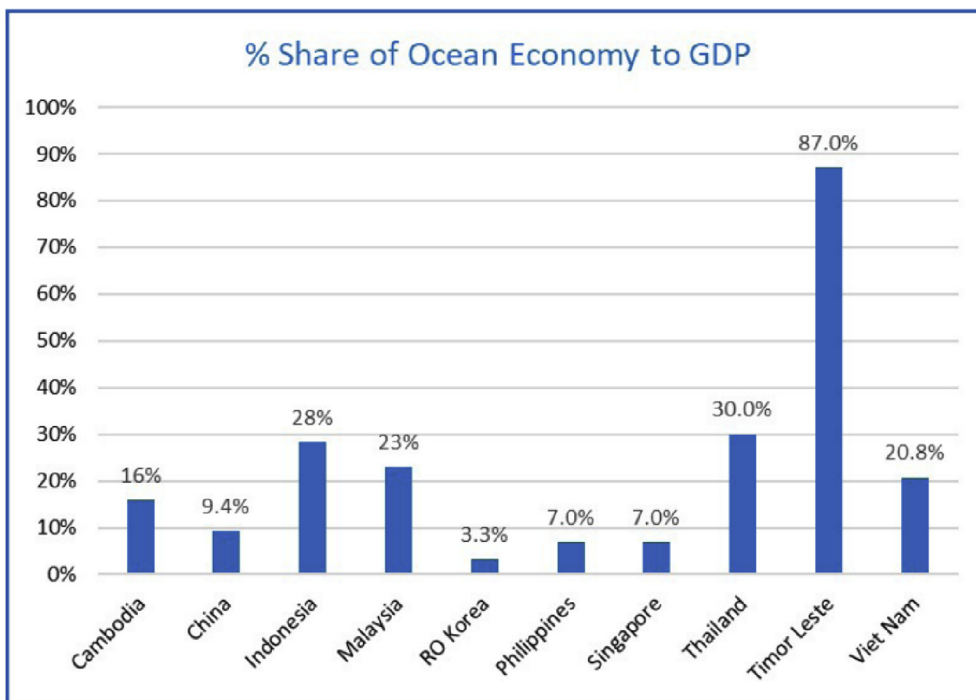


Fig. 2. % Share of Ocean Economy to GDP (PEMSEA, 2018).

knowledge products featuring cases and lessons in implementing the Blue Economy approach and sustainable finance and investment will be available by mid-2019.

7. The current status of the East Asian large marine ecosystems

Having now reviewed the evolution of PEMSEA and its role fostering a collaborative, partnership approach in the East Asian region to implement sustainable coastal and ocean development, an examination of the current status of the LMEs in which PEMSEA functions will point to specific areas where intervention is most needed. This ecosystem approach provides a fresh perspective to the status of the coastal and marine resources in the East Asian region, considering the entire spatial domain of LMEs. Assessment indices for each of the six East Asian LMEs

were selected from a 2016 global comparative assessment of baseline and future trends in LMEs published by United Nations Environment Programme. This report was part of the GEF-funded Transboundary Waters Assessment Programme (TWAP), in which the evaluation of LMEs was centered on five suites of science-based indicators for supporting the assessment and management of LME goods and services, including (i) productivity, (ii) fish and fisheries, (iii) pollution and ecosystem health, (iv) socioeconomics, and (v) governance (IOC-UNESCO and UNEP, 2016; Sherman, 2014). This review of the current status of the East Asian LMEs includes indicators for each of these five modules.

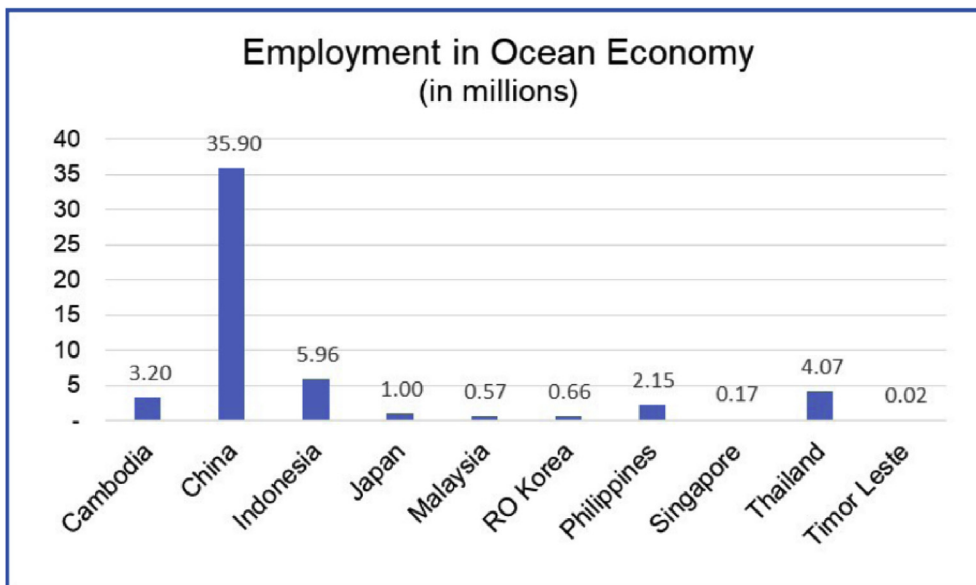


Fig. 3. Employment in the ocean economy (PEMSEA, 2018).

Table 4
Oceans and blue economy: What's happening?.

Ocean economic activities	Emerging industries	Transition to Blue Economy	
		x	Policies and governance
1. Fisheries and aquaculture	<ul style="list-style-type: none"> Coastal aquaculture at industrial scale Seaweed farming at industrial scale 	<ul style="list-style-type: none"> Climate smart aquaculture (Viet Nam) Marine ranch (China, RO Korea, YSLME) Sustainable tuna fisheries (WCPFC, Philippines, Viet Nam, Indonesia) 	<ul style="list-style-type: none"> International agreements: UNCLOS; UN Fish Stocks Agreement; FAO Port State Measures Agreement (on IUU Fishing); Ramsar Convention on Wetlands Regional and National Plans of Action on IUU Fishing Ecosystem approach to fisheries management Monitoring: Electronic catch documentation and traceability system; Registration of fisherfolk and fishing vessels; Pollution monitoring of aquaculture farms Conservation: Establishment of fish sanctuaries and MPAs; closed season and fishing ban of certain species; Incentives: Certification from Marine Stewardship Council; Government-funded R&D
2. Coastal and marine tourism	<ul style="list-style-type: none"> Cruise tourism; theme cruises (but negative impacts have to be addressed) 	<ul style="list-style-type: none"> Ecotourism (Malaysia, Philippines) Marine parks (Malaysia) Zero carbon resorts (Philippines) Wastewater treatment and reuse (Bali, Indonesia) Green Fins (Thailand, Philippines) 	<ul style="list-style-type: none"> Ecotourism policy and strategic action plan MSP; Coastal us plan and zoning schemes Beach Management Financing: environmental user fees (collected from tourists); conservation charge; hotel guests contribute to habitat conservation financing Incentives: UNESCO World Heritage Sites; ASEAN Heritage Parks – for conservation and sustainable tourism Adoption of international conventions (e.g., MARPOL, London, Basel, CITES, etc) Green ports index World Ports Climate Initiative Port Safety, Health and Environmental Systems (PSHEMS) Joint oil spill response (Gulf of Thailand) Incentives: Green Port Award System (APEC); fiscal incentives and tax benefits (Singapore) Emission control areas, which require ships to use fuel with 80% less sulphur (China) Monitoring of water quality and sediments in the area of offshore oil rigs (Timor Leste and Australia)
3. Ports and shipping	<ul style="list-style-type: none"> Green ports 	<ul style="list-style-type: none"> Green ports (waste management; energy efficiency and reduced GHG emissions; etc) Shore reception facilities Shore-based power supply using renewable energy Infrastructure for ballast water management 	<ul style="list-style-type: none"> Adoption of international conventions (e.g., MARPOL, London, Basel, CITES, etc) Green ports index World Ports Climate Initiative Port Safety, Health and Environmental Systems (PSHEMS) Joint oil spill response (Gulf of Thailand) Incentives: Green Port Award System (APEC); fiscal incentives and tax benefits (Singapore) Emission control areas, which require ships to use fuel with 80% less sulphur (China) Monitoring of water quality and sediments in the area of offshore oil rigs (Timor Leste and Australia)
4. Offshore oil and gas			
5. Energy	<ul style="list-style-type: none"> Marine renewable energy (ocean energy; offshore wind power, etc) 	<ul style="list-style-type: none"> Ocean energy – tide, current, OTEC (Korea) Coastal wind power, coastal solar power (China, Thailand, Philippines) 	<ul style="list-style-type: none"> Policies and Action Plans on marine renewable energy Incentives: feed in tariff Government-funded research, development and deployment Partnerships with private sector National laws on wastewater management Incentives and R&D: environment- and climate-friendly technologies to increase energy efficiency, reduce GHG emissions and operational cost Government-funded R&D: Marine biotechnology for new medicines (Philippines) Climate financing
6. Water supply	<ul style="list-style-type: none"> Desalination 	<ul style="list-style-type: none"> Wastewater treatment and reuse 	
7. Shipbuilding	<ul style="list-style-type: none"> Clean ships 		
8. Chemicals, pharmaceuticals	<ul style="list-style-type: none"> Genetics, Marine Biotechnology 		
9. Marine construction	<ul style="list-style-type: none"> Climate-resilient infrastructure 		
10. Marine services	<ul style="list-style-type: none"> Technology-based maritime logistics 		
Ecosystem conservation	<ul style="list-style-type: none"> Blue Carbon market 	<ul style="list-style-type: none"> Regional and National Strategic Action Plans for the LMEs MPAs, MPA networks, marine parks Co-management arrangements Mangrove and coral reef restoration and alternative livelihood Market-based instruments: conservation financing Singapore: tough anti-littering laws, integrated solid waste management; Singapore Packaging Agreement Indonesia: National Action Plan on Marine Plastic Debris Japan: marine litter research; heavily-subsidized cleanup Philippines: National Sewerage and Septage Management Plan and Program; > PhP3 billion investment by concessionaires in Metro Manila RO Korea; Coastal Total Pollutant Load Control System Wastewater reuse: for potable water (Singapore); for irrigation (Viet Nam; China) sludge as soil conditioner (Philippines; China; Japan); recovered methane as fuel for buses and trains (Japan) 	
Environmental protection	<ul style="list-style-type: none"> Wastewater treatment plants with facilities for reuse applications 		

7.1. Productivity

Primary productivity, expressed as grams of carbon per square meter per year ($\text{gC m}^{-2}\text{yr}^{-1}$), helps to communicate the potential value of an LME. The magnitude of primary production has implications for critical ecosystem services, including fisheries (Rosenberg et al., 2014). Using primary productivity, marine ecosystem productivity and potential sustainable fishery yield can be estimated (Pauly and Christensen, 1995; Fogarty et al., 2016). Excluding scenarios where

high primary productivity results in hypoxia, high primary productivity is general considered favorable (IOC-UNESCO and UNEP, 2016). The TWAP report groups the LMEs based on 16-year mean primary productivity values (see full TWAP report for full methodology). All of the LMEs of East Asia were in Group 3, the middle range of primary productivity, or greater. The Yellow Sea LME was placed in Group 5, the group representing the highest levels of primary productivity ($441\text{--}755 \text{gC m}^{-2}\text{yr}^{-1}$). The Gulf of Thailand, the East China Sea, and the Indonesian Sea LMEs were placed in Group 4, with high levels of primary

productivity ($331\text{--}441 \text{ gC m}^{-2}\text{yr}^{-1}$). Lastly, the South China Sea and the Sulu-Celebes Sea LMEs were placed in Group 3 ($181\text{--}331 \text{ gC m}^{-2}\text{yr}^{-1}$).

7.2. Fish and fisheries

Fish are an important source of protein for the global community. The 66 LMEs produce approximately 80% of the annual global marine fisheries biomass yield (Pauly et al., 2008). The TWAP report includes nine indicators for the status of fish and fisheries: 1) ratio of capacity-enhancing subsidies to the value of landed catch; 2) primary production required to sustain the landings reported by countries fishing within the LME; 3) Marine Trophic Index; 4) Fishing-in-Balance; 5) stock status by number; 6) catch biomass of exploited stocks; 7) catch from bottom-impacting gear types; 8) fishing efforts; and 9) change in catch potential under projected global climate change by the 2050s (IOC-UNESCO and UNEP, 2016). 64 of the 66 LMEs were assessed and categorized into five relative risk categories for each indicator.

The Yellow Sea LME was in the highest risk category for the ecological footprint indicator, in the high risk category for three other indicators, the medium risk category for four more, and the lowest risk category for stock status (biomass). The East China Sea is in the highest risk category for four indicators, the high risk category for one, the medium risk category for three and the low risk category for one. The Indonesian Sea LME is in the highest risk category for three indicators, the high risk category for one, the medium risk category for two, the low risk category for one, and the lowest risk category for two indicators. The Sulu-Celebes LME is in the highest risk category for three indicators, the high risk category for two, the medium risk category for two, and the lowest risk category for two. The South China Sea LME is in the highest risk category for three indicators, the high risk category for two, the medium risk category for one, the low risk category for two, and the lowest risk category for one indicator. The Gulf of Thailand LME is in the highest risk category for three indicators, the high risk category for two, the medium risk category for one, and the lowest risk category for three indicators.

The range of risk categories under which each LME falls shows the value of examining a variety of indicators, but also points to the complexity of achieving sustainable fisheries. The SDS-SEA acknowledges the threat of unsustainable fisheries practices in the EAS region and, under the strategic action statement, aims to ensure the sustainable use of coastal and marine resources (SDS-SEA, 2015). Specifically, the SDS-SEA describes an objective of equitable and sustainable fisheries and conservation of fish stocks, outlining specific action programmes to achieve this objective (SDS-SEA, 2015).

7.3. Pollution and ecosystem health

7.3.1. Eutrophication and plastic pollution

Pollution was the central focus of the first GEF/UNDP/IMO programme that would eventually lead to the development of PEMSEA and it continues to be a central focus of PEMSEA's work today. In the SDS-SEA, one of the stated principles directs state partners to “use the best practicable means at their disposal and in accordance with their capacities to prevent, reduce and control pollution of the marine environment” (SDS-SEA, 2015). The TWAP report examines two types of pollution in LMEs: marine debris, in the form of floating plastics, and eutrophication, in the form of nitrogen load risk.

The negative impacts of plastic pollution and other marine debris on marine ecosystems has been well documented (Derraik, 2002; Gregory, 2009; Lamb et al., 2018; Ryan et al., 2009). LMEs were grouped into five categories based on model estimates of the spatial distribution of the relative abundance of floating micro- and macro-plastics. For the risk category based on estimates of the relative abundance of floating micro-plastics, all six East Asian LMEs were placed in the highest risk category. For the risk category based on floating macro-plastics, all six

East Asian LMEs, excluding the Yellow Sea LME, were again placed in the highest risk category. The YSLME was placed in the high risk category.

Eutrophication can be caused by excess nutrients entering waterways with a variety of negative impacts, including high-biomass algal blooms and oxygen depletion (IOC-UNESCO and UNEP, 2016). The TWAP report grouped the 66 LMEs into five groups based on their nitrogen load risk - the risk of eutrophication from increased dissolved inorganic nitrogen (DIN). The six LMEs of East Asia varied broadly in their DIN load category. The South China Sea and the East China Sea are both in the highest risk category, emphasizing the importance of addressing nitrogen pollution in these two LMEs. The Indonesian Seas LME and the Yellow Sea LME are both in the medium risk category, and the Gulf of Thailand LME and the Sulu-Celebes Sea LME are both in the low risk category.

7.3.2. Pollution and ecosystem health: The Ocean Health Index

The TWAP report applied the Ocean Health Index to the 66 LMEs. “The Ocean Health Index tracks the current status and expected future condition of human benefits (expressed as goals and sub-goals) from ocean ecosystems. The Index assesses the cumulative stressors on ecosystem services and tracks the resulting status of the sustainable delivery of services to people (Halpern et al., 2012). It also incorporates measures of governance to quantify the potential resilience of the system (Halpern et al., 2012).” (IOC-UNESCO and UNEP, 2016). The OHI was calculated for 221 exclusive economic zones, which were then used to calculate LME scores by averaging the EEZ scores on the basis of overlap within each LME (IOC-UNESCO and UNEP, 2016). The TWAP then developed five categories to classify the 66 LMEs based on their OHI scores. The South China Sea LME, the Sulu-Celebes Sea LME, and the Indonesian Seas LME were all in the highest risk category. The Gulf of Thailand LME, the East China Sea LME, and the Yellow Sea LME were all in the high risk category.

7.4. Socioeconomics

Of the five modules used to guide the assessment and management of LMEs, socioeconomics is typically the least studied or documented (Kelley and Sherman, 2018). The TWAP examined socioeconomic indicators for LMEs and developed a Contemporary Threat Index to “determine which LME coastal populations are most threatened by extreme climate events and by LME environmental degradation, both of which exacerbate their core socio-economic vulnerability” (IOC-UNESCO and UNEP, 2016). Again, five categories were created to classify the 66 LMEs, based on this threat index. All East Asian LMEs were placed in the highest risk category (IOC-UNESCO and UNEP, 2016). This assessment demonstrates the critical need for intervention to achieve sustainable environmental management to support the human populations at risk in this region.

7.5. Governance

Governance is a critical aspect of effective LME assessment and management, as it influences if and how transboundary environmental threats will be addressed. The TWAP evaluated international governance arrangements to assess three governance indicators: completeness, integration, and engagement (IOC-UNESCO and UNEP, 2016). Each LME was sorted into one of five risk categories for each of these three indicators. For completeness, integration, and engagement, the Gulf of Thailand LME was placed in the medium, highest, and low risk categories, respectively. The South China Sea and Sulu-Celebes LMEs were also placed into the same categories for the same indicators. The Indonesian Sea LME was placed in the medium risk category for completeness, the highest risk category for integration, and the medium risk category for engagement. The East China Sea LME was placed in the medium risk category for completeness, the highest risk category for

integration, and the lowest risk category for engagement. Lastly, the Yellow Sea LME was placed in the high risk category for completeness, the medium risk category for integration, and the lowest risk category for engagement (IOC-UNESCO and UNEP, 2016). PEMSEA's partnership approach and focus on principles-based governance has made it well poised to continue addressing these governance challenges in the East Asian LMEs.

8. Conclusions

For the past 25 years, PEMSEA has been at the forefront of the sustainable development of coasts and oceans in the East Asian region, advancing science, governance, policy reform and the application of blue economy. This partnership-based institution, with its regional framework and common SOC reporting and monitoring system, has evolved from a regional programme to an international organization and has been able to help institutionalize ICM at the regional, national and local levels. PEMSEA's activities have also shown to work in harmony with the LME assessment and management approach for sustainable development. Country and non-country partners are working together to implement the SDS-SEA, which is strategically aligned to global and regional commitments. PEMSEA is working on an investment facility aimed at helping address its financial sustainability, as well as helping develop means of financing for partner local governments through the ocean investment facility. These advances have been made possible through strategic partnership with local universities and learning centers who understand the context and needs of the local communities and therefore deliver frontline extension services on the ground. Together, this capacity helps PEMSEA position itself as hub for ICM and blue economy in the region and give it an advantage that ultimately benefits coastal communities.

PEMSEA must continue to leverage these strengths to address transboundary challenges highlighted in the TWAP analysis, such as sustainable fisheries and socio-economic vulnerability of human populations. Looking forward, partnerships with other organizations with complementary mandates, resources and expertise is critical to tackle ocean drivers and pressures such as illegal, unregulated and unreported (IUU) fishing and marine and coastal biodiversity loss. PEMSEA is currently working with regional and local organizations dealing with integrated river basin management to apply the 'source to sea' continuum to address the impacts on the coasts of pressures from upstream, such as plastic pollution and eutrophication. With a focus on the importance of governance, PEMSEA is building timely and relevant partnerships to fill policy and technical needs and gaps of country partners as well as encouraging country partners to share best practices to other partners.

References

Chua, T.E., Bernad, S.R., 2015. The sustainable development strategy for the seas of East Asia: policy implications at local, national and regional levels. In: Cicin-Sain, B., VanderZwaag, D.L., Balgos, M. (Eds.), *Routledge Handbook of National and Regional Ocean Policies*. Routledge, New York, U.S.A., pp. 522.

Chua, T.E., Bonga, D., Bernad, S.R., 2008. The evolving partnership model in coastal and ocean governance in the seas of East Asian region – PEMSEA's role. In: Chua, T.E., Kullenberg, G., Bonga, D. (Eds.), *Securing the Oceans: Essays on Ocean Governance – Global and Regional Perspectives*. Global Environment Facility/United Nations Development Programme/International Maritime Organization Regional Programme on Building Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) and the Nippon Foundation, Quezon City, Philippines.

Chua, T.-E., Chou, L.M., Jacinto, G., Ross, S.A., Bonga, D. (Eds.), 2018. *Local Contributions to Global Sustainable Agenda: Case Studies in Integrated Coastal Management in the East Asian Seas Region*. Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) and Coastal Management Center (CMC), Quezon City, Philippines.

Derraik, J.G.B., 2002. The pollution of the marine environment by plastic debris: a review. *Mar. Pollut. Bull.* 44, 842–852.

Fogarty, M.J., Rosenber, A.A., Cooper, A.B., Dickey-Collas, M., Fulton, E.A., Gutiérrez, N.L., Hyde, K.J.W., Kleisner, K.M., Kristiansen, T., Longo, C., Minto-Vera, C.V., Minto, C., Mosquiere, I., Osio, G.C., Ovando, D., Selig, E.R., Thorson, J.T., Yimin, Y., 2016. Fishery production potential of large marine ecosystems: a prototype analysis. *Environ. Dev.* 17, 211–219.

Gregory, M.R., 2009. Environmental implications of plastic debris in marine settings—entanglement, ingestion, smothering, hangers-on, hitch-hiking and alien invasions. *Phil. Trans. R. Soc. B* 364, 2013–2025.

International Monetary Fund, 2018. April. IMF DataMapper: GDP, current prices. Retrieved from: <http://www.imf.org/external/datamapper/NGDPD@WEO/OEMDC/ADVEC/WEO/JPN/FRA/THA/CHN>.

IOC-UNESCO, UNEP, 2016. *Large Marine Ecosystems: Status and Trends*. United Nations Environment Programme (UNEP), Nairobi.

Kelley, E., Sherman, K., 2018. Trends of the Large Marine Ecosystem assessment and management approach as reflected in the literature. *Ocean Coast Manag.* 155, 104–112.

Lamb, et al., 2018. Plastic waste associated with disease on coral reefs. *Science* 359 (6374), 460–462.

Pauly, D., Christensen, V., 1995. Primary production required to sustain global fisheries. *Nature* 374, 255–257.

Pauly, D., Alder, J., Booth, S., Cheung, W.W.L., Close, C., Sumaila, U.R., Swartz, W., Tavakolie, A., Watson, R., Wood, L., Zeller, D., 2008. Fisheries in large marine ecosystems: Descriptions and diagnoses. In: Sherman, K., Hempel, G. (Eds.), *The UNEP Large Marine Ecosystems Report: A Perspective on Changing Conditions in LMEs of the World's Regional Seas*. UNEP, Nairobi, Kenya.

PEMSEA, 2008. *State of the Coasts Reporting*. Retrieved June 5, 2018, from PEMSEA website: <http://www.pemsea.org/news/state-coasts-reporting>.

PEMSEA, 2011. *Regional Review: Implementation of the Sustainable Development Strategy for the Seas of East Asia (SDS-SEA) 2003-2011*. Global Environment Facility/United Nations Development Programme/United Nations Office for Project Services Regional Programme on Scaling Up SDS-SEA Implementation (PEMSEA), Quezon City, Philippines.

PEMSEA, 2013. *Perspectives on Building a Regional Mechanism for Coastal and Ocean Governance in the Seas of East Asia*. Partnerships in Environmental Management for the Seas of East Asia (PEMSEA). (Quezon City, Philippines).

PEMSEA, 2015. *Regional Review: Implementation of the Sustainable Development Strategy for the Seas of East Asia (SDS-SEA) 2003-2015*. Partnerships in Environmental Management for the Seas of East Asia (PEMSEA). (Quezon City, Philippines).

PEMSEA, 2017. *Local Solutions to Global Sustainable Development Agenda: ICM Cast Studies in the East Asian Seas Region*. Retrieved from PEMSEA website: <http://www.pemsea.org/our-work/integrated-coastal-management/ICM-sites>.

PEMSEA, 2017. *State of Oceans and Coasts: Monitoring the SDGs, Promoting Blue Economy*. [Brochure]. Partnerships in Environmental Management for the Seas of East Asia (PEMSEA). (Quezon City, Philippines).

PEMSEA, 2018. *List of ICM Sites*. Retrieved June 5, 2018, from PEMSEA website. <http://www.pemsea.org/our-work/integrated-coastal-management/ICM-sites>.

PEMSEA, 2018. *ICM System Certification*. Retrieved June 5, 2018, from PEMSEA website. <http://www.pemsea.org/our-services/certification-services/ICM-system-certification>.

PEMSEA, 2018. *State of Oceans and Coasts 2018: Blue Economy Growth in the East Asian Seas Region*. Retrieved from PEMSEA website. <http://pemsea.org/publications/reports/state-oceans-and-coasts-east-asian-seas-region>.

PEMSEA. (n.d.). *Port Safety, Health and Environmental Management Systems (PSHEMS)*. [Brochure] Retrieved June 5, 2018, from PEMSEA website: <http://pemsea.org/sites/default/files/port-safety-health-and-environmental-management-system-pshems-brochure.pdf>.

Rosenberg, A.A., Fogarty, M.J., Cooper, A.B., Dickey-Collas, M., Fulton, E.A., Gutiérrez, N.L., Hyde, K.J.W., Kleisner, K.M., Kristiansen, T., Longo, C., Minto-Vera, C., Minto, C., Mosquiere, I., Chato Osio, G., Ovando, D., Selig, E.R., Thorson, J.T., Ye, Y., 2014. *Developing New Approaches to Global Stock Status Assessment and Fishery Production Potential of the Seas*. FAO Fisheries and Aquaculture Circular No. 1086. FAO, Rome, pp. 175.

Ryan, P.G., Moore, C.J., van Franeker, J.A., Moloney, C.L., 2009. Monitoring the abundance of plastic debris in the marine environment. *Phil. Trans. R. Soc. B* 364, 1999–2012.

SEA Knowledge Bank, 2018. *State of the Coasts Reporting System*. Retrieved June 5, 2018, from PEMSEA Knowledge Bank website. <http://seaknowledgebank.net/state-of-the-coasts-reporting-system>.

Sherman, K., 2014. Toward ecosystem-based management (EBM) of the world's large marine ecosystems during climate change. *Environ. Dev.* 11, 43–66.

Whisman, R., Reyes, A., 2015. *Blue Economy for Business in East Asia: towards an Integrated Understanding of Blue Economy*. Partnerships in Environmental Management for the Seas of East Asia (PEMSEA), pp. 69 Quezon City, Philippines.

World Bank, 2017. *The Little Green Data Book 2017 (English)*. World Development Indicators. World Bank Group, Washington, D.C. <http://documents.worldbank.org/curated/en/239271500275879803/The-little-green-data-book-2017>.