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Economic Assessment of Oceans for Sustainable Blue Economy Development

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1. INTRODUCTION

The potential linkages between blue economy, sustainable development and economic growth have been recognized in a number of international forums and documentations in recent years, such as the 2012 Changwon Declaration Toward an Ocean-based Blue Economy: Moving Ahead with the Sustainable Development Strategy for the Seas of East Asia, and the Xiamen Declaration of the Fourth APEC Ocean-related Ministerial Meeting Towards a New Partnership through Ocean Cooperation in the Asia Pacific Region in 2014.

The *blue economy*, as discussed during the East Asian Seas (EAS) Congress 2012, refers to a sustainable ocean-based economic model that is largely dependent on coastal and marine ecosystems and resources, but 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 an ecosystem-based climate change mitigation and adaptation measures.

For many in the public and business sectors, the linkage between blue economy, economic growth, and ocean and coastal resource conservation has to be clarified and assessed. First, the blue economy encompasses all economic activities with a direct dependence on the ocean or coastal and marine resources. These include economic activities that are (a) ocean-based, and (b) ocean-related. Ocean-based activities include those that are undertaken in the ocean (e.g., fisheries and aquaculture, offshore oil and gas, mining, ocean energy, desalination, shipping/marine transportation, marine tourism, marine construction). Ocean-related activities use products from the ocean (e.g., seafood processing, marine biotechnology, chemicals, salt, etc.); and produce products and services for the ocean and ocean-based activities (e.g., ship building and repair, ports, tourist resorts, communication, maritime insurance and law, maritime technical services, etc.).

Second, the blue economy also includes marine education and research as well as activities of the public sector agencies with direct coastal and ocean responsibilities (e.g., national defense, coast guard, marine environmental protection, etc.).

Third, the ocean generates economic values that are not usually quantified, such as habitat for fish and marine life, carbon sequestration, shoreline protection, waste recycling and storing, and ocean processes that influence climate and biodiversity.

Fourth, new activities are also evolving over the recent years, such as desalination, marine biotechnologies, ocean energy, and seabed mining. There are also innovations in activities that aim to protect ocean health, such as ballast water and invasive species management, waste-to-energy, wastewater treatment systems with low footprint, etc. These activities have to be included and measured in the ocean economy accounts. Ecotourism, eco-ports, and eco-ships aim to make these industries more environmentally sound, while ocean energy offers low carbon and renewable energy source. These innovations and emerging markets offer opportunities for investments and business, further contributing to blue economy development.

2. RATIONALE

This project finds its rationale against this backdrop of on-going changes in ocean activities as well as impacts of urbanization, pollution, over-exploitation, and climate change, and the need for careful planning of coastal and sea areas, and management of ecosystems. Estimating the value of ocean activities as well as the ecosystem services would help improve understanding of the role of the oceans and coasts in the economy. It would also provide a mechanism to monitor the investment and net returns from ocean activities. Moreover, knowing the structure of the current ocean economy and status of the coastal and marine ecosystems would be helpful to see how external events, such as storms, climate change and environmental changes, may impact blue economy development. Innovative technologies, new products and services, and demand for 'green' infrastructure and processes are also reshaping the traditional ocean economy. The assessment of the state of the ocean economy and ocean health and investment opportunities would therefore support evidence-based policy- and decision-making, and provide direction in ocean stewardship and governance.

3. CHALLENGES AND CONSIDERATIONS

Determining what constitutes the blue economy is a challenge in itself. The initial approach to blue economy assessment is to analyze first the current state of the

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ocean economy as well as the state of ocean health. Defining the scope of the ocean economy, and deciding what sectors and activities to include in the initial assessment would be the primary step, given the formidable data problems in estimating the extent of coastal and ocean activities, and the direct and indirect impacts.

In addition, we have to look at the values of coastal and marine ecosystems and biodiversity, and their contribution to the national economy as a whole. Countries have maintained their national income accounts to evaluate economic performance, and assess the effectiveness of their national development policies and plans. However, economic indicators, such as GDP, can be deceptive because the wealth of the country is not fully accounted for. Moreover, GDP does not indicate whether growth is sustainable or inclusive. National income accounts usually measure the produced capital, but not the natural capital (forests, mangroves, coral reefs, wetlands, water, minerals, etc.), human capital (education, skills and health of the people), and social capital (innovation, entrepreneurship).

The losses resulting from unsustainable use of coastal and marine resources and environmental degradation also have to be examined since these are not usually captured in the GDP. Assessment of economic performance should be based on both measures of annual growth (such as GDP) and measures of the natural capital to provide a more complete picture, and indicate if the economic growth is sustainable over the long term. Thus, it is particularly important to measure the natural capital in the coasts and oceans, its economic contribution and depreciation, especially in countries where economic activities and livelihoods rely on coastal and marine ecosystems, and maintaining them for future use.

One way to do this is through the UN Statistical Commission's System of Environmental and Economic Accounting (SEEA), which was approved in 2012. By accounting for the natural assets, more accurate information can be provided to policymakers, planners, and various stakeholders about development priorities and investments, and where resource conservation and environmental protection measures are most needed. Considering that SEEA is relatively new, the major problem is not all the countries in the EAS Region have SEEA systems and integrated economic and environmental accounts. Moreover, data problems, such as fish stocks, make it difficult to develop coastal and marine asset accounts. Data disaggregation in sectors, such as tourism, construction, education and research also pose complications.

3.1 Adopting a Common Framework for the Ocean Economy-Environment Accounting

APEC has initially identified the core economic sectors that would constitute the ocean economy. In 2009, PEMSEA asked participating countries in EAS region to make an assessment of the ocean or marine economy, and provide information on the contribution of these core sectors to gross domestic product (GDP). Notwithstanding the use of different methodologies, these studies showed that activities dependent on the oceans and coasts make a substantial contribution to the economies of the EAS region. In July 2015, PEMSEA again organized a workshop on Blue Economy Assessment, with participants from China, Indonesia, Malaysia, Philippines, South Korea, Thailand and Vietnam. The participants reported their respective ocean economy, coastal and marine ecosystem services, and key policies and plans. They also discussed data concerns for the assessment of ocean economy, ocean health, and investment opportunities.

The core ocean economic activities to be included by the participating countries in the ocean economy assessment are shown in Table 1. All the participants in the 2015 workshop said that data on most of the ocean economic activities are available from published government statistics, such as industry data, national income accounts and input-output tables (Table 1). Except for China, data on public sector activities like defense/navy, coast guard, and marine environment protection are available and can be accessed from the national accounts and government budget.

The following points show that a common framework can be initiated in China, Indonesia, Philippines and South Korea, but more work is needed for Malaysia, Thailand and Vietnam. The ocean economy assessment in the three latter countries used various data sources and studies, and did not show the GVA of the ocean economic activities and their contribution to GDP.

Indonesia, Japan, South Korea, and the Philippines: The ocean economy assessments in these countries were based on their respective national income accounts, and Input-Output tables. The System of National Accounts (SNA) is the internationally agreed framework to monitor the performance of an economy.

Indonesia: In the 2015 report, output, employment and GVA of each ocean economic activity, and their %age and total contribution to GDP were reported for the year 2008, although there were no estimates for the government sector (naval and coast guard activities). Initial GVA of the ocean economy in 2013 was also

reported, however there were no estimates yet for the marine services sectors. Initial estimates of the coastal and marine ecosystem services were also reported.

South Korea: The 2009 and 2015 reports showed the total output and GVA for key marine sectors, but did not present the employment data per sector. Using the input-output table, the backward and forward linkages, and production- and employment-inducing effects of the ocean economy were shown in the 2009 report. Economic values of key coastal and marine resources were presented in the 2015 report. It was pointed out that South Korea has a number of ocean energy projects, and should be included in the assessment of its ocean economy.

Philippines: The gross output, employment, and GVA for the ocean economic activities were presented for the period 2003 to 2006 in the 2009 report. There are initial estimates for the period 2010 to 2014, but the contribution of marine tourism, marine biotechnology, and ocean energy still have to be included. Initial estimates of the coastal and marine ecosystem services and costs of resource and environmental degradation were obtained from a 2006 country environment assessment study (World Bank 2006).

Thailand: The 2009 report for Thailand showed the contribution of marine resources and marine activities to the national economy, as well as the use and non-use values of coastal and marine resources, including some endangered species.

Based on the initial ocean economy assessments, the following are the major points that relate to having a common framework for the ocean economy-environment assessment:

- Clear-cut definition
- Common approach or system
- Scope and Boundaries in operational terms
- Harmonization of statistical concepts and terms
- Data concerns
- Appropriate estimation methodology
- Development of indicators
- Measuring backward and forward linkages and spin-off effects.

The Changwon Declaration 2012[1] provides a definition of blue economy. However, there is a need to have a clear definition and scope of the components of

[1] "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

blue economy to be included in the assessment. Ecosystem and environmental data are available from various studies, but the environmental and natural resource accounts still need to be developed in a systematic way. The SEEA provides a framework for integrating the ecosystems and environment in the national income accounts, but the EAS countries have to adopt this system, and provide resources for its development. The on-going initiatives on blue economy assessment encourage countries to fill in the numbers for the blue economy framework. This will help determine if: a) data are available and from which government agencies or other organizations; b) the data of the different economic activities are sufficiently covering the scope of the ocean economy-environment accounts, c) the estimation methodology, including the needed parameters, to be adopted is appropriate; and d) the proposed framework is suitable in the settings of the EAS countries.

The SEEA framework, studies on The Economics of Ecosystems and Biodiversity (TEEB), and the Wealth Accounting and Valuation of Ecosystem Services (WAVES) projects are intended to meet the needs of policymakers by providing indicators and descriptive statistics as well as serving as a tool for strategic planning and policy analysis to identify more sustainable development paths. It is crucial to invest in mapping, surveys, statistics and economic valuation to remain competitive with the knowledge-based economies.

and enhancing its potential contribution to sustainable development, including improving human well-being, and reducing environmental risks and ecological scarcities." (Changwon Declaration 2012)

Table 1. Data Availability and Accessibility.

1. OCEAN ECONOMIC ACTIVITIES	PR China	Indonesia	Malaysia	Philippines	RO Korea	Thailand	Vietnam
• Fisheries and Aquaculture	•	•	•	•	•	•	•
• Offshore Oil and Gas	•	•	•	•	•	•	•
• Mining (Minerals)	•	•	•	•	•	•	•
• Energy/electric supply (tidal and wave energy; renewables)	•			•		•	
• Water (desalination)						•	
• Manufacturing							
• Seafood processing		•	•	•	•	•	•
• Ship building and repair	•	•	•	•	•	•	
• Marine transport equipment		•	•	•		•	
• Marine biotechnology,	•	•	•	•		•	
pharmaceuticals, chemicals	•	•	•	•		•	
• Marine Construction	•	•	•	•		•	•
• Shipping (marine transportation, ports, warehouses)	•	•	•	•	•	•	•
• Marine tourism and recreation		•	•	•		•	•
• Defence/Government (navy, coast guard, etc.)		•		•	•	•	•
• Marine research and education	•		•	•	•	•	•
• Marine services (mapping, monitoring, consulting, maritime insurance, etc.)	•			•		•	•
2. GDP	•	•	•	•		•	•
3. ECOSYSTEM SERVICES							
• Direct use/market values	•		•	•		•	
• Indirect use and nonmarket values	•		•	•		•	
4. CLIMATE CHANGE			•	•		•	•

• *Available, accessible (online; government statistics and published data; studies)*

Partly available; accessible from separate statistics and studies

No activity; not available; not accessible (not published)

Source: PEMSEA. 2015. Proceedings of the Inception Workshop on Blue Economy Assessment. Manila, 28-30 July 2015.

4. OCEAN ECONOMY IN THE EAST ASIAN SEAS (EAS) REGION

This section provides an overview of the ocean economy in selected countries in the EAS Region. The contribution of the ocean economy to the gross domestic product (GDP) shows that countries in the region depend on the ocean and coastal and marine resources in varying degrees. The oceans provide us with subsistence; source of food, energy, medicines and recreation; means of transportation and commerce, and source of income and jobs.

4.1 Indonesia

Indonesia has 17,504 islands, distributed throughout the total marine area of about 6.32 million square kilometers (km^2). The contribution of the ocean economy to the total GDP of Indonesia in 2008 was US$73 billion (at current prices), which was around 13 % of GDP, and it increased to US$256.5 billion (at current prices) in 2013 (Table 2). The ocean economy in Indonesia is calculated from seven sectors, namely, fishery, marine tourism, marine transportation, maritime industry (manufacturing), energy and mineral resources, marine facility (ports, warehouses, etc.), and marine services, plus government services. Marine manufacturing industries have the highest contribution to the Indonesian ocean economy in terms of output and GVA, followed by marine construction. In 2008, more than 5 million Indonesians work in ocean economic sectors, representing 5.11% of total employment (Table 3). Of these, 1.85 million work in the marine construction sector while 1.69 million work in the fisheries and aquaculture sector.

Table 2. Gross Value-added of Ocean Economy (in million USD, in current prices)

Nr.	Sectors	2013	2008
1	Fisheries and Aquaculture	29,179.91	13,534.75
2	Mining (minerals, oil and gas)	40,113.91	12,351.12
3	Marine industries (manufacturing)	67,426.94	27,005.85
4	Marine transportation (shipping)	3,233.22	2,352.34
5	Marine tourism and recreation	24,846.57	994.62
6	Marine construction	90,726.70	16,100.15
7	Marine services		672.85
8	Defense/Government	1,017.17	
	Total	**256,544.42**	**73,011.68**

Source of data: For 2008: Indonesian Maritime Council, 2012; for 2013: Indonesian Statistics Council, 2015. Reported in Fahrudin, A. 2015.

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Table 3. Employment in the Ocean Economy, Indonesia, 2008

Nr.	Sectors	Employment in Ocean Economy	Share to Total Employment (%)
1	Fisheries and Aquaculture	1,687,560	1.64
2	Mining (minerals, oil and gas)	69,397	0.07
3	Marine industries (manufacturing)	302,201	0.29
4	Marine transportation (shipping)	840,390	0.81
5	Marine tourism and recreation	343,080	0.33
6	Marine construction	1,850,627	1.79
7	Marine services	190,444	0.18
	Total	**5,283,699**	**5.11**

Source: Fahrudin, A. 2015.

4.2 Philippines

The Philippines is an archipelago, with more than 7,500 islands, and a coastline of 36,289 km. Given the available data, the gross value added of the ocean economy in 2012 was USD12.39 billion (at 2000 constant prices).[2] Fisheries and aquaculture accounts for 37 % share of the GVA for the Ocean Economy (Table 4). The estimated average contribution of the ocean economy to GDP for the period 2011-2013, at constant prices, is about 5.35 % of the Philippine GDP (Talento, et al. 2015). It has an average growth of 3.42 % for this period.

In 2010, the National Statistical Coordination Board (now integrated into the Philippine Statistics Authority), conducted an assessment of the Philippine ocean economy for the period 2003-2006 (Virola, *et al*. 2010). The key findings are as follows:

- The ocean economy contributed an average of 4.5 % to the country's GDP for this period. The fisheries and aquaculture sector has the highest share in the ocean economy.
- The ocean economy contributed 5 % to 5.5 % of the total employment. The number of people employed in the ocean economy in 2006 was 1.65 million. Employment in the ocean economy grew at an annual average of 1.9 % in 2003-2006.
- Per capita compensation in the ocean economy is higher by 52.5 % than the total economy.

[2] This is an initial estimate, and is also underestimated because it does not include the GVA of marine tourism and coastal wind power.

- Approved investments in the ocean economy increased considerably in 2006, due to the investment in ship building by South Korea. The foreign direct investment (FDI) in ocean economy was 12 % of the total FDI.

Table 4. Gross value added of the ocean economy in the Philippines, 2012 (in billion USD, in constant 2000 prices)[3]

Ocean economic activities	**Billion USD**
• Fisheries and Aquaculture	4.55
• Offshore Oil and Gas	0.24
• Energy/electric supply	1.31
• Manufacturing	1.11
• Marine Construction	1.13
• Shipping and Ports	0.42
• Marine tourism and recreation	not estimated
• Public administration (navy, coast guard, etc.)	0.46
• Marine education	1.78
• Marine business activities and services	1.62
TOTAL	**12.39**

Source: Recide, R. 2015.

4.3 China

From 2006 to 2010 (11th Five-Year Plan), the average annual marine economic growth is 13.5%. The structure of China's marine economy consists of: (a) marine industries (core marine industry plus support services, such as marine scientific research, education, management, and service), and (b) marine-related industries. The core marine industries are shown in Table 5 (next page), with a total value of CNY2.5 trillion. The gross ocean product includes the core marine industry, support services, and marine-related industries. The State Oceanic Administration (SOA) reports the following (Wei Bo 2015):

- Marine GDP or gross ocean product (GOP) of China in 2010 was nearly CNY4 trillion, which is around 9.7% of total GDP. In 2014, the GOP reached CNY6 trillion, accounting for 9.4% of the China's GDP in that year.
- The GOP is around 9-10% of the country's GDP from 2005 to 2014 (Figure 1).

[3] Energy/electric supply does not include coastal wind power; Manufacturing includes fish and seafood processing, ship and boat building, manufacture of engines and turbines for marine propulsion, pulleys, etc; marine education include related maritime business activities, maritime research and development, and maritime insurance

- Ocean-related employment in 2010 was about 33.5 million, and increased to 35.5 million in 2014.

Table 5. Core Marine Industries, China, 2014 (based on CNY to USD of 6.3 to 1)

Core marine industries	**Annual product** (billion CNY)	**Annual product** (billion USD)*	**% Share**	**Growth from previous year** (%)
Marine fishery	429.3	68.14	17.1%	6.4
Offshore oil and gas	153.0	24.29	6.1%	5.9
Mining	5.3	0.84	0.2%	13
Salt	6.3	1.00	0.3%	-0.4
Chemicals	91.1	14.46	3.6%	11.9
Bio-medicals	25.8	4.10	1.0%	12.15
Energy; Electric power	9.9	1.57	0.4%	8.5
Seawater utilization	1.4	0.22	0.1%	12.2
Ship building	138.7	22.02	5.5%	7.6
Engineering and construction	210.3	33.38	8.4%	9.5
Transportation (Ports and shipping)	556.2	88.29	22.1%	6.9
Coastal tourism	888.2	140.98	35.3%	12.1
Total	**2515.5**	**399.29**		

Source: Wen Quan. 2015.

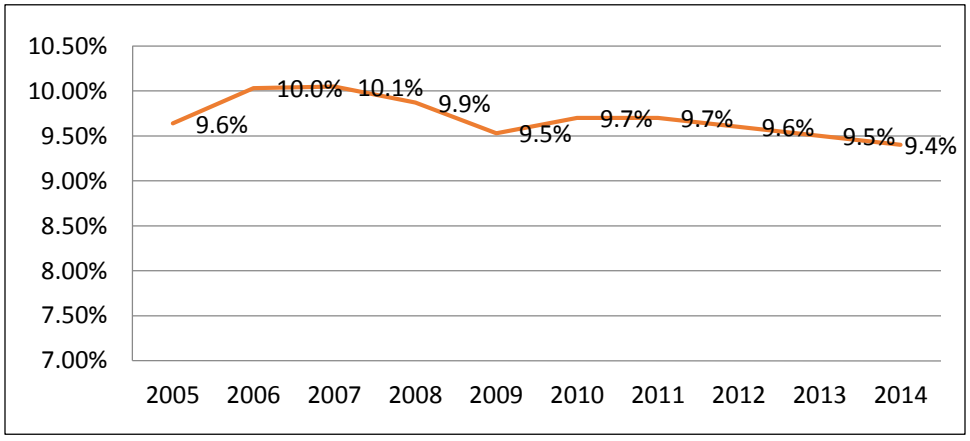

Figure 1. Share of gross ocean product in GDP, China, 2005-2014
Source: Wei Bo. 2015.

Coastal tourism, transportation, and marine fisheries provide the largest share in China's ocean economy. China's seven ports are in the global top 10 ports in

2013, with China's Ningbo-Zhoushan port ranked first in terms of cargo handled while Shanghai port ranked first in terms of containers handled (Wei Bo 2015). Shipbuilding capacity has been enhanced comprehensively in China. The country took the lead in all the three major shipbuilding indicators (ships built, handling order, contracting (new order) from 2010 to 2013. Offshore oil and gas production also took off, and reached more than 50 million tons each year from 2010 to 2012 (Wei Bo 2015).

4.4 Republic of South Korea

There are 14 sectors and 40 sub-sectors in the ocean economy of South Korea, with GVA of USD2.9 billion. (Table 6, next page) The average share of the ocean economy to the national GDP is 3.7 % in 2008-2011 (Table 7). Ship building constitutes 42% of the ocean economy of South Korea. The contribution of ocean energy and electric power was not included yet in the current ocean economy assessment.

Table 6. Total Gross Output and Gross Value Added of the Ocean Economy in South Korea, 2010.

Sector		Total gross output		Value added	
		million USD	(%)	million USD	(%)
Entire Industry		3,124,037.4	100.0	1,152,580.8	100.0
Ocean Industry		**133,846.8**	**4.3**	**37,822.6**	**3.3**
Ocean-based Sectors	Fisheries and aquaculture	7,515.3	5.6	3,226.4	8.5
	Marine chemical and salt	563.7	0.4	363.1	1
	Marine electric power				
	Marine construction	2,835.0	2.1	1,272.3	3.4
	Shipping	34,555.5	25.8	3,287.8	8.7
Ocean-related Sectors	Machine equipment	10,120.1	7.6	2,641.7	7.0
	Ship building	53,008.4	39.6	15,919.2	42.1
	Marine services (mapping, surveying, consulting)	1,448.6	1.1	935.6	2.5
	Research and development (R&D)	601.9	0.4	404.7	1.1
	Government, education	4,294.6	3.2	2,805.7	7.4
	Seafood processing and retails	8,926.4	6.7	2,312.2	6.1
	Pharmaceuticals, Biotechnology, etc.	7.0	-	3.1	0

	Port	3,522.6	2.6	1,747.0	4.6
	Marine tourism	6,447.8	4.8	2,903.7	7.7

Source: Chang, J. 2015.

Table 7. Gross Value Added of Ocean Economy in South Korea, 2008-2011

Year	Value added (million USD)	GDP contribution (%)
2008	37,845.0	3.8
2010	37,826.6	3.3
2011	39,795.4	3.3

Source: Chang, J. 2015.

4.5 Malaysia

The contribution of the ports and shipping, oil and gas production, and fisheries and aquaculture sectors is significant in Malaysia. The country is a strategic maritime hub. The following are some of the key features of Malaysia's ocean economy (Kaur 2015):

- Oil, gas and energy sectors contributed RM127 billion to Malaysia's GDP in 2012. This is around 19 % of the GDP.
- Around 95 % of Malaysia's trade by volume is seaborne.
- In the 2011 Bank Negara Annual Report, the share of the transportation and storage sector was RM16 billion or 3.8 % of Malaysia's GDP in 2011, while transport equipment, a component of 'Domestic Oriented Industries' contributed RM29.7 million in 2010.
- In 2012, maritime transport attracted >RM5 billion in investment. This is more than 40 % of the total investments in transportation.
- Port Klang and Port of Tanjung Pelapas (PTP) was ranked 13th and 17th, respectively, in the list of world's busiest container ports by throughput handled in 2011 (UNCTAD, 2011). Bintulu Port is the world's largest export terminal for liquefied natural gas (LNG). Johor Port is the world's largest palm oil export terminal.
- Malaysian ship yards generated RM7.36 billion of revenues, and provided 31,000 jobs in 2011.
- Coral reef-related businesses in Malaysia are worth approximately US$635 million annually in food, fisheries, tourism and even pharmaceuticals.

4.6 Thailand

The estimation for the contribution of marine resources and marine activities was based on secondary data from published and unpublished government reports and research studies from various years. Marine resources constitute both living and non-living resources. In estimating the value of living resources, the 2009 report (Jarayabhand, *et al.* 2009) considered the use (both direct and indirect uses) and non-use values of coral reefs, mangrove, seagrass, fisheries, and endangered species, such as sea turtles. Non-living resources include offshore oil and gas, salt, and coastal land. The total contribution of marine resources and marine activities in Thailand amount to USD212.7 billion (Table 8).

Values for marine activities are for maritime transport, ship-building and repair, maritime insurance, seafood processing and transport, tourism, pharmaceutical products, archaeological surveys and defense (navy). Contribution from tourism was estimated based on income from visitors in some of major coastal resorts in 2004. Maritime transportation is estimated from the value of imports and exports, but not the contribution from maritime transport within the country due to the limitation of data. Shipyards and ship repairing and maritime insurance were included in the estimation of maritime transport related activities.

Thailand has become one of the top ten producers and exporters of fisheries products in the world since 1992. Jarayabhand, et al. (2008) reported that the GVA of fisheries in 2006 was USD 29,000 million or 1.27 % of the total GDP, and more than 220,000 people were employed in the fisheries sector.

Tourism is another major contributor to the Thai economy. The total contribution from coastal tourism in 2004 is about USD 5,639.72 million (Table 8). This constitutes about 30 % of the national revenue from tourism which was USD19 billion in the same year (Jarayabhand, et al. 2008).

Table 8. Contribution of Marine Resource and Activities and Environmental Cost in Thailand

	USD Million	%
1. Contribution from marine resources		
1.1 Living	6,703.11	3.15
1.2 Non-living	14,259.12	6.71
2. Contribution from marine activities		
2.1 Maritime transport	174,882.88	82.24
2.2 Related industries	9,744.61	4.58
2.3 Tourism	5,639.72	2.65
2.4 Others	1,422.47	0.67
Total contribution	**212,651.91**	**100**
3. Economic cost of resources degradation and environmental impact of marine activities		
3.1 Coastal erosion	133.06	
3.2 Oil spill	54.83	
3.3 Tsunami	2,430.97	
Total cost	**2,618.86**	

Source: Jarayabhand, et al. 2009. Contribution of the Marine Sector to Thailand's National Economy.

5. LINKAGES OF OCEAN ECONOMY, EMERGING INDUSTRIES AND INNOVATIONS

The ocean economy also has forward and backward linkages with various sectors of the economy. These linkages can indicate the connectedness of ocean industries with land-based industries, and quantify the benefits of investment in the ocean industries for the whole economy.

The fishery industry provides more than just a source of protein and food. It has generated many resource-based ocean economic activities, such as mariculture, seafood processing, and marine biotechnology. The ocean is considered the world's last frontier in the search for novel drugs from nature for serious human diseases, such as cancer, AIDS, tuberculosis, and drug-resistant infections. The Philippine PharmaSeas Drug Discovery Program is tapping the rich marine biodiversity in the

Philippines, and it is focused on bioactives from marine organisms, including pain killers using marine snails, and anti-infectives from sponges (Concepcion 2008).

The EAS region feature some of the world's busiest and most strategic shipping routes serving much of the maritime trade between East Asia and South Asia, Persian Gulf, Africa, Europe and the Americas. Seaports facilitate trade of manufactured products, raw materials and commodities, as well as development of trade centers and industrial zones, which, in turn, create jobs and business opportunities. Ports also generate supporting activities, such as transportation, services and construction.

The huge demand for shipping services to support growing intra-regional and world trade and increasing offshore activities has been a boon to the shipbuilding and ship repairing industry in the region. Many shipyards in the EAS region have upgraded their capacity and expanded their business, while new ones have been built to meet the demand for merchant vessels.

The ocean industry in the region has expanded beyond just maritime trade to include service-based activities. Ocean ancillary services, such as logistics, banking, insurance, maritime law, ship classification, bunkering, crewing, and information technology, etc., provide essential support to the operations of ports and shipping, which serve as the conduit for much of the region's trade.

The offshore oil and gas industry has emerged as a major industry. Several countries in the EAS region are located on the Sunda Shelf, known to be a site with huge hydrocarbon deposits. Indonesia, Malaysia, Thailand, Brunei, Vietnam, Cambodia and Timor Leste benefit from the rich energy resources available in this continental shelf. The oil and gas industry provides opportunities to other support service providers as well. It created a huge demand for equipment, such as oil rigs, tankers, and offshore service vessels. The demand for supporting services by the oil and gas industry creates employment, and facilitates technology transfer and development of technical skills.

With the rapid development of marine high technology, emerging ocean industries, such as marine biotechnology, ocean energy, and desalination, reached an average annual growth rate of more than 20 % in China (Wei Bo 2015).

Ocean energy is one of the innovative ocean industries. It contributes to a lower carbon energy future by reducing consumption of fossil fuels, air pollution and greenhouse gas emissions, and appears to have low environmental impacts. It has the potential to supply local requirements, be a large source of energy in the EAS

region, and meet a significant share of the world renewable energy needs. For example, the Sihwa Tidal Power Plant in South Korea can generate a total capacity of 254 MW, which can supply energy to around 200,000 residents. It can also contribute to cutting down oil imports in South Korea by 862,000 barrels per year and reduce the emission of carbon dioxide by 315,000 tons per year (Kim 2009). Offshore wind power is also developing fast in China. Technology on tidal energy and offshore wind utilizations are already commercially available while wave power, hydrokinetic energy from tides and ocean currents, and ocean thermal energy conversion are still in the nascent stage of development. However, government policies are contributing to accelerate the implementation of ocean energy technologies. Funding mechanisms, such as the Clean Development Mechanism (CDM) or Joint Implementation (JI) projects could provide additional external funding for ocean energy projects in developing nations. The Sihwa barrage project was funded, in part, by CDM finance (Lewis, et al. 2011).

Innovations and investments in the following industries are expected to grow, and contribute to more sustainable blue economy development:

- Sustainable fisheries (rebuilding fish stocks) and sustainable aquaculture
- Ecotourism
- Eco-ports and eco-ships
- Marine biotechnology
- Ocean energy
- Pollution reduction, remediation, waste recycling
- Ecological engineering, habitat restoration and marine protected areas
- Climate change resiliency infrastructure

6. OCEAN ECONOMY AND OCEAN HEALTH

Covering more than 70 % of our planet, oceans provide us with food to eat, sources of energy, commerce, transportation, recreation, medicines, and even freshwater. The ocean supplies jobs and supports industries that sustain the GDP of countries in the EAS region, but the sustainability of the ocean economy relies on robust ocean health. Policymakers, planners and managers need information on ecosystem services and the values of the benefits that people obtain from ecosystems as well as the costs and impacts of human activities on the ocean. Environmental and natural resource valuation and wealth accounting are approaches aimed to influence policy- and

decision-making to support conservation and environmental management. Figure 2 shows the different ecosystem services and types of values (direct use, indirect use, option value, and non-use and existence value), and how they contribute to overall human well-being, in terms of water, energy and food security, health, basic materials for good life, and good social relations. Direct use values include extractive uses (e.g., fisheries and aquaculture, oil and gas production, etc.) as well as non-extractive uses and dependence on the ocean (e.g., tourism, shipping, ports, shipbuilding, marine construction, marine commerce and trade, etc.).

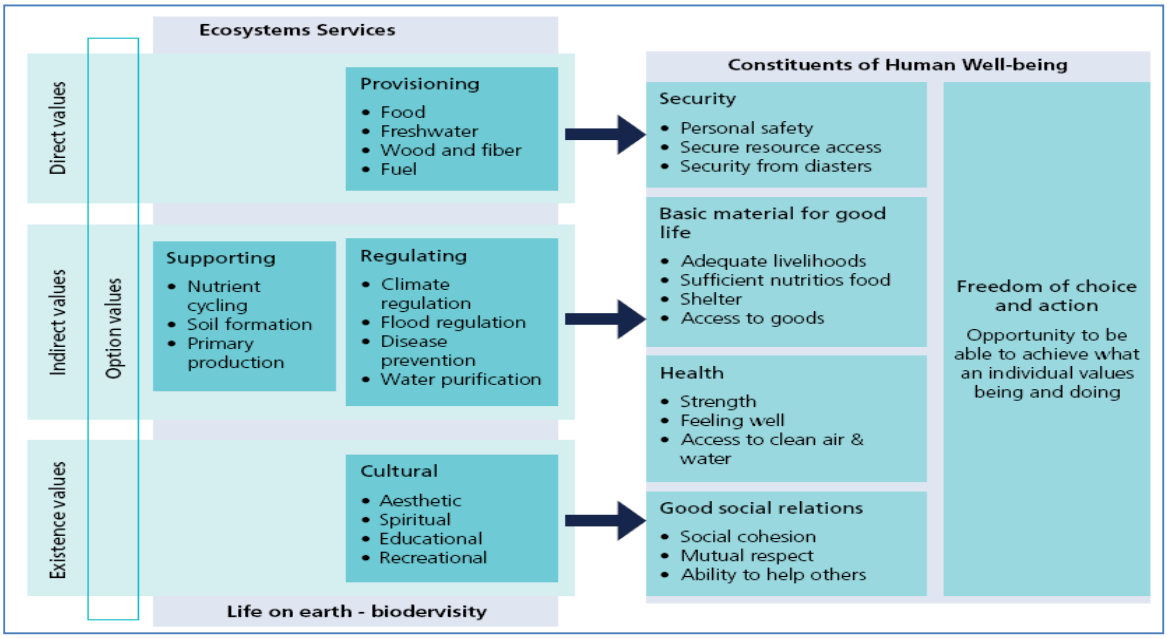

Figure 2. Ecosystem services
Source: UNEP. 2010. The Economics of Ecosystems and Biodiversity (TEEB).

Ecosystem services are classified along functional lines within the Millennium Ecosystem Assessment (MA), using categories of provisioning, regulating, cultural, and supporting services:

- *Provisioning services*: These are products obtained from the ecosystems (e.g., fisheries and aquaculture, wood fuel, etc.). They are direct use values and already included in the assessment of ocean economic activities.
- *Cultural services*: These are nonmaterial benefits of ecosystems. Only tourism and recreational activities are usually included in the 'measured' ocean economic activities.

- *Supporting services* (e.g., primary production, production of atmospheric oxygen, nutrient cycling, water cycling, provisioning of habitat, nursery for fisheries etc.): These are the ecosystem benefits that are necessary for the production of all other ecosystem services. These are indirect use values of ecosystems, and their impacts on people occur over a very long period. As such, these are not usually included in the ocean economy assessment.
- *Regulating services* (e.g., climate regulation, waste assimilation, storm protection, etc.): These are the benefits obtained from the regulation of ecosystem processes. These are also indirect use values.

The EAS region is home to 30% of the world's mangroves and a third of the world's coral reefs, and known as the center of marine biodiversity. Countries of the East Asian Seas region account for 80% of global aquaculture, and more than 65% of harvesting and processing of the world's capture fisheries. Table 9 shows the total fisheries production in the EAS region in 2012 and the average annual growth of the capture fisheries and aquaculture from 1990 to 2012. China has the highest fishery production (70,368 metric tons), followed by Indonesia (15,422 metric tons). Indonesia also has the largest area of mangroves and coral reefs among the seven countries. In terms of conservation, the Philippines have the highest &age of marine protected areas in relation to territorial area (52.8%), followed by Japan (30%).

Table 9. Ocean Data (as of 2012).

	Cambodia	**China**	**Indonesia**	**Japan**	**South Korea**	**Malaysia**	**Philippines**	**Thailand**	**Vietnam**
Total fisheries ('000 mT)	641	70,368	15,422	4,817	3,187	2,097	4,869	3,068	5,942
Capture fisheries growth (avg. annual %, 1990-2012)	8.0	4.1	3.7	-4.3	-1.8	2.0	1.1	-1.4	5.7
Aquaculture growth (avg. annual %, 1990-2012)	11.8	9.1	13.4	-1.1	3.0	11.8	6.2	6.8	14.7
Marine protected areas (% of territorial waters)	6.5	1.3	2.2	30.0	0.17	2.0	52.8	4.4	1.7

	Cambodia	China	Indonesia	Japan	South Korea	Malaysia	Philippines	Thailand	Vietnam
Coral reef area (km^2)	<50	1,510	51,020	2,900	--	3,600	25,060	2,130	1,270
Mangrove area (km^2)	728	208	31,894	7.4	--	7,097	2,565	2,484	1,056

Source: The World Bank. 2014. *The Green Data Book*.

It is worth noting that of an estimated 12–20 million fishermen in Southeast Asia, almost all are small-scale, artisanal fishers, with only 1 million fishermen associated with commercial fisheries (Mulekom 2008). Fisheries and aquaculture contribute significantly to inclusive economy, food security and livelihoods, but those depend on healthy aquatic ecosystems.

Tourism is another big sector in the ocean economy of the EAS countries. Over the period 2005–2007, tourism contributed on average 14.8 % of Cambodia's GDP, increased from 6.9 to 8.4 % of Thailand's GDP, and rose from 7.9 to 9.0 % of Malaysia's GDP (UNESCAP 2010). Marine tourism helps spur the development of supporting infrastructure, such as hotels and resorts. It has become one of the most important sources of revenue for coastal communities, and much of the activities, such as boating, fishing, bird watching, swimming, diving, and other water sports, are directly related to healthy ecosystems and clean water.

Coastal and marine ecosystems also have an enormous value in safeguarding settlements, and reducing vulnerability, but their physical integrity must be maintained. Natural barriers, such as sand dunes, mangrove forests and coral reefs reduce the impacts of a range of coastal hazards, including storm surges and tsunami waves, helping to protect coastlines from their full impact.

The region also serves as an important conduit for 90% of world trade. Facilities and infrastructure built around port areas contribute to raising the standard of living of the residents in the vicinity of the seaports. However, these ports are situated at an interface between land and sea, and connected to rich habitats (e.g., seabed; estuarine waters; mudflats; wetlands; mangroves; seagrass beds; coral reefs). Some of these ports are directly on the shore, established on reclaimed land and the surrounding seabed, or located along the banks or mouths of rivers. These sites are connected to habitats, which are at risk from port operations as well as from accidental oil and chemical spills. Problems, such as soil contamination, water and air pollution, solid waste, safety of port operation and storage of goods, safety of industrial processes, ballast water and invasive alien species management, and marine biosafety, must be addressed by the ports and shipping sectors.

The dearth of valuation studies conducted for coastal and marine ecosystems shows the need for mapping the ecosystems, identifying the ecosystem services specific in each location, and for more research and robust assessment of the ecological and economic linkages as well as the policy and institutional arrangements that affect such relationships. In many instances, there are more studies being undertaken for provisioning ecosystem services since these are relatively easier to value as compared to other ecosystem services, such as regulating and supporting (Brander and Eppink 2015). The following section shows some of the efforts in the EAS region towards the valuation of ecosystems.

6.1 Philippines

The World Bank supported a Country Environmental Assessment in the Philippines, which shows that the net benefits of coastal and marine resources amount to PhP24 billion (approx. US$545.5 million) in 2006 (Table 10). Around 45 % of this amount is from the provisioning services (fisheries and timber). More than half of the net benefits are from the regulating, supporting and cultural services, which are not usually accounted for in the GDP.

6.2 Indonesia

Initial estimates of the coastal and marine ecosystem services in Indonesia are shown in Table 11. Fisheries account for 86 % of the total economic value of USD 245 million. However, the regulating services, such as carbon sequestration and shoreline protection have not been estimated yet, and these services could be considerable given the large areas of mangroves and coral reefs in Indonesia.

6.3 South Korea

The economic value of coastal and marine ecosystems (beaches, national parks, coastal water, tidal flats and estuaries) ranges from USD40.5 billion to USD 42.6 billion (Table 12). Beaches and tidal flats contribute 78 % of this amount. Table 12 shows the ecosystem services taken into account in doing the valuation.

6.4 Thailand

The total economic value of coastal and marine resources in Thailand is around USD27.67 billion. Almost 37% of the value of ecosystems and selected endangered species came from indirect use and non-use values (Table 13). Direct use referred

to fisheries and tourism. Indirect use values are the ecosystem support to coastal fisheries, and provision of coastal protection, carbon sink, and nutrients. The valuation of endangered species is based on studies that estimated the existence value, using the contingent valuation method (CVM) to determine the cost of conservation that people are willing to pay or accept.

Table 10. Net Benefits of Coastal and Ocean Ecosystems in the Philippines (million USD)

	Coastal					Oceanic	Total	
	Mangrove	**Seagrass**	**Coral Reef**	**Other Coastal**	**Sub-Total**		**Amount**	**%**
Provisioning								
Fisheries	143.1	56.7	997.6	5,912.4	7,109.8	3,176.9	10,286.70	42.7
Timber	595.2				595.2		595.2	2.5
Sub-total	**738.3**	**56.7**	**997.6**	**5,912.4**	**7,705.0**	**3,176.9**	**10,881.9**	**45.2**
Cultural								
Recreation	26.5		94.7	125.6	246.8		246.8	1
Education/research	7.5	8.3	10.1	4.7	30.6		30.6	0.1
Existence			199.3	16.8	216.1	1.4	217.5	0.9
Sub-total	**34.1**	**8.3**	**304.1**	**147.1**	**493.5**	**1.4**	**494.9**	**2.1**
Regulating								
Carbon Sequestration	172.2				172.2		172.2	0.7
Shoreline protection	854.1		2,018.4		2,872.5		2,872.5	11.9
Waste Assimilation	53.8	25.2	695.1	6,091.9	6,866.0		6,866.0	28.5
Sub-total	**1,080.1**	**25.2**	**2,713.5**	**6,091.9**	**9,910.8**	**-**	**9,910.7**	**41.2**
Supporting								
Mariculture				**2,775.1**	**2,775.1**		**2,775.1**	**11.5**
TOTAL	**1,852.6**	**90.1**	**4,015.2**	**14,926.5**	**20,884.3**	**3,178.3**	**24,062.6**	**100**
%	7.7	0.4	16.7	62	86.8	13.2	100	

Source: World Bank. 2006. Country Environmental Assessment: Philippines

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Table 11. Estimated Value of Coastal and Ocean Ecosystem Services in Indonesia (thousand USD)

Ecosystem Service	Coastal			Oceanic	Total	
	Mangrove	Seagrass	Coral Reef		Amount	%
Provisioning						
Fisheries	12,444.40	100,313.79	97,877.76	41.97	210,677.93	86.06
Wood fuel/ charcoal	125				125	0.05
Cultural						
Recreation and tourism	14		3,176.88		3,190.88	1.3
Existence value	33.3	3,932.07	14,643.97		18,609.34	7.6
Regulating						
Carbon sequestration		154.48			154.48	0.06
Supporting						
Aquaculture	10,238.70				10,238.70	4.18
Mariculture		1,799.25			1,799.25	0.74
TOTAL	22,855.40	106,199.59	115,698.61	41.97	244,795.58	100
%	9.34	43.38	47.26	0.02	100	

Source: Fahrudin, A. 2015.

Table 12. Economic Value of Marine Ecosystems in South Korea, 2012 (million USD)

Marine ecosystem	Marine ecosystem services	
Coastal waters	food production raw materials (aggregates, sand) natural gas	5,710.3 250.0 256.8
Beaches **National parks**	Recreation, cultural services, conservation value	16,614.6 591.2
Estuaries	food production waste treatment refugia recreation indirect-use value, non-use value	2,380.0 ~ 4,463.8
Tidal flats	food production, waste treatment refugia recreation disturbance regulation non-use value (conservation value)	16,629.9
Total		**40,460.1 ~ 42,543.9**

Source: Chang, J. 2015.

Table 13. Economic Value of Coastal and Marine Ecosystems in Thailand (million USD)

Type of Value	Ecosystem Service	Million USD
1. Use value		
a) Fisheries	Provisioning	**4,606.7**
b) Tourism	Cultural	**13,165.2**
• income from tourism (including foreigners)		*13,159.3*
• income from tourism in marine protected areas		*5.9*
2. Indirect use value		
a) Mangrove forest		**6,409.7**
• Carbon Sequestration	Regulating	*1,630.2*
• Coastal Protection	Regulating	*4,194*
• Fish breeding ground and nursery	Supporting	*585.2*
b) Coral reefs		**982.6**
• Rehabilitation of coral reefs		*65.9*
• Coastal protection	Regulating	*916.7*
c) Seagrass		
• Carbon sequestration	Regulating	**2,056.9**
3. Non-use value	Cultural	
a) Mangrove Forest		
b) Coral Reef		**53.47**
c) Seagrass		**168.36**
d) Value of threatened species (year 2014)		
• Turtle		**158.36**
• Irrawaddy Dolphin		**38.46**
• Manta Ray		**14.08**
• Whale Shark		**11.86**
Total		**27,665.41**

Source: Jarayabhand*, et al.* 2009.

It has been recognized that the flows of ecosystem services do not accurately reflect their condition, since a given flow may or may not be sustainable over the

long term. The ASEAN TEEB Scoping Study reported that Southeast Asia is expected to lose one third of mangroves between 2000 and 2050 under a 'business as usual' scenario. The cost of loss of mangroves was estimated at US$2 billion (annual value in 2050), estimated from the reduction in the value of regulating and supporting ecosystem services: coastal protection and habitat/nursery support for fisheries (Brander and Eppink 2015). For the coral reefs, the value of lost reef-related fisheries in Southeast Asia is US$5.6 billion (annual value in 2050), with the highest loss in Indonesia and the Philippines (Brander and Eppink 2015).

The environmental costs from unsustainable fishing, coastal development, pollution, and climate change impacts in the Philippines amount to PhP5.7 billion or around USD129.5 million (World Bank 2006). Such figures indicate unsustainable practices that impact on the health of coastal and marine resources, and the benefits they generate.

In Thailand, the total cost of resource degradation and environmental impact of marine activities amounted to USD2.62 billion (Table 8). The impact of tsunami due to loss in shoreline protection from degraded coastal habitats was estimated to cost USD 2.43 billion. The cost from tsunami-related damages would have been lower if the habitats have not been degraded or destroyed by man-made activities.

The area of coastal wetland has decreased 57 % in China in the past 60 years. Mangrove forest and coral reef decreased by 73 % and 80 %, respectively (Wei Bo 2015). Land-based sources of pollution and offshore marine pollution in China also pose significant environmental pressures.

The port industry has been faced with government regulations to achieve regulatory compliance on safety, security and environmental protection. These requirements are perceived as added costs, which could hamper port productivity and competitiveness. On the other hand, some ports in the region are developing or are in the process of implementing port safety, health and environmental management system (PSHEMS) on a voluntary basis, and considered 'green' initiatives and 'sustainability' issues as business attributes that enhance port competitiveness.

7. CONCLUSION

The ocean economy in the EAS region contributes significantly to the GDP of the countries in the region. However, economic growth over the past 50 years in the

EAS region had been accompanied by decline in natural capital and the ability of ecosystems to sustain services. Loss of habitats, pollution and other environmental pressures impact human health and wellbeing as well as health of ecosystems, which people rely on for their sustenance, livelihood, medicines, amenities, and protection from natural hazards.

The blue economy advocates a growth strategy with low environmental impacts, and this has emerged as a feasible development path. In a blue economy, development in the coastal and marine areas, and growth in income and employment should be driven by public and private consumption and investments that prevent the loss of biodiversity and ecosystem services, reduce pollution and carbon emissions, enhance resource efficiency, and address water, food and energy security for all.

Ocean economic sectors, such as fisheries, aquaculture, seafood processing, marine biotechnologies, and tourism, rely on healthy ecosystems. The ocean economy also affects the ocean environment: pollution, sedimentation, conversion of habitats, overfishing, introduced invasive species, operational and accidental oil and chemical spills to name a few. Other land-based activities also affect ocean health.

However, there are also ocean economic activities that help restore and protect habitats, biodiversity, and water quality, and reduce greenhouse gas emissions. Sustainable fisheries and aquaculture practices, green ports and ships, and ecotourism involve changing practices to shift from the traditional industries to the blue economy paradigm. The impact on climate change from the fossil fuel energy sector will put increasing pressure on the energy sector to invest in alternative renewable technologies in the future. Ocean energy offers the potential to be a large source of energy in the region. Demand for sustainability, cost effectiveness, and eco-friendly goods and services drive innovations, and commercialization of these innovations.

Until recently, arguments in support of the conservation of species and habitats were based primarily on issues, such as their evolutionary uniqueness, rarity or threat of extinction. Today, these arguments also point out that maintaining biodiversity and ecosystems directly benefits people by contributing to economic well-being and quality of life. It is essential to recognize natural capital as a critical economic asset and as a source of public benefits.

Having adopted the Changwon Declaration on blue economy in 2012, countries in the EAS region have begun to assess their respective ocean economy and ocean health. This paper shows the initial estimation of ocean economy and ecosystem services, and the major gaps. Policy and institutional support is essential to institutionalize the ocean economy-environment accounting, and integrate it into national and local development plans and investments.

Through valuation and proper accounting system, it can be shown that preserving ecosystems and protecting the environment make economic sense rather than sacrificing them for short-term gains. It has therefore become imperative to develop a system for ocean economy-environment accounting, and mainstream the valuation of ecosystems services and environmental impacts, including climate change, as a means to better manage natural resources, contribute to the sustainability of economic growth in the region, and move towards a blue economy.

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