The YSLME Story

Management and Governance for the Restoration and Protection of the Yellow Sea Large Marine Ecosystem

UNOPS

YSLME
UNDP/GEF Yellow Sea Large Marine Ecosystem

COVER PHOTO: Traditional shellfish harvest in intertidal mudflats of Tiaozini, Yancheng City of Jiangsu Province, PR China. (Photo by Dongming LI)

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Congratulatory Message

Carlos Manuel RODRIGUEZ
CEO and Chairperson
Global Environment Facility

Since its establishment in 1992, the Global Environment Facility (GEF) has provided a total of $1.2 billion USD, which has leveraged $9.8 billion in more than 200 investments within the world's Large Marine Ecosystems. The size and diversity of the portfolio is a testament to the cultural, social and economic value and opportunities, that these transboundary marine ecosystems present for the countries sharing the resources within them.

I would like to congratulate the countries and all partners with the successful adoption of the Yellow Sea LME TDA 2020 and the YSLME Strategic Action Programme (SAP) 2021-2030. Having been a key supporter of the YSLME region for two decades, the GEF is pleased to see the implementation of the YSLME SAP and for the foundation it provides for cooperation between the Yellow Sea countries.

The YSLME project has played an important role in advancing knowledge and good practices on sustainable fisheries and aquaculture, in the YSLME region and in other LMEs. Engagement of various stakeholders from governments, civil society, academia and the business sector have fostered strong regional and national collaboration on YSLME ocean governance, directly informing formulation and adoption of national policies and regulations.

The results of this set of investments is a shining example of what can be achieved through cooperation on shared marine resources and how it is a prerequisite for local, national and regional sustainable blue development.

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Congratulatory Message

Achim STEINER
Administrator
United Nations Development Programme (UNDP)

The Yellow Sea, which lies between mainland China and the Korean peninsula, is one of the world's largest areas of continental shelf covered in shallow water.[1] It is so named because the rivers that flow into the Yellow Sea carry mineral-rich soil that turns the water a shade of yellow. The sea's marine and coastal habitats are home to some 1,600 species of wildlife – from porpoises and marine turtles to diverse fish life and migratory waterbirds.[2] Yet, like so many of nature's wonders, the Yellow Sea's ecosystems and biodiversity have faced extraordinary pressures from human activity. The region has a coastal population of some 600 million people – over 12 per cent of the world's population.[3] Industrial pollution, agricultural run-off and domestic sewage contaminated the sea's coastal waters and habitats. Intertidal mudflats, which are so vital to birdlife, may have receded by up to 65 per cent since the 1950s due to coastal reclamation.[4] By the early 1990s, fish and invertebrate populations had declined by an estimated 40 per cent.[5]

Responding to this multitude of threats, the United Nations Development Programme (UNDP) and the Global Environment Facility (GEF) teamed-up with the Governments of the People's Republic (PR) of China and the Republic of Korea to save the Yellow Sea from a cycle of terminal decline. Centered around the principle of transboundary cooperation, the partners initiated the first of two Yellow Sea Large Marine Ecosystem (YSLME) projects in 1997. This publication details the results of this productive partnership to *transform* the management and governance of the YSLME. They include innovative solutions to combat marine pollution, reduce overfishing, restore habitats and upscale sustainable mariculture. And in this era of increasingly extreme weather due to climate change, it outlines ways to boost the resilience of coastal communities, including through nature-based solutions. A defining feature of the project has been its role in advancing

1 https://iwlearn.net/iw-projects/basins/lmes/yellow-sea
2 https://wwf.panda.org/discover/knowledge_hub/where_we_work/yellow_sea/
3 http://www.yslmep.org/
4 https://fullerlab.org/muddy-business-in-the-yellow-sea/
5 https://wwf.panda.org/discover/knowledge_hub/where_we_work/yellow_sea/

effective multi-country governance towards the sustainable use of the Yellow Sea's unique marine and coastal resources. Specifically, some of the transformational impacts of the YSLME programme include:

- A 22 per cent and 17 per cent reduction in fishing pressure (# of vessels) in PR China and the Republic of Korea, respectively. At the same time, re-employment training has helped people to transition to alternative, sustainable opportunities;
- The creation of an additional 207,000 hectares in marine protected areas – now representing some 5.5 per cent of the total Yellow Sea area;
- The scaling up of integrated multi-trophic aquaculture in both countries – it now covers some 13,000 hectares and produces over 200,000 metric tonnes of sustainable seafood products every year;
- A more than seven-fold increase in the *catch per unit effort* in the Republic of Korea's marine ranching sites;
- A 49 per cent improvement in water quality (chemical oxygen demand) in Sihwa Lake in the Republic of Korea;
- Measurable declines in the occurrence of harmful algal blooms in the Republic of Korea with none observed in 2016 or 2017.

As we approach the completion of the second phase of the YSLME project, it is heartening to look back on how far the Yellow Sea region has come. Development is now much more sustainable than it was when the project began in 1997. It is also founded upon a much clearer recognition of the *intrinsic link* between communities and the environment. In this Decade of Action for the Sustainable Development Goals, the many tangible results achieved as a result of our cooperation can serve as an inspiration to drive forward the protection and restoration of other vital marine ecosystems across the globe.

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Congratulatory Message

Hong WANG
Vice Minister
Ministry of Natural Resources
People's Republic of China

In 1999, the Governments of PR China and RO Korea in collaboration with the United Nations Development Programme (UNDP) and the Global Environment Facility (GEF) began the conceptualization of the Yellow Sea Large Marine Ecosystem (YSLME) Project. Since then, the project has already undergone two phases that inspired significant paradigm shifts in the way we manage and value the Yellow Sea and its resources.

For PR China, the Yellow Sea is not just a body of water, it is part of our cultural heritage, our way of life, and a key driving force to our socio-economic development. However, decades of overexploitation in support of industrialization and economic growth have weakened its capacity to provide valuable ecosystem services. Thus, to overturn its decline, a more concerted and holistic approach is needed. This realization inspired the birth of regional cooperation through the YSLME project.

In alignment with the overarching philosophy of ecological civilization development, the State Oceanic Administration of the Ministry of Natural Resources (SOA/MNR) has been mandated to protect the marine ecosystem services, pursue economical and intensive use of marine resources, and promote high-quality development of the marine economy. Over the years, tangible results have been achieved in resolutely curbing illegal reclamation of coastal areas, protecting and restoring marine ecosystems, optimizing marine spatial plans, promoting sustainable and healthy development of marine economy, and building blue partnerships. These achievements have strong underpinnings upon the implementation of the Strategic Action Programme (SAP) of the YSLME.

With the adoption of the SAP 2021-2030, the MNR will continue to take innovative efforts to implement management actions to achieve the targets and objectives of enhancing ecosystem resilience through ecosystem-based and integrated coastal management. Management measures will be further strengthened in the control of reclamation, improvement of control and prevention of *Ulva* and green tide outbreaks, and establishing the marine protected area network with focus on protection of full extent of intertidal

mudflats of the Yellow Sea. Innovative financial instruments and marine public service products will be developed to promote marine economic development and contribute to global ocean governance through blue partnership development.

The completion of YSLME Phase II Project this 2020 also marks the end of the 13th Five-Year Plan of PR China. Building on the results in the past years, PR China is moving forward with a new Five-Year Plan beginning 2021 that embraces the importance of "blue sea and green mountain" development to speed up low carbon economic development, improve ecosystem resilience and increase efficiency in the use of resources. This principle will also guide our continued commitment to ensure that the good foundations, innovation and learning from YSLME Project are carried forward and sustained for the benefit of future generations in the region.

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Congratulatory Message

Ki-doo EOM
Vice Minister
Ministry of Oceans and Fisheries (MOF)
Republic of Korea

Yellow Sea has long been regarded as a driving force for sustainable growth both to RO Korea and PR China, and also an old friend to the people, providing much relax and cultural joy.

In particular, Yellow Sea brings much significance to RO Korea as it has high economic value in fisheries as a repository of abundant biological resources which accounts for vast majority of the domestic fish stock. Moreover, the Sea has much importance in terms of environment, as 82% of the coastal wetlands in RO Korea are located in the Yellow Sea. Tidelands and summer beaches along the West Coast are enjoyed and visited by a large number of people.

Yet, despite all of the advantages that the Yellow Sea has, it is faced with different issues and challenges of being destroyed in the midst of excessive development and overwhelming visit. Negative issues are constantly arisen mostly by human activities such as marine pollution, deprivation of fisheries resources, marine litter and etc.

As of 2005, a bilateral project named UNDP/GEF YSLME was launched by RO Korea and PR China reaffirming commitment on preserving the priceless Yellow Sea. A decade from then, today RO Korea has learnt valuable lessens that scientific approach and thinking process must take place as a premise to actively proceed transnational preservation of natural resources and marine environment as it was engaged in the YSLME Phase I & II Project.

RO Korea established and implemented NSAP to proceed SAP based upon the TDA result of the Yellow Sea conducted by the two countries, and such action taken by RO Korea has served as an opportunity to consider the harmonious relationship between the mankind and the nature, thus to bring marine environment management and restoration measures based on scientific diagnosis.

Particularly speaking, the Ministry of Oceans and Fisheries of the RO Korea has played a centric role as a government ministry by actively conducting various forms of management activities in accordance to YSLME. A national-level monitoring system and joint project with

PR China have been established in order to effectively tackle the issues of depleted fish stock due to over-fishing, cause and flow of marine litter and various culprits of marine pollution. With that said, more systematic measures and response have been initiated along with the establishment of dedicated organization, relevant policies and regulations. Along with these processes, even though the Ministry did not succeed in every step that it took, it saw a glimpse of hope that once all these efforts to achieve what YSLME aims become constant, the political, biological and socio-economic landscape will be transformed.

Against this backdrop, the YSLME Phase II Project has been wrapped up with much success as well as the implementation of Post-YSLME is planned to take place in order to inherit the past achievement and agreement. RO Korea stays committed to achieve the goals of YSLME which aims to build a harmonious environment both for the mankind and the nature with deepened commitment and determination followed by the regional and national cooperation.

Under the principle of YSLME, it is my sincere delight to share meaningful and various changes as well as results achieved by the RO Korea government on preserving precious resources and environment via actively engaging the public as well as rising the public awareness. I would take this opportunity to extend my deepest gratitude to UNDP, GEF, UNOPS, researchers from home and abroad, NGO and partner agencies for taking their part in this challenging but meaningful journey.

Amongst all, I would like to send my best regard to an old friend of ours, the Yellow Sea.

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Congratulatory Message

Kenneth SHERMAN
Adjunct Professor of Oceanography
Coastal Resources Center, Graduate School of Oceanography
University of Rhode Island
Director, Large Marine Ecosystems Program (2012-2019)
National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Narragansett Laboratory

In 1995, the People's Republic of China and the Republic of Korea joined in the planning and implementation of an ecosystem-based approach to the assessment and management of the Yellow Sea Large Marine Ecosystem (YSLME) in collaboration with the United Nations Development Programme (UNDP), the Global Environment Facility (GEF), Non-Governmental Organizations (NGOs), US NOAA, and other organizations. Now in 2021, following 15 years of applying innovative and pragmatic ecosystem focused assessment and management practices in support of recovery and sustainability of YSLME goods and services, the YSLME program has well established the benefits of ecosystem-based actions and results for advancing towards sustainable development of the world's LMEs.

Through meticulous joint YSLME planning the two countries People's Republic of China and the Republic of Korea assessed and prioritized major human and environmental stressors for mitigation actions. Among the stressors subjected to mitigation actions during the past decade were overfishing, pollution, habitat degradation, nutrient overenrichment, toxic algal events, biodiversity loss, disruptions of natural biogeochemical cycles, and climate change. Within the spatial domain of the YSLME, science supported activities were placed on strategic time-tracks, and many cutting-edge science tools and methodological solutions for stress mitigation were implemented.

The volume is complete with stories of results and actions for recovering depleted fish stocks and augmenting capture fisheries with innovative methods for integrated marine trophic aquaculture, restoration of degraded critical habitats including mud flats and algal forests on denuded substrates, wetland conservation, marine protected areas, controls over marine litter and microplastics contamination, reduction and control of nutrient overenrichment, and strengthening governance and enhancing socioeconmomic benefits from stress reduction actions.

The publication of the YSLME Story in 2021 is most timely and appropriate as it provides a comprehensive narrative on the application of cutting-edge science towards achievement of the goal and targets of the 2015 United Nations ocean sustainable development initiative and the 2019 UN proclamation describing 2021-2030 as the Decade of Ocean Science for Sustainable Development.

The YSLME Story provides insight on how strong science support can be integrated into stress mitigation actions necessary to achieve sustainable development of YSLME goods and services. The YSLME Story should be widely disseminated among the marine science and marine resource management communities as a comprehensive example of ecosystem-based management practices.

The third phase of the YSLME program scheduled for 2021-2030 is to be focused on further elaboration of governance mechanisms for strengthening the fusion between applications of science in support of ecosystem-based mitigation of human and environmental stress to maximize sustainability and socioeconomic benefits of the YSLME by the People's Republic of China and the Republic of Korea, an objective that is wholly consistent with the 2021-2030 UN Decade of Ocean Science for Sustainable Development.

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Congratulatory Message

Moin KARIM
Regional Director
Europe and Central Asia
Director and Representative
Switzerland Office

The YSLME Story is a good testimony of how cooperation and collaboration around the Yellow Sea led to remarkable results and benefits for its stakeholders. While the complexity of challenges with which the water body has been confronted over the years seemed at times insurmountable, with the commitment of and leadership from the two countries, PR China and RO Korea to "work it out and make it work" and with the dedicated support from a whole range of partners, not least the Global Environment Facility and UNDP, significant progress has been made towards sustainable ocean and marine management. UNOPS is proud of having been associated and able to contribute to the YSLME's success during both phases of the project for the protection of the Yellow Sea Large Marine Ecosystem (LME).

As impartial operational and management experts of the United Nations, we have brought to the table our skills and expertise and implemented the agreed project's programme of work. We understood what was at stake. However, managing such an important LME project has not always been easy. Complex and interdependent environmental, social and economic problems and agendas of multiple stakeholders needed to be integrated into joint cross-cutting transboundary approaches and tailored work plans with clear deliverables. Naturally, there have been varying priorities between the partners, and different socio-economic and political systems that influenced the way we worked together. Ultimately, the zealous commitment to ecosystem-based management for the benefit of a healthy marine and coastal environment from all stakeholders around the Yellow Sea and beyond, helped to overcome differences and ultimately led to impressive results and spurred transboundary cooperation. The updated YSLME Transdiagnostic Analysis and the regional Strategic Action Programme, to name but two of the remarkable projects deliverables, are results that reflect the stakeholder commitment and offer an excellent basis for continuous cooperation.

Through the work of YSLME, as illustrated in this publication, it has become clear that transformational change for sustainable development requires the systematic integration of marine and ocean management into national and regional development plans. And not only there, the project activities needed to link local perspectives with those of the national level and

connect these to the regional dimension. All this has to be done through well-selected high caliber and pragmatic interventions. Guided by the overarching framework of the Sustainable Development Goals, during our work with the different YSLME partners we also learned that impactful responses to YSLME project's objectives demand agility, openness to innovation as well as access to and application of high quality scientific knowledge. And we learned that respect for and integration of nature and its assets, the respect for the ecosystem and its capacity to contribute to development plans is crucial. The COVID-19 crisis, which emerged at the end of the project, has inexorably underlined the need to respectfully manage natural resources.

YSLME has proven resilient and able to sustain and adapt to the changing circumstances in the region over the years, while staying true to its commitment to deliver ecosystem-based solutions and on-the-ground changes.

I congratulate the "key movers" and all other participants of the YSLME project for the successful completion of its second phase. On behalf of UNOPS, I would like to extend my sincere congratulations and best wishes to the YSLME family.

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Physical Characteristics

Coverage area: 400,000km^2
Seafloor depth: 44m (average); 100m (max)

Socio-Economic Characteristics

200 million coastal residents

Surrounded by large coastal cities

Main economic sectors: fisheries, aquaculture, oil exploration, port development and tourism

Biological Characteristics

Key global resource for coastal and offshore fisheries

- **339** fish species
- **100** species of polychaetes
- **171** species of mollusks
- **107** species of crustaceans
- **22** species of echinoderms

Key stopover site for 50 million migratory birds in the East Asian-Australasian Flyway (EAAF).

Home to endangered and threatened mammals (i.e., Spotted Seal, Black Right Whale, Finless Porpoise, etc.).

Varied geological formations in Yellow Sea - cliffs of Baengneyong-do, Incheon, RO Korea.

A Call to Action:
Saving the Yellow Sea Heritage

The Declaration of the United Nations Conference on the Human Environment adopted in 1972 represents a crucial turning point on the way environment and development are viewed globally. This landmark Declaration underscored the detrimental consequences of human actions on the very environment to which all life depends, and laid down basic principles on regional and global cooperation to address environmental challenges, including the need to protect and ensure legitimate use of the seas (UN Stockholm Declaration, 1972).

Oceans and seas contribute approximately US$ 3-6 trillion annually to the global economy in terms of the market value of goods and services including fisheries, energy, shipping, tourism, recreation, and mining sectors, as well as non-market ecosystem services such as climate regulation, nutrient cycling and carbon sequestration. But the increasing roles of and dependence on oceans for social and economic development have been threatening their integrity and sustainability.

Over the years, it became more apparent that a holistic management strategy and innovative approaches are needed to effectively address the transboundary and complex challenges in global oceans. This led to the introduction of the **Large Marine Ecosystem (LME)** concept pioneered by Dr. Kenneth Sherman and Dr. Lewis Alexander in the 1980s. The LME approach puts emphasis on ecosystem functioning, thereby fostering integration and cooperation among countries working towards implementation of ecosystem-based management (EBM) of coastal and marine resources.

What are LMEs?

The LME covers large area of coastal oceans, approximately 200,000 km^2 and greater, and are shared by two or more countries. LMEs represent ecosystem-based management units that are defined ecologically and not politically (GEF, 2015).

Among the 66 LMEs around the world, the Yellow Sea LME has been one of the richest in terms of productivity, but is also one of the most highly vulnerable to human development. Driven by their common concern for the Yellow Sea, PR China and RO Korea recognized the urgent need to address problems of reduced fish catches, red tide outbreaks, degradation of coastal habitats, and marine pollution through regional cooperation. There was also a call for stronger science to guide planning and policy decisions, and for a well-coordinated framework and structure for cooperation in the Yellow Sea region. The leaders of the stewardship agencies from the two countries came together to turn the corner, from degradation to sustainability, of the shared goods and resources of the Yellow Sea ecosystem.

"The policies that are not based on sufficient and accurate data will fall short of being as effective as have been expected."

- **Moo-Hyun KANG**
  Vice Minister, Ministry of Maritime Affairs and Fisheries, RO Korea (Congratulatory Address, YSLME Phase I Project Inception Ceremony)

"Through the joint efforts of the surrounding countries, the Yellow Sea, although a geographical barrier separating the countries on both sides, will become a sea of peace, a sea of friendship, and a sea of cooperation."

- **Zhihui SUN**
  Deputy Administrator, State Oceanic Administration, PR China (Congratulatory Address, YSLME Phase I Project Inception Ceremony)

In response to this regional priority, the GEF and UNDP supported the initiative to reduce development stress and promote sustainable development of the Yellow Sea ecosystem through ecosystem-based and sustainable environmental management. Through the UNDP/GEF YSLME Phase I Project launched in 2005, the participating countries took a step-wise process by focusing on the preparation and completion of the region's Transboundary Diagnostic Analysis (TDA), Strategic Action Programme (SAP), and National Strategic Action Plans (NSAPs).

YSLME TDA and SAP

As a 'fact-finding' process, the development of TDA under the YSLME Phase I Project provided the Yellow Sea region with a better understanding of the status of the Yellow Sea ecosystem, and highlighted the region's **key transboundary issue areas** (**Figure 1**). This provided an important basis for the crafting of priority targets and corresponding management and governance measures in the YSLME SAP covering 2010-2020.

The YSLME SAP 2010-2020 serves as a common regional framework that is structured along an ecosystem services model, whereby 11 regional targets and 32 management actions were framed. Based on the regional YSLME SAP 2010-2020, corresponding NSAPs were developed by PR China and RO Korea to facilitate more coordinated SAP implementation at the national level.

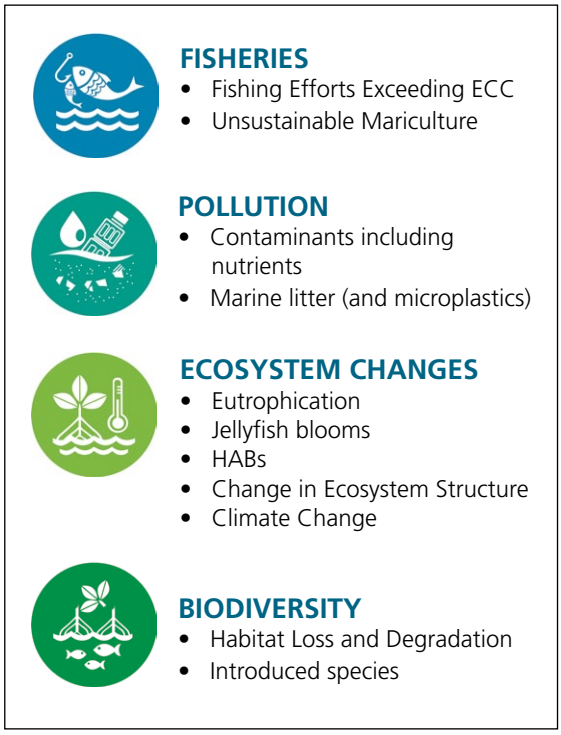


Figure 1. Key Transboundary Issue Areas.

Zhanhai Zhang (right), Director-General, Department of International Cooperation, State Oceanic Administration, PR China, and Sang-Pyo Suh, Director, Economic Organization and Environment Division, Ministry of Foreign Affairs and Trade, RO Korea, signed the Statement of Agreement approving the SAP at an endorsement ceremony in PR China in November 2009.

Synergies between YSLME SAP and the UN SDGs

Anchored on the principles of sustainable development and ecosystem-based management, the YSLME SAP 2010-2020 is linked and contributing to a number of key international instruments (i.e., UNCLOS, Convention on Biological Diversity's Aichi Targets, RAMSAR Convention, IMO related conventions). In particular, in support of restoring fish stocks, habitat protection and restoration, reduction of marine pollution, and responsible ocean governance, the SAP Targets are contributing directly to key UN Sustainable Development Goal (SDG)14 objectives and targets to 'conserve and sustainably use the oceans, seas, and marine resources for sustainable development'. Through its cross-cutting initiatives, the SAP 2010-2020 also provides instrumental contributions across various SDG targets. Highlights of these contributions are showcased through the on-the-ground stories featured in this report.

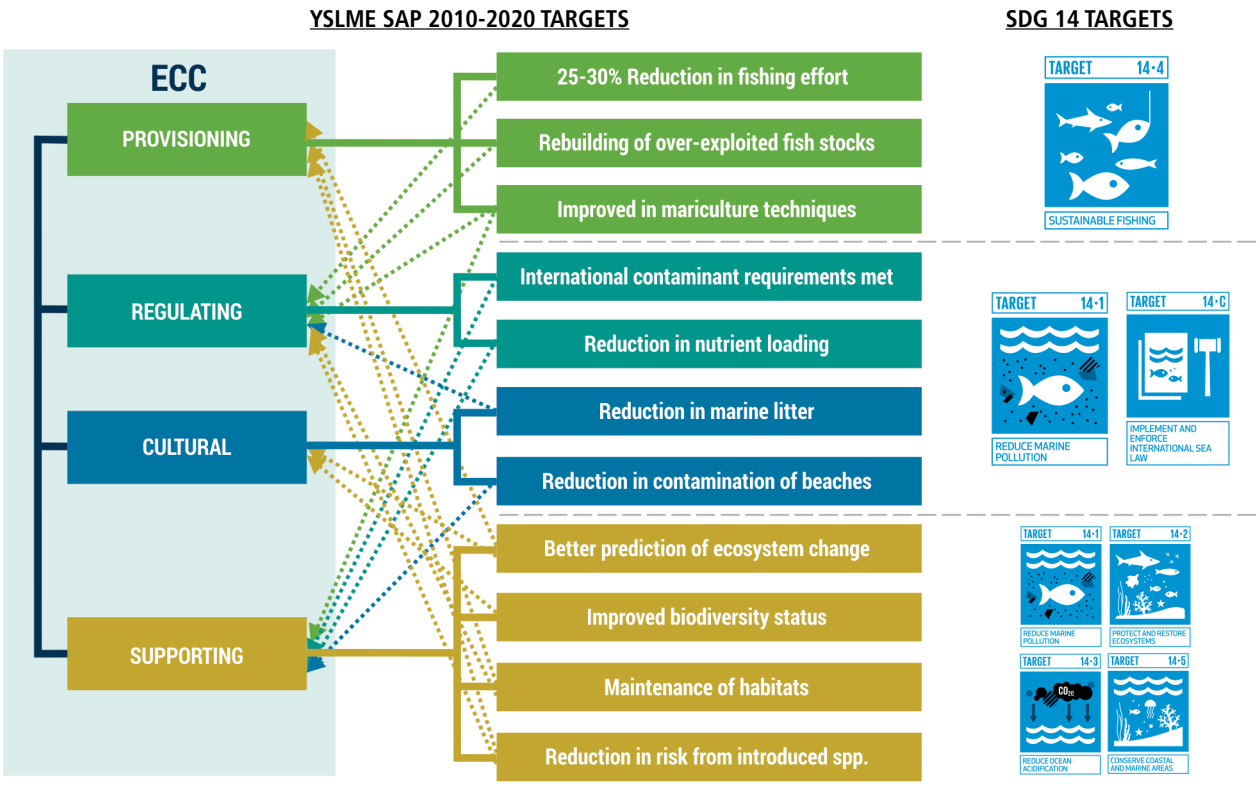


Figure 2. Direct Linkages between Targets of the YSLME SAP 2010-2020 and the SDG 14 Targets.

Implementation of the YSLME SAP 2010-2020

Following a highly successful Phase I project that closed in 2011, with successful completion of the TDA in 2007 and adoption of the YSLME Strategic Action Programme (SAP) 2010-2020, the Phase II project was developed to support the implementation of the YSLME SAP 2010-2020. The Phase II project obtained endorsement from the GEF CEO in February 2014 and was approved by the Government of PR China, UNDP and UNOPS in July of that year. Project implementation commenced in July 2017 and ended in December 2020.

"The preservation of the Yellow Sea ecosystem is not possible with the individual efforts of governments of RO Korea and PR China. The Yellow Sea environment will be improved when the policy making authorities of two countries, related experts, NGOs, and all stakeholders cooperate together."

- **Yang-soo KIM**
  Deputy Minister of Ministry of Oceans and Fisheries, RO Korea (Welcome Address, YSLME Phase II Project Inception Ceremony)

"Conservation and sustainable use of YSLME cannot be successful without the wide participation of coastal countries and international organizations. We deeply salute scientists of both countries who have contributed remarkably to use of science in LME management."

- **Fengkui LIANG**
  Associate Counsel, State Oceanic Administration, PR China (Congratulatory Message, YSLME Phase II Project Inception Ceremony)

"The YSLME Phase I Project has been recognized globally as a model for regional cooperation in an area that is important for marine biodiversity, ecosystem services, navigation and other uses. Regional cooperation, partnership beyond governments, supportive governance mechanisms and action on the ground are key to the success of the second phase of the project."

- **Jose Padilla**
  Regional Technical Adviser, UNDP/GEF (Congratulatory Message, YSLME Phase II Project Inception Ceremony)

The SAP 2010-2020 provided the guiding framework for the implementation of various activities on the ground under the UNDP/GEF YSLME Phase II Project (**Figure 3**).

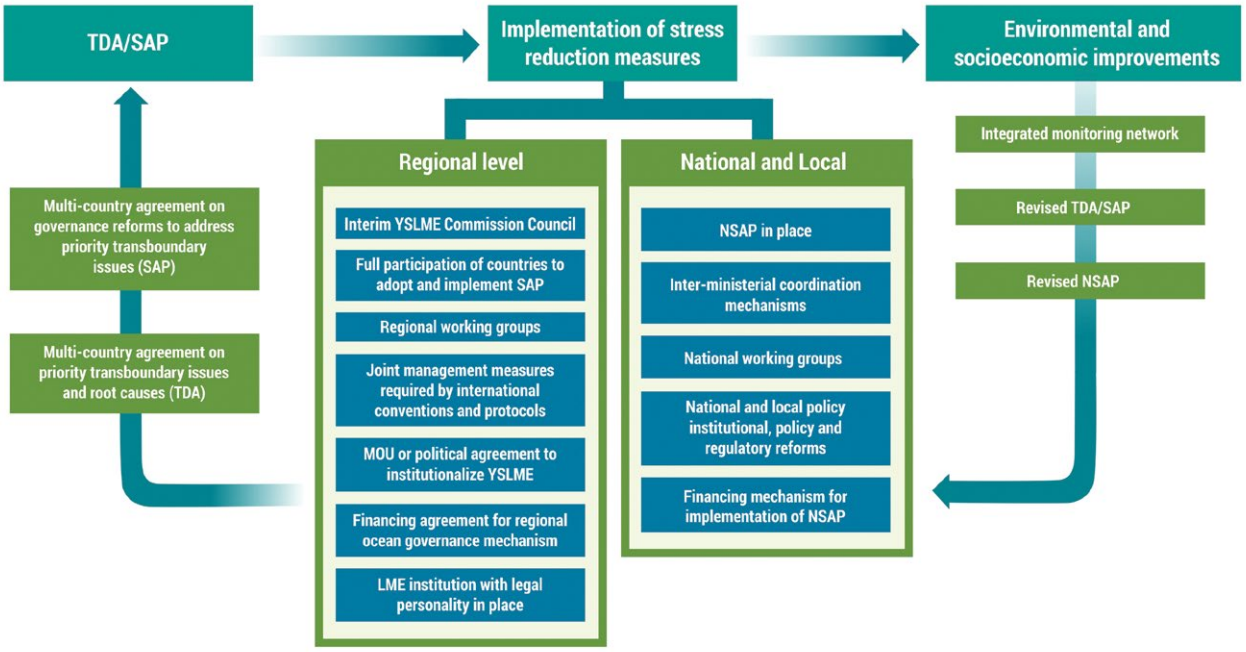


Figure 3. Process and Institutional Framework for Implementation of YSLME Strategic Action Programme.

The SAP 2010-2020 implementation further boosted the region's aspiration towards a stronger cooperation and better governance of the YSLME. Facilitated by an Interim Commission Council (ICC) and six Regional Working Groups (RWGs), there has been substantive progress towards reaching consensus on a regional governance mechanism for the YSLME. The memorandum of understanding (MOU) to be signed by PR China and RO Korea will confirm their commitment towards regional governance and set out the next steps for operationalizing an agreed collaborative arrangement.

The Phase II Project funded the updating of TDA, which was adopted in October of 2020, and a new SAP covering the period of 2021-2030. The analysis undertaken as part of the TDA 2020 provided an opportunity to revisit the concerns addressed in the TDA 2007, to assess developments and progress in the region, and to consider emerging issues, including drifting macroalgae, marine plastics, and contaminants of emerging concern.

The two countries have made significant investments in line with the ecosystem-based management priorities outlined in the SAP 2010-2020, including: monitoring, surveillance, and control of fisheries operations; buy-back of fishing vessels; improving mariculture operations; expanded monitoring of point source and non-point sources of pollution; development and operation of environmental information systems; collection and control of marine debris; upgraded and expanded wastewater collection and treatment; restoration of degraded coastal ecosystems; management of MPAs; marine surveys; public awareness campaigns; etc. From Phase I to the current phase, **Table 1** shows how GEF investments has catalyzed even bigger country support, signifying commitments from Yellow Sea countries to realize the strategic goals for the region.

Table 1. Summary of Investments in YSLME.

Summary	Actual (in USD)
YSLME PHASE I	
GEF Financing	14,394,089
Co-Financing PRC and ROK	520,121,536
Co-Financing (Other Sources)	3,179,399
Overall Total	**537,695,024**
YSLME PHASE II	
GEF Financing	7,562,430
Government	192,709,103
Other multi/bilateral	6,891,327,224*
UNDP	2,967,000
NGOs	128,085
Total Co-financing	**7,087,131,412**
Total GEF Funding (Phase I & II)	**21,956,519**
Total Co-financing (Phase I & II)	**7,610,432,347**
Total Project Funding (Phase I & II)	**7,632,388,866**

Notes: * Co-financing reported by the Republic of Korea Ministry of Oceans and Fisheries covers funding expended over the period of 2014-2020 for the coastal and marine initiatives across the country, not only the YSLME area.

The implementation of YSLME Phase I & II Projects has also highlighted a number of GEF additionalities, including: facilitating regional dialogue and formulating a framework agreement for durable regional cooperation and financing arrangements; exchanging knowledge and lessons among the scientific communities; providing added value to innovative approaches and technologies, such as integrated multi-trophic aquaculture, ecological engineering approaches like constructed wetlands; providing small grants to civil society organizations and research institutions for promoting best practice management and raising community awareness; delivering technical assistance in analyzing current and emerging threats, as well as updating the TDA 2007 and the SAP 2010-2020.

Ganwolam (Ganwol temple) in Seosan of RO Korea. (Photo by KOEM)

Aquaculture in Weihai. (Photo by Dajun LIU)

On The Road to Transformation

This part highlights key transformations evident through scaling-up success of the different demonstration sites and initiatives in line with the YSLME SAP 2010-2020 implementation throughout the YSLME Phase II Project period. Such transformations cover: (1) Ocean governance through institutional restructuring, policy and plan development and implementation; (2) Technical advancement guided by stronger scientific information and evidence; (3) Behavioral and awareness change through demonstration of stronger multi-stakeholder and citizen science participation, as well as building of networks; (4) Capacity enhancement with more stakeholders engaged in various capacity and awareness building initiatives; (5) Socioeconomic transformation with the introduction and implementation of alternative sources of livelihoods and innovative technologies; and (6) Environmental change with a number of regional trends showing progress on coastal and marine resources improvement in the Yellow Sea.

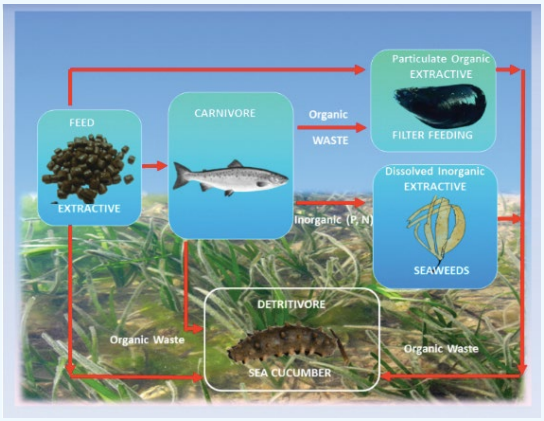
Supporting Recovery of Fish Stocks: Sustainable Fisheries and Mariculture

The Food and Agriculture Organization of the UN (FAO) estimates that globally 90% of fish stocks have limited or no potential for increasing production. From 2011 to 2016, global marine capture fishery production declined by 2.7%, while in 2016, the contribution of aquaculture to the global production of capture fisheries and aquaculture combined reached 46.8%, compared to 25.7% in 2000 (FAO, 2018). Increasing global demand for seafood means that mariculture will be critical in the years to come.

Traditional monoculture aquaculture development is constrained by increased disease transmission and competition for food amongst farmed organisms, shortage in suitable aquaculture space, and excess waste and nutrient release into surrounding environment from excess fish feed and fish feces which contribute to eutrophication and dead zones. Traditional practices cannot supply future expected demand of 60% of global fish consumption.

Story of Change: Enhancing Fish Stocks through Marine Ranching and IMTA

Located in the east coast of PR China, facing the Yellow Sea is Shandong Peninsula, which has the biggest coverage of marine aquaculture and seafood production in the country. Faced with a number of fishery challenges mainly as a result of traditional high-density monoculture practices, the Shandong province has started to implement several measures offering key learning of how to bounce back through application of ecosystem-based approaches.



Source: Fang et al.

What is IMTA?

This approach is based on the ecosystem carrying capacity of an area, where species from different trophic levels are cultivated in a way that produces more food and increases incomes of coastal communities while ensuring that nutrients or wastes produced at one trophic level are recycled naturally and becomes available resource for another trophic level.

In Shandong Province lies a small fishing island in Sanggou Bay called, Dongchu. The island dwellers rely heavily on fisheries as a key source of livelihood. In 1990s aquaculture increased sharply in the village. While it initially brought income, the release of large amounts of organic waste from standard monoculture fish farming resulted to disease and low production and eventually significant financial losses. With the help of the Yellow Sea Fisheries Research Institute (YSFRI), the fishermen of Dongchu were trained on **Integrated Multi-trophic Aquaculture (IMTA)**. Slowly, IMTA has changed their way of life. IMTA is now applied to over 13,000 ha with an annual production of 80,000 MT dry

Another year of bumper harvest of kelp in Dongchu Village. Under IMTA, cultured organisms are harvested in different seasons of the year thus keeping the fishermen resilient to economic losses from disasters such as COVID-19 which would otherwise be hard hit under monoculture. (Photo by Yitao ZHANG)

kelp, 2,000 MT fresh abalone, 120,000 MT fresh oyster, 10,000 MT fresh scallop, 100 MT fish, and 50 MT sea cucumber. The successful application of IMTA showed that ecological protection and economic development could go hand in hand. Now, IMTA provides 300 jobs and opened up tourism opportunities for Dongchu, which is now receiving about 15,000 visitors each year. Tourists of Dongchu also enjoy their environment-friendly seafood, household hotels, such as unique seagrass-thatched cottage houses run by women, while enjoying the beauty of its clean sea.

"Chinese are very wise to scientifically build a multi-nutrient-level integrated farming system of fish - algae - shellfish - sea cucumber, which turns sunlight into high-grade seafood, and provides abundant food for human beings. This farming model does not cause significant pressure on the environment, and absorbs a large amount of carbon, nitrogen and phosphorus in seawater. The contribution of IMTA to the control of offshore eutrophication and protection of the ecological environment is enormous."

- **Kenneth SHERMAN**
NOAA, 2010

"We participated in the first and second phases of the YSLME project and have made many international friends. Now, we are one of the training bases for UN and conservation organizations for eco-farming. We have supported the establishment of an academician workstation to conduct carbon sink observation, IMTA, and development of marine ranches."

- **Junwei WANG**
General Manager, Rongcheng Chudao Aquatic Products Co., Ltd. PR China

Although the upfront investment to establish IMTA may be higher than monoculture type aquaculture, the return on investment is higher. Comparing with monoculture, the IMTA has the following benefits:

- Optimized carrying capacity of an ecosystem
- Faster growth of cultured organisms
- Decreased disease transmission
- Decreased competition among cultured species
- Improved water quality
- Greater productivity per unit area
- Providing higher protein yields and better quality products
- Creating more jobs
- Providing more income to fishermen
- Supporting consumer demand for sustainably sourced fish
- Cultured species acting as carbon and nutrients sinks

IMTA is an innovative solution which can set the Yellow Sea and other LMEs on an economically viable yet sustainable path for blue and green growth.

Story of Change: Protecting and Restoring the Yellow Sea Forests

Labeled as the "Islands of Gods", the island of Jeju in RO Korea is one of the most sought-after vacation areas because of its majestic landscape and beautiful beaches. But even this magical island could not escape from the different pressures besetting the ocean environment. In 1992, a case of barren ground was first reported near the coastal area of Jeju Island of RO Korea. Barren ground occurs as a result of various environmental factors (i.e., marine pollution, excessive coastal development, increase in herbivores like sea urchins, etc.) as well as the rise of sea temperature brought about by climate change. This causes destruction of spawning grounds and fisheries habitats, leading to decrease in marine resources and destruction of marine ecosystems. Eventually, barren ground cases have also started to appear in the South Sea and the Yellow Sea.

At the forefront of addressing barren ground in RO Korea is the Korea Fisheries Resources Agency (FIRA). Working with various agencies, FIRA introduced ocean reforestation projects to address barren ground, restore ecological ecosystem, and secure stable supply of marine resources. The Government of RO Korea designed a Medium- and Long-Term Strategy for Marine Forest Creation with the goal of restoring coastal areas affected by barren ground through marine reforestation that include seagrass and seaweed habitat restoration. From the first phase of 2009 to 2013, the restoration program targets to restore 24,258 ha of fishing villages, reaching 39,258 ha by 2020, and up to 54,000 ha by 2030 (**Table 2** and **Figure 4**). As of 2013, 3,334 ha of marine reforestation projects amounting to KRW 314.3 billion of investments have been completed.

Table 2. RO Korea's Medium- and Long-Term Strategy for Marine Forest Creation.

	Execution Period			
	2009-2014	**2015**	**2020**	**2030**
Creation area (accumulation)	5,709 ha	9,145 ha	24,258 ha	54,000 ha
Strategy	• Marine forest creation: Seek and explore useful marine plants. • Secure marine forest development site in advance (considering climate change). • Promote the Marine Gardening Day.	• Seek and explore marine plants that can adapt to high water temperature. • Explore and preserve natural marine forests. • Collaborate with environmental organizations. • Expand the scale of the event.	• Develop widespread, clear-water marine plants • Expand creation of low-cost high-efficient marine forests. • Marine Gardening Day	• Create ascidians and coral reefs marine forests. • Provide space such as experience areas in order to enhance the happiness of people. • Establish reforestation campaigns.

Marine Forest Project in Jeju Island, RO Korea by Eungyu-Han.

Figure 4. Marine Forest Development Map of RO Korea.

Five core technologies and approaches are currently being used by RO Korea for its marine forest creation projects: installation of artificial reefs for seaweed, submerged mooring ropes technique, spore pocket technique, transplant panel technique, and sea grass transplantation.

To ensure continuous awareness building on pressures being faced by coastal and marine ecosystems, as well as to promote creation of marine forests, the Government of RO Korea has legislated the Fisheries Resources Management Act in 2012, which took effect in 2013. This Act includes the establishment of Marine Gardening Day, which is now celebrated every 10th of May.

Parallel with marine reforestation efforts, RO Korea is also actively promoting marine ranching as a means to restore fish stocks. Included in the country's pilot marine ranching projects were Tongyeong, Yeosu, Uljin, Taean, and Jeju. Based on the assessment on the economic impact of artificial reefs, fishery seedling releases, and eco-tourism initiatives in marine ranching sites, there is an internal rate of return of 23.15% or a benefit cost ratio of 3.3. In terms of Capture Per Unit Effort (CPUE), data shows an increasing trend from 876 g/width in 2007 to 7,997 g/width in 2013 (**Figure 5**).

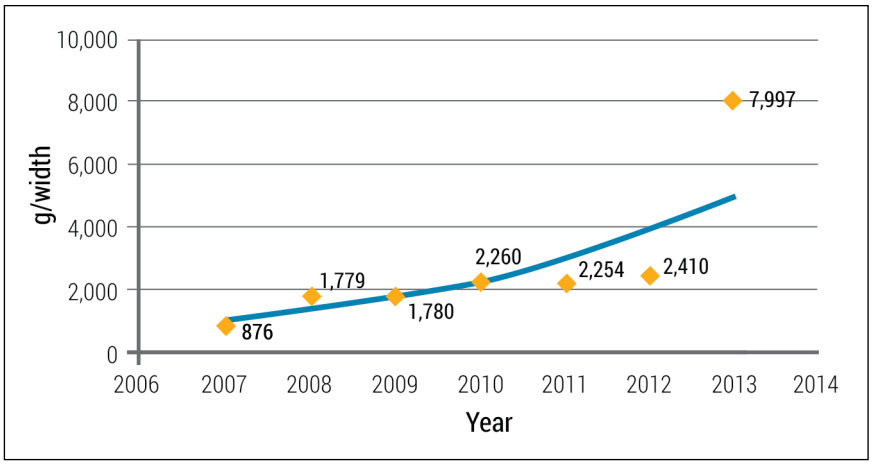


Figure 5. CPUE Trend in Marine Ranching Sites, 2006-2014.

The project in Jeju, in particular, highlighted the integration of marine ranching efforts with awareness and tourism initiatives, making Jeju an Eco-Experience Zone on marine ranching. This is in line with RO Korea's effort to consider the characteristics of coastal areas in developing marine ranches. Five key areas for marine ranching were identified in Jeju Island and under implementation from 2006 to 2022. (**Figure 6**). The project included installation of artificial reefs, natural rocks, release of fishery seeds, and conduct of effectiveness surveys. An ocean experience center and convenience facilities for divers have also been established as part of the project.

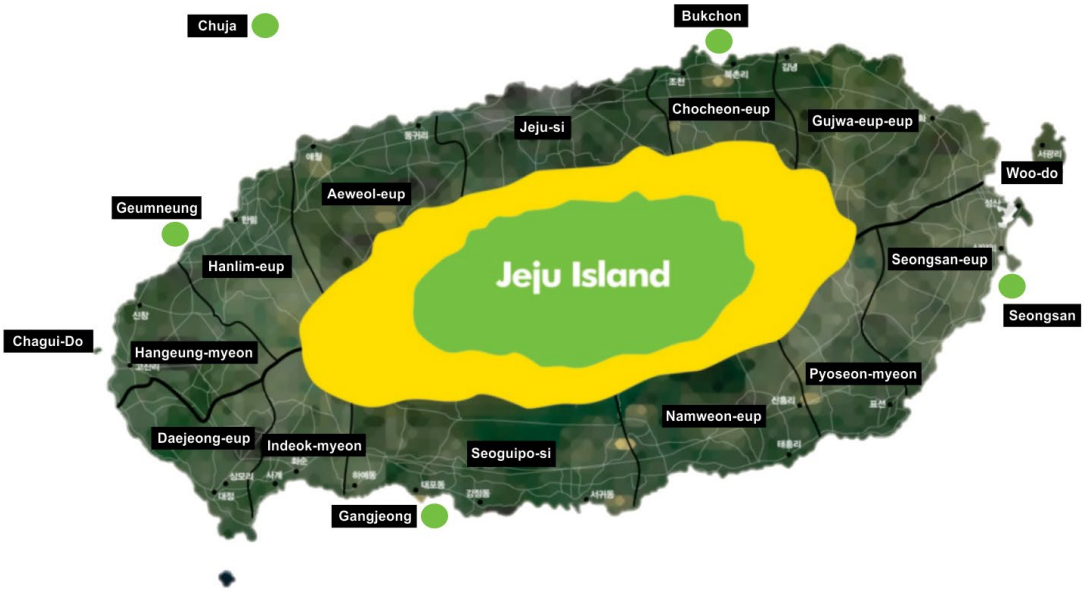


Figure 6. Five Key Areas to Implement Marine Ranching in Jeju Island, RO Korea.

Driving change from the national and regional level

Fishery resources obtained through marine fishing and marine aquaculture have become important sources of food and protein for human being. Also, fishing and consumption of fish is a way of life and a tradition for countries in the Yellow Sea. With the introduction of bottom trawl vessels in the early twentieth century, many stocks have been intensively exploited and some economically important species have declined in abundance, making the Yellow Sea one of the most exploited areas in the world. This was confirmed by the TDA developed in YSLME Phase I whereby two priority fisheries problems were identified: (1) Declines in landings of commercial fisheries, and (2) Unsustainable mariculture practices. To address these challenges, both PR China and RO Korea have undertaken a combination of fisheries management measures (fishing closures in area and in time, mesh size regulations, total allowable catch, vessel reduction, etc.) and innovative fish stock enhancement programs (marine ranching, artificial reefs, marine reforestation, fish fry release and IMTA).

Table 3. Conservation and Management Measures (CMMs) in PR China and RO Korea.

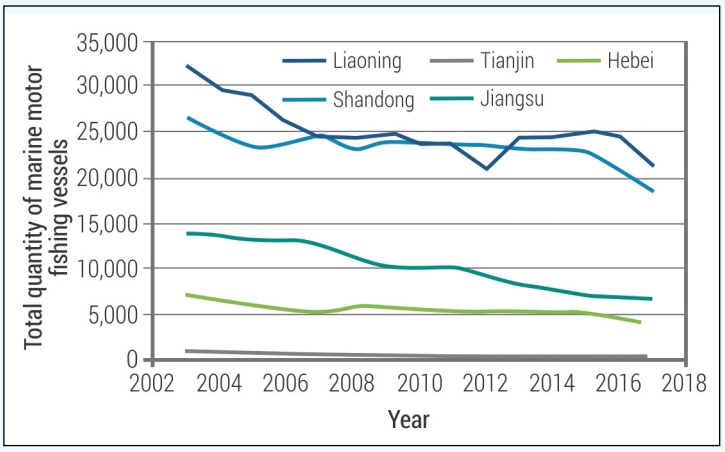
CMMs	PR China	RO Korea
Fishing vessel buy-back scheme	• At the beginning of 2003, 30,000 fishing boats (~2010), 20,000 fishing boats (~2020)	• Target under the Five-Year Plan for Reducing Fishing Vessels: 2,315 vessel reduction in Phase I (2014-2018), and 4,413 vessels reduction by 2023
Marine ranching	• Guidelines in stock enhancement and marine ranching issued by Ministry of Agriculture and Rural Affairs (MARA)	• Phase I (1998-2010) marine ranch pilot projects; Phase 2 (2005-2014) promotion of marine ranching through development projects; Phase 3 (2015-2030) participation of fishing professionals and private companies. Target of 50 marine ranches from 2006 to 2022.
Summer fishing moratorium	• Closed season/areas: 2 or 3 months closed fishing were issued from 1995 in Bohai Sea, Yellow Sea and East China Sea; 4-4.5 months since 2017	• Comprehensive no-fishing season for all fishery resources in effect from April 1 to October 31 in certain seas (Gunsan and Buan in Jeollabuk-do)
Mesh size control	• Limit of catchable size of 15 commercial fishery species and limit of their juveniles and young fish proportion in the total catch announced by MARA in 2018.	• Enforcement Decree of the Fisheries Act stipulates mesh size of fishing net that is prohibited by fishing type.
Control in tonnage and horsepower of fishing vessels	• Dual control program introduced in 2002 covering vessel buy-back program and reduction of engine power of individual vessels.	• 1982 Regulation limited fishing permits to control increasing fishing capacity due to increase in number, tonnage and horsepower of fishing vessels
Total allowable catch (TAC)	• TAC program started in 2017. Quota management of swimming crab and jellyfish since 2017 and expanded to 5 provinces (Liaoning, Shandong, Zhejiang, Fujian, and Guangdong) in 2018	• TAC system promoted based on scientific surveys and assessment of resources (12 target species in 2020)

Table 3. Conservation and Management Measures (CMMs) in PR China and RO Korea. (cont.)

CMMs	PR China	RO Korea
Control in harvest level	• Total catch in China coastal waters will be no more than 10 million tons in 2020	
Reduction in fisheries subsidies to fuels	• Issued in 2015, reduce by 60% of 2014 during 2015-2019	
Promotion of green aquaculture including IMTA	• 'Five Major Actions' for green and healthy aquaculture issued by MARA in 2020	• Development of IMTA Techniques for Fishery Tourism Using Fishing Ports from 2011 to 2013, and Development of Offshore-specific IMTA Techniques from 2014 to 2018.
Financial incentives to fishing vessel owners joining buy-back program	• Funds earmarked for buying back fishing vessels and supporting projects to employ and provide re-employment training to displaced fishermen	
Biodegradable gears		• Eco-friendly Fishing Gear Distribution Project implemented by the Ministry of Oceans and Fisheries (MOF) • Annual consumption of biodegradable gear is 600 tons.
Establishment of aquatic germplasm conservation zones	• National Marine Functional Zoning (2011-2020) authorized by State Council in 2012. 272 new national aquaculture germplasm resource protected areas built, making the total 492. By 2019, a total of 25 aquatic germplasm resources conservation zones have been designated, covering an area of over 14,000 km^2.	• 12 Fisheries Resource Protection Areas established

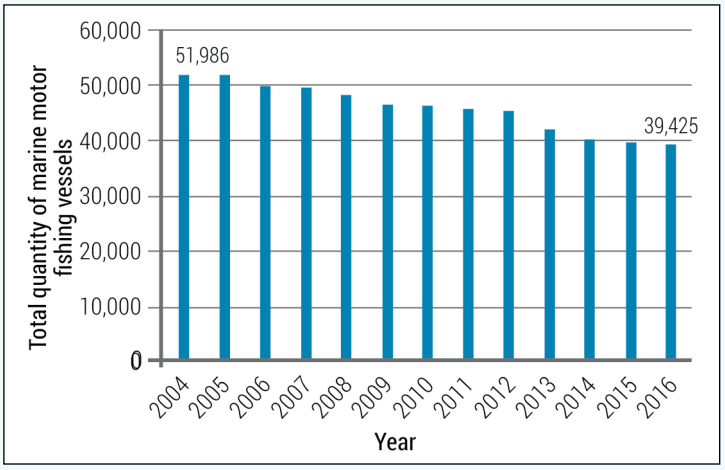
To secure the stability of fishery resources in the Yellow Sea, key fisheries regulations and development plans in both countries facilitated significant changes that are already being observed at the local level.

Guided by China's 13th Five-Year Plan (2015-2020), about 22% of fishing vessels has been reduced in the provinces of Liaoning, Shandong and Jiangsu in the Yellow Sea area in 2018 (**Figure 7**). RO Korea's 5-Year Plan on Reduction of Fishing Vessels, on the other hand, showed 17% reduction from 2011 to 2017 (**Figure 8**).



Source: YSLME, 2019.

Figure 7. Marine Motor Fishing Vessels in China, 2002-2018.



Source: D. Kim, 2019.

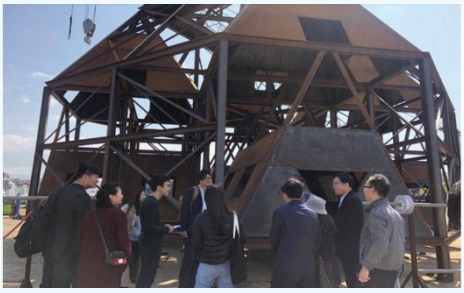
Figure 8. Marine Motor Fishing Vessels in RO Korea, 2004-2016.

Ensuring social safeguards in the reduction of fishing vessels was also integrated into the fishing vessel reduction program. In PR China, funds have been earmarked for buying back fishing vessels and supporting projects that would employ and provide re-employment training to displaced fishermen. MARA of PR China has also provided more frequent training and subsidies to displaced fishermen to participate in social insurance.

Application of TAC and seasonal fishing closures have been instrumental in the increase of 18.7% on CPUE from August 2016 to 2017 as found in the *YSLME Assessment Report on the Effectiveness of Closure in the Yellow Sea (YSFRI, 2019)*. The YSLME Phase II Project also facilitated the conduct of Korea-China Workshop on Stock Assessment in 2018.

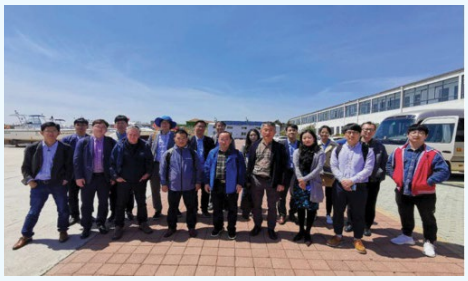
Re-employment Training of Fishermen Supported by YSLME Phase II Project. (Photo by Lei WANG)

Sharing knowledge and experiences on marine ranching efforts were also conducted through exchange visits in both countries, which was made possible with the assistance of Korea Marine Environment Management Corporation (KOEM), and FIRA of RO Korea and YSFRI of PR China. A key takeaway from the visits is the cost-effectiveness of marine ranching (5-6 times return of investment).



Chinese experts visited marine ranching sites in Jeju, RO Korea.

To date, three groups of national marine ranches have been piloted and supported by MARA of PR China with a total of 64 operations in Yellow Sea, East China Sea and South China Sea in 2017. While a total of 50 coastal marine ranch sites have been initiated in RO Korea since 2006 and are expected to be completed in 2022. Out of these 50 sites, 36 sites have been completed and are now in the post-management phase by local governments.



Korean experts visited Hailufeng, Qingdao, PR China.

Marine Ranching Activities in RO Korea

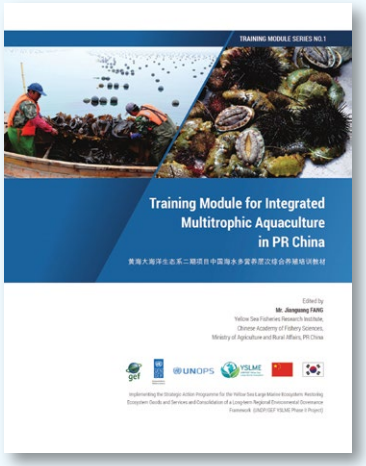
Formation of fishing grounds

Seed releasing

Marine experiment facilities

Habitat improvement and Post-management

The IMTA approach has shifted the paradigm on mariculture. To promote the application of IMTA, the YSLME Phase II Project supported the development of a training module as well as the conduct of IMTA trainings.



The successful demonstration of IMTA has gained recognition not only in the Yellow Sea region but also outside. This is evident from the Notification issued by MARA of PR China in March 2020 on implementation of 'Five Major Actions' for green and healthy aquaculture in 2020 in response to COVID-19 pandemic. The action

plan included IMTA as one of the nine ecological and healthy aquaculture technology models for demonstration and replication in the whole of PR China. A twinning between YSLME and Caribbean Regional Fishery Mechanism (CRFM) was also facilitated by IW:LEARN of IOC/UNESCO to transfer the IMTA knowledge in three Caribbean countries, signaling widespread recognition of YSLME as a source of knowledge and expertise in sustainable mariculture.

Through the Yellow Sea Grant Program (YSGP) supported by the YSLME Phase II Project, China Aquatic Products Processing and Marketing Association (CAPPMA) in collaboration with Qingdao Marine Conservation Society (QMCS), and Aquaculture Stewardship Council (ASC) launched the YSLME Responsible Mariculture Initiative (YSRMI) in 2019 to engage private sector in pursuing sustainable mariculture practices in the supply chain. A first batch of 31 enterprises joined the initiative and committed to put ecological safety and consumer health at the forefront of corporate development goals, to produce, process and sell aquatic products responsibly, and to contribute to maintaining the health of the YSLME, as well as to developing China's ecological civilization.

Launching of YSRM Initiative in Qingdao in 2019. (Photo by CAPPMA)


Participation of women in the bountiful harvest of kelp. (Photo by Dajun LIU)

Yellow Sea is a major stop-over site for waterbirds along the East Asian and Australasian Flyway. (Photo by Team Piersma of Global Flyway Network)

Promoting Biodiversity Conservation, Wetland Conservation and MPA Networking

Story of Change: Saving the Critically Endangered Spoon-billed Sandpipers

It is almost wintertime up north and millions of waterbirds have started to make their journey to their wintering grounds in Southeast Asia, Australia, New Zealand and the Pacific Island countries, along the East Asian-Australasian Flyway (EAAF). Amongst those traveling in flocks are the tiny shorebirds called Spoon-billed Sandpipers (*Calidris pygmaea*).

Measuring only 14-16 cm in length, these Spoon-billed Sandpipers embark annually on a journey that spans 8,000km from breeding sites in Russian Far East to the wintering sites in Southern China and Southeast Asia. To survive such a demanding flight, it is crucial for migratory birds to stop and refuel along the way.

"The location of the Yellow Sea is very important. This area is exactly in the middle of the East Asia – Australasia migratory bird flyway. More than 200 species, nearly 50 million waterbirds, migrate through this area. Some are wintering here, some are just stopping over, before flying to Southeast Asia, Australia, New Zealand and the Pacific island countries."

- **Guangchun LEI**
  Dean, Nature Reserve College,
  Beijing Forestry University,
  PR China

Coastal wetland of Tiaozini of Yancheng, Jiangsu Provice of China, a UNESCO World Natural Heritage site inscribed in 2019. (Photo by Dongming LI)

At the heart of the EAAF lie the world's biggest tidal flats of the Yellow Sea. Included here are the Tiaozini wetlands, one of the known critical habitats and staging areas for migratory birds, particularly the Spoon-billed Sandpipers. With combined efforts from conservationist groups, Yancheng government, and non-government entities, Tiaozini wetlands were designated as UNESCO World Heritage Site in July 2019. This was heralded as a victory on wetland protection as well as on initiatives to save the Spoon-billed Sandpipers. In the same year, an area of 12,746 ha in Tiaozini of Yancheng City was set as one of China's new city wetland park. Korean tidal flats, one of main habitats of the Spoon-billed Sandpipers, are also under the process of official evaluation to be inscribed as a UNESCO World Heritage Site.

Educational Tour on Spoon-billed Sandpiper for Young Students in PR China. (Photo by Jun FENG)

Globally, only 9 of the 22 breeding, staging and wintering sites hosting 1% of its population along the flyway are protected. A broader partnership and a network of flyway countries are needed to effectively save this critically endangered species.

In conserving Spoon-billed Sandpipers, non-profit organizations have played irreplaceable roles in conducting synchronized population census. In PR China, the Spoon-billed Sandpiper Conservation Alliance composed of partners from NGOs, private sector, protected area management groups, learning institutes, and government agencies have been promoting wetland conservation to enhance harmony, biodiversity and human well-being. The Alliance has conducted population census on Spoon-billed Sandpipers in wintering sites in China in 2019 and 2020 with the aim of contributing to the global census on Spoon-billed Sandpipers.

The Ministry of Ocean and fisheries (MOF) of RO Korea also has protected Yubu Island tidal flat of Seocheon County, a major habitat of the Spoon-billed Sandpiper, by designating them as a MPA. This area is also designated as a Flyway Network Site of the East Asian-Australasian Flyway Network (EAAFP). In addition, local government, research institutes and NGOs are jointly promoting monitoring, education and awareness programs and international cooperation projects. In particular, Seocheon County has signed an MOU with Birdlife International to carry out various conservation activities for migratory birds in this area.

Under YSLME Phase II Project, another critical stopover site for Spoon-billed Sandpiper, Xiaoyangkou mudflat of Rudong City of Jiangsu Province passed the review for inclusion as a national MPA. With support of Disney Conservation Fund, the local NGO Spoon-billed Sandpiper in China opened the first "Spoon-billed Sandpiper Nature Station" to educate kids about this little bird and the roles of people at the staging sites in safeguarding this flagship species as a perpetual friend. To date, a total of 9 Spoon-billed Sandpiper nature stations or classrooms have been installed in different primary schools in Rudong and Lianyungang City.

Spoon-billed Sandpiper in Xiaoyangkou of Rudong, Jiangsu Province, PR China.(Photo by Dongming LI)

Spotted Seals in Panjin of Liaodong Bay. (Photo by Jiguang TIAN)

Story of Change: Networking for the Benefit of the Spotted Seals

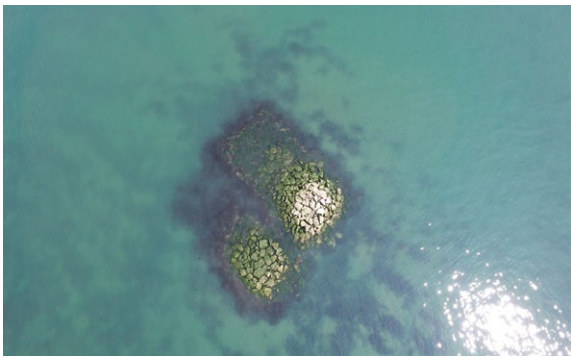
The Spotted Seal is considered as one of the top predators of marine ecosystem. This fascinating species has excellent mobility with a life span of more than 40 years. But even this top predator could not withstand the ecological changes and disturbances brought about by overfishing, increased marine transport use, and habitat destruction for industrial developments.

The Spotted Seal is one of the flagship species in the Yellow Sea. According to a 1940s survey conducted in Bohai Bay, PR China, about 8,000 Spotted Seals inhabited the area. However, its population in the Yellow Sea declined sharply with the pursuit of massive economic and industrial development in the region. Liaodong Bay and Yellow Sea pupulations are now under actual threat but are still considered as "Least Concerned" in the IUCN Red List.

Cooperation initiative in RO Korea

Baengnyong-do of RO Korea is one of the well-known island habitats of Spotted Seals. Between spring and autumn seasons, the Spotted Seals are often seen in various haul-out sites of Baengyong-do: Mulbeum-rock, Yeonbong-rock, and Dumujin. While no cases of Spotted Seal poaching were reported in the entire of RO Korea, the Spotted Seals have been threatened mostly by habitat disturbance, such as fishing activities.

Seals at the haul-out site in Baengneyong-do, RO Korea.



Artificial haul-out site for Spotted Seals.

Under the Law on Conservation and Management of Marine Ecosystems, the Spotted Seal is designated as Marine Protected Species in RO Korea. Protection measures including monitoring and management plans have been implemented for the species and its habitats. For example, Garorim Bay was designated as a MPA in 2016 to protect the habitat of the species by the MOF.

To monitor the Spotted Seals and understand their behavior, movement, environmental condition and challenges, the Cetacean Research Institute (CRI) of the National Institute of Fisheries Science (NIFS) of RO Korea has been conducting surveys on Spotted Seals in Baengnyong-do since 2006. In 2019, surveys were conducted on a monthly basis between April and November using ship-based and drone-assisted surveys. The August 2019 ship-based survey recorded 205 seals, while drone survey recorded additional 30% from the same haul-out site.

To support the development of a Management Plan, the CRI and the Marine Ecology Division of the MOF proposed the Korea-Russia Environmental Cooperation Agreement with Pacific Oceanological Institute (POI) of the Russian Academy of Science in 2016. In line with the agreement, satellite tracking tags of Spotted Seals were carried out. Information on Russian Spotted Seals (population size, breeding ecology, environmental pollution, illegal capture, etc.) will also be collected and applied to further research on the status of Spotted Seals in Baengnyeong-do. This bilateral initiative is expected to contribute in securing the Spotted Seal populations.

Networking through biophysical connectivity in the Yellow Sea

In August of 2017, the Ministry of Agriculture (now known as Ministry of Agriculture and Rural Affairs) of PR China launched the Spotted Seal Protection Action Plan (2017-2026) aiming to revive the populations of Spotted Seal in Liaodong Bay and Yellow Sea through scientific research, law enforcement, education and awareness raising, and MPA networking and international cooperation.

Recognizing the need to consider and use biophysical connectivity to design a network of MPAs, the YSLME Phase II Project facilitated the conduct of a training workshop in 2018 to

maximize the benefits and effectiveness of existing and future MPA expansion in partnership with National Marine Biodiversity Institute Korea (MABIK). In 2020, a YSLME MPA Networking workshop was conducted in Dalian, PR China to review the latest studies on migration and conservation status of the populations of Liaodong Bay/ Yellow Sea Spotted Seal. This was followed by a webinar workshop for the management plan for Spotted Seals.

> *"Spotted Seals are born in winter in Liaodong, China. From spring to autumn, it is the ecological character of these animals to inhabit the west coast of RO Korea. Because of this and in order to protect and preserve the seals, both countries need to work together."*
>
> - **Hyung Min LEE**
> Deputy Director,
> Marine Ecology Division,
> MOF, RO Korea

The First Institute of Oceanography (FIO) of the Ministry of Natural Resources (MNR) and Liaoning Ocean and Fisheries Research Institute of PR China benefited from the project's support to collaborate with the NIFS of the MOF of RO Korea on satellite tracking of Spotted Seal migration route and distribution patterns. The results of the study suggested that conservation efforts for the species through MPA networking are more effective if the migration route to the east of the Korean Peninsula could be protected as well. Collaboration with North East Asian Marine Protected Area Network (NEAMPAN) of UNESCAP and Coastal Ecosystem Regional Activity Center (CERAC) of Northwest Pacific Action Plan (NOWPAP) of UNEP is under way to enlarge the MPA network to entire distribution ranges for protection of Spotted Seal populations of Liaodong and Yellow Sea.

In support of "Building the Yellow Sea - Bohai Sea Spotted Seal Marine Conservation Area Network", China Biodiversity Conservation and Green Development Foundation (CBCGDF), through the YSGP, conducted promotional and educational activities in 22 Community Conservation Areas (CCAs) in more than 20 cities and provinces in PR China. Various information materials including the book "Spotted Seal on the Broken Ice" were developed and released in 2019 in four CCAs of Liaodong Bay and Yellow Sea.

Popular science activities for Spotted Seal protection. (Photo by CBCGDF)

Driving change from the national and regional level

The vast Yellow Sea has a high level of biodiversity, supporting substantial populations of fish, invertebrates, marine mammals, and waterbirds. The region has also been recognized as one with rich coastal wetlands, with the largest areal extent (~10,486 km^2) of tidal flats in the world that provides staging sites for over 50 million waterbirds in the EAAF. However, the YSLME TDA findings have shown that many of these resources are threatened by habitat loss, as well as land and sea-based sources of pollution resulting from reclamation and extensive economic development in the coastal zone, and by unsustainable exploitation of natural resources.

In order to maintain the ecosystem functions of the Yellow Sea, countries bordering the Yellow Sea have put in place key policies and plans (**Table 4**) and employed MPA approach to support efforts on coastal wetland protection and restoration, and conservation of critical habitats for rare and endangered species and other important coastal and marine organisms.

Table 4. Key Laws, Policies and Plans in Support of Coastal Protection.

PR CHINA	RO KOREA
• Ecological Redline Policy - use of spatial planning to safeguard ecologically important areas covering conservation spaces and natural reserves • 13th Five Year Plan of China (2016-2020) - 35% of the country's coastlines should be kept intact • 2021-2035 Plan - protect and restore national critical ecosystems	· Act on Conservation and Management of Marine Ecosystems · Act on the Sustainable Management and Restoration of Tidal Flats · Marine Environment Management Act · Marine Spatial Planning and Management Act · 2019-2028 2nd Master Plan for Conservation and Management of Marine Ecosystem · 2018-2022 3rd Master Plan for Wetland Conservation

Yellow Sea countries have imposed limitations on reclamation projects and initiated several wetland restoration initiatives. In PR China, the ecological redline policy has designated over 19,000 km^2 of coastal areas in Liaoning, Shandong and Jiangsu as Development Restricted Zones (DRZs) which disallow construction activities or Development Prohibited Zones (DPZs) where construction is strictly controlled and reclamation is prohibited. In 2018, PR China put a moratorium on coastal reclamation in Yellow Sea and Bohai Sea. While in RO Korea, large-scale reclamations have been cancelled since 2002 but previously planned projects are still ongoing. As of 2018, 10 restoration projects have already been completed in RO Korea.

Since the early 1990s, MPA establishment in the Yellow Sea region has also steadily increased. From 2009 to 2019, MPA areas in PR China and RO Korea including Marine Nature Reserves, Marine Special Protected Areas and Aquatic Germplasm Resources Protected Areas at all levels in Yellow Sea have grown from 2,051,366 ha to 2,210,741 ha, covering 5.52% of the total areas of the Yellow Sea (**Figure 9**).

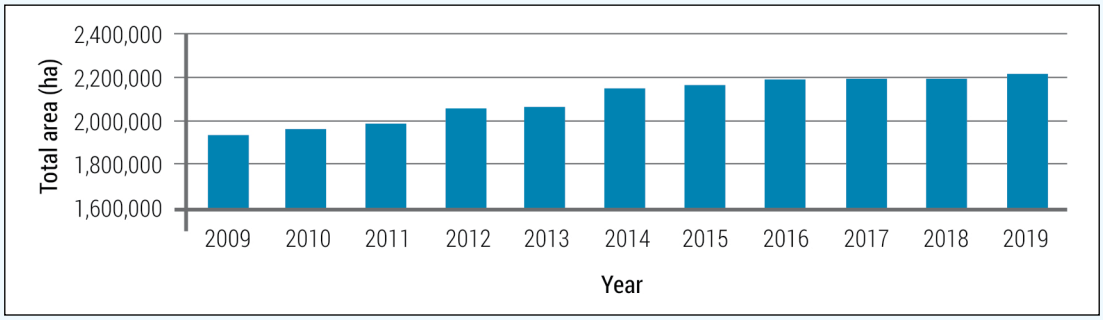
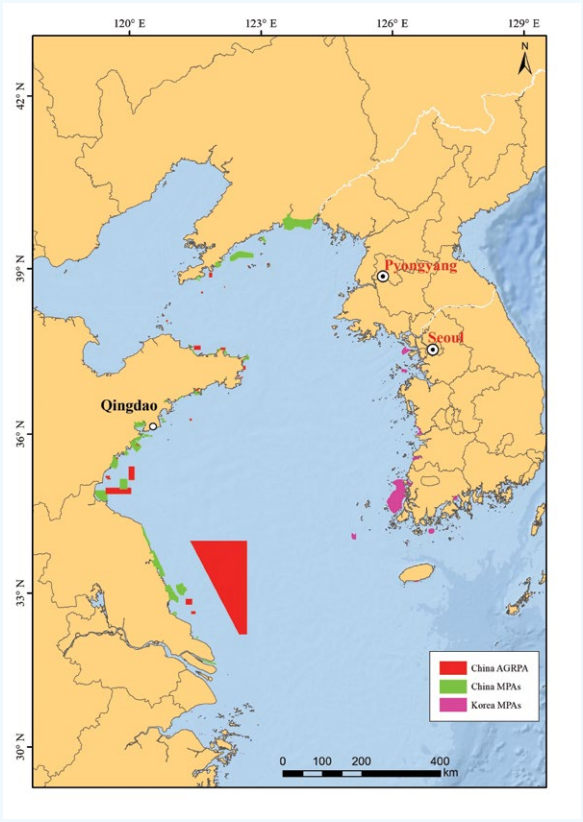
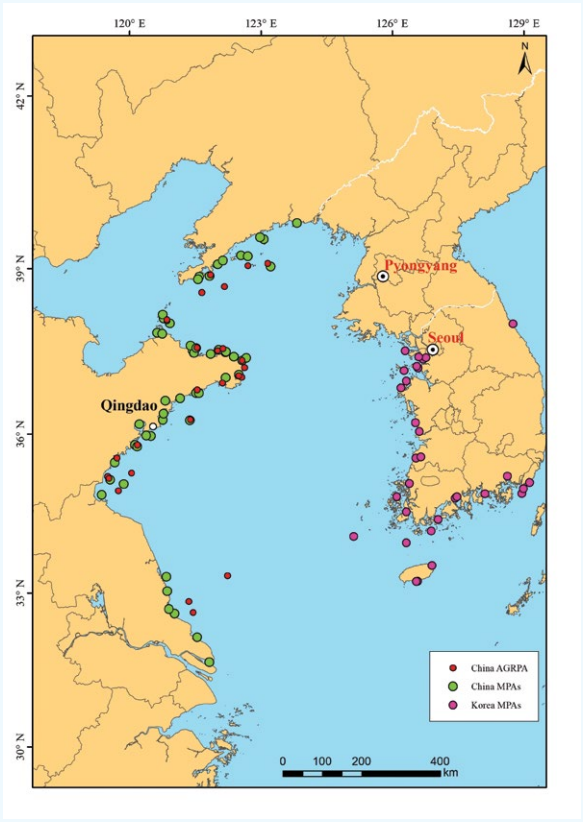


Figure 9. Trends of MPA in total areas from 2009 to 2019.



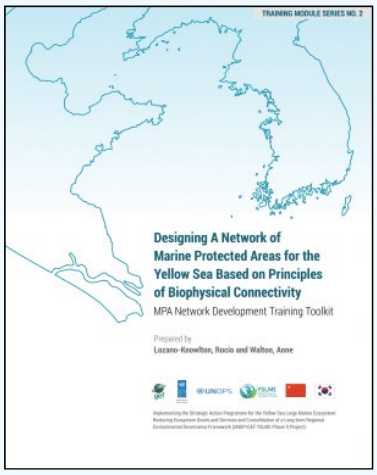


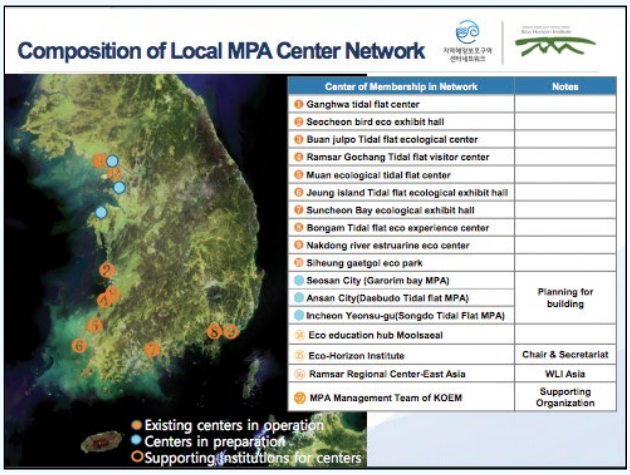
Data source: FIO/MNR of PR China and KOEM/MOF of RO Korea.

Figure 10. Aquatic Germplasm Resources Protected Areas (AGRPAs) and MPAs around Yellow Sea in PR China, and MPAs in RO Korea by size.

Figure 11. Aquatic Germplasm Resources Protected Areas (AGRPAs) and MPAs around Yellow Sea in PR China, and MPAs in RO Korea by number.

In support of the region's long-term target to establish a region-wide network of MPAs for the YSLME, significant building blocks have been put in place, including conduct of capacity and awareness building on MPA networking and spatial gaps analysis for migratory species. In RO Korea, efforts to establish a domestic and international network of MPAs are ongoing. The KOEM of RO Korea has been working to expand the domestic Tidal Flat Center Network more broadly to a Regional MPA Center Network. RO Korea is also targeting to further increase the local network of MPA centers for exhibition, public relations, education, information sharing, and operational sites for MPA management and cooperation.





Using the principles of ecological connectivity, five sites were identified as conservation spatial gaps in PR China and RO Korea for endangered waterbirds and their habitats, and spotted seals as shown in **Figure 12**.

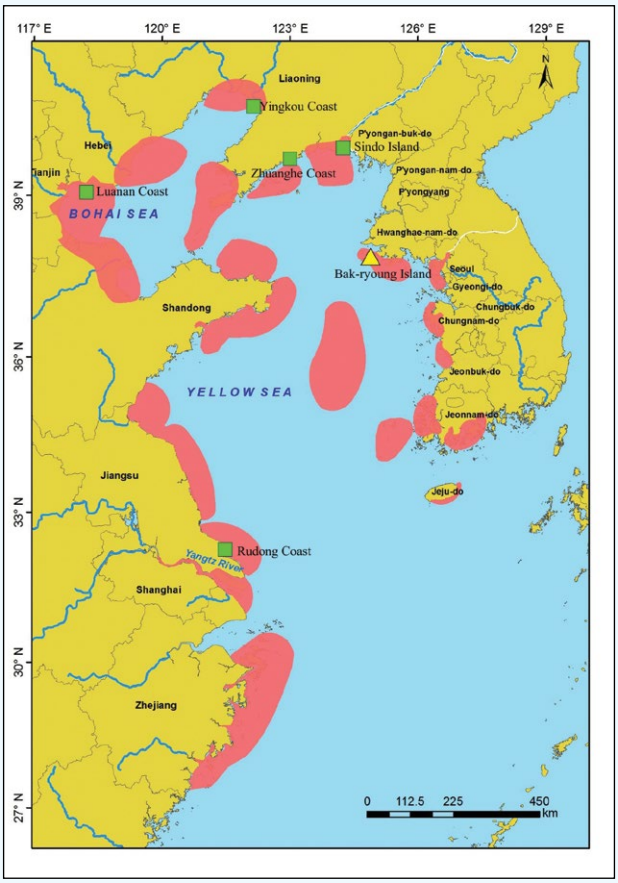


Figure 12. Spatial Gaps of Endangered Mammals and Waterbirds and their Habitats in YSLME.

A Regional YSLME Biodiversity Conservation Plan was also developed based on two separate reviews conducted in PR China and RO Korea. The Plan identified 15 priority actions including improving wetland biodiversity and MPA planning and management.

Microplastics at 1.5-1.6 mm. (Photo by Weiwei ZHANG)

Addressing Marine Litter including Microplastics

Story of Change: Partnerships between Local Fishing Community, Private Sector and Civic Groups to Recycle Wastes

"*We want to increase recycling efforts. Many scallop farms generate discarded nets that have nowhere to put them but into the sea. They are not reusable and they pollute the sea. We don't want that, but we don't know how to change it,* " said Ms. Wang Xiaoyan, a resident of Jinghai Community who participated the Inception Meeting of the Condominium Program of Fisheries Community (Waste Reduction) of Jinghai Community of Shandong Province held at the Ivy League International School in Weihai, PR China in May 2019.

Over the past years, Jinghai Community has slowly transformed from a rural village into an urban community composed of about 400 permanent residents. As a predominantly fishing community, mismanaged wastes coming from fishing activities as well as household became an increasing concern. Annually, more than 20 tons of fishery wastes, mainly composed of plastics, is being discharged to the village's tributaries and the sea. The key problems arise from: (a) improper discharge of fishery waste, (b) loopholes in the garbage collection system, (c) weak environmental awareness, (d) lack of access to environmental education, and (e) outdated ways of communication.

Following the successful joint signing of the Condominium Cooperation Agreement with community and fishermen representatives, the Blue Ribbon Ocean Conservation Association (BROCA) with the support from Huayi Social Work Center, Shandong University, Ivy League International School and two recycling enterprises proceeded to the implementation of the

Condominium Program through YSGP of the YSLME Phase II Project. The program focused on delivering four major goals: (1) establishment of an effective management system for marine litter; (2) raise public awareness on environmental protection; (3) foster community co-management; and (4) promote multilateral cooperation and exchanges between PR China and RO Korea.

Figure 13. Waste Reduction through Environmental Protection Facilities and Partnership with Recycling Enterprises.

In a short span of time, this demonstration project has already gained valuable results, contributing to the establishment of a sustainable development model of fishery community waste management and significant transformations including behavior change, public and private collaboration, and reduction in household and fishing wastes. Collection of household organic waste was done in collaboration with Shandong Weihai Mingliu Household Organic Waste Recycling Company. Disposal of about 4,000kg of kitchen wastes from 180 households (42% of households) was centralized in the facility donated by the company for production of fertilizers, biodiesels and feed additives. Recyclable solid wastes, on the other hand, were collected by Yueneng Recycling Enterprise from over 100 households. All these initiatives were combined with a series of awareness raising, outreach and educational programs in the village. Partnership with Korean and local NGOs such as Our Sea of East Asia Network (OSEAN) and Huayi Social Work Center, as well as Ivy League International School and Shandong University, and village leaders contributed to the establishment of a platform for public

participation and regional cooperation on marine conservation and education. The project also led to BROCA's signing of a Memorandum of Understanding with a Korean NGO, the Korea-China Economic and Cultural Exchange Center, to promote cooperation and communication on ecological protection, including sharing of expertise and experiences on marine litter management.

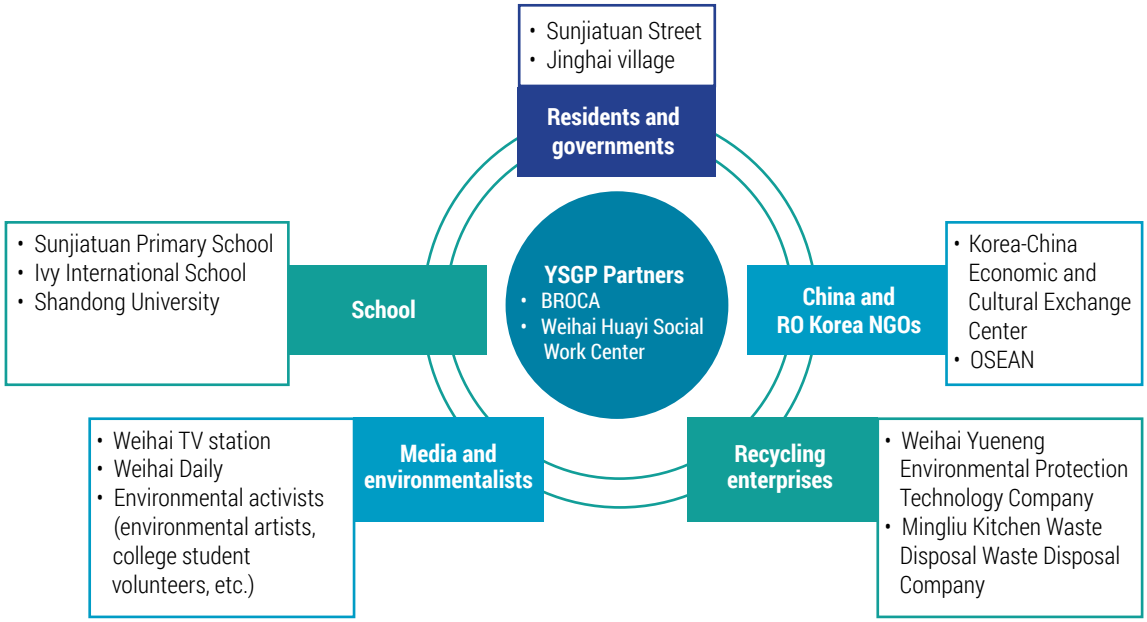
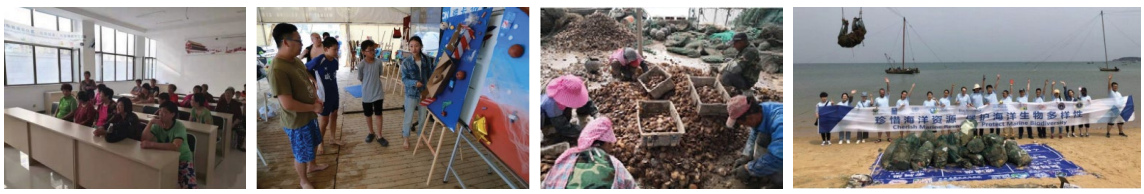


Figure 14. Cooperation on Ecological Protection and Marine Litter Management.



Jinghai Fishing Village participating in various activities under the Condominium Program on Waste Reduction. (Photo by BROCA)

Unveiling of Kitchen Waste Recycling Station. (Photo by BROCA)

MOU signing between BROCA and the Korea-China Economic and Cultural Exchange Center. (Photo by BROCA)

Story of Change: Shifting the Paradigm on Marine Litter Management at the Local Level

For Chungcheongnam-do, or Chungnam Province of RO Korea, to combat marine litter there should be a clear framework guided by a common vision. In 2015, the provincial government of Chungnam established its Comprehensive Measures for Clean Marine Environment with two major goals: to minimize marine litter through prevention and integrated management, and to establish a prompt and systematic marine litter response system (**Figure 15**).

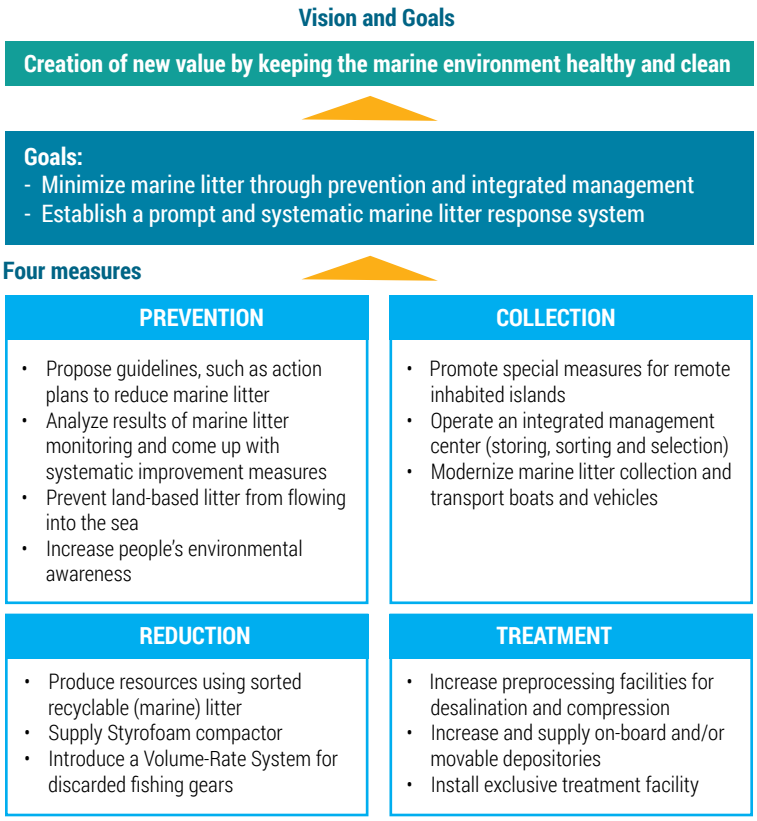


Figure 15. Comprehensive Measures for Marine Litter in Chungnam Province.

With the growing issues on marine plastic litter, compounded by the impacts of climate change, Chungnam has been one of the key local governments in RO Korea that advocated for the eventual shifting of the paradigm from post-management of marine litter to prevention and constant management. In line with this, the province has put in place integrated measures and strategy focusing on Prevention, Collection, Reduction, and Treatment to address coastal, fishery, sea floor deposited, and island litters (**Figure 16**).

Annually, Chungnam Province invests an average of KRW4.5 billion (roughly US$ 3.8 million) in litter collection and treatment, and collects 9,000 tons of marine litter, making it the second largest to invest on marine litter management in RO Korea. Since 2018, the province has been undertaking marine litter monitoring six times per year in 60 locations along its coast. Monitoring locations are designated every 10 km and precise investigation is carried out in every 100m-long sections of every location. From 2015 to 2018, marine litter collection in Chungnam has steadily increased.

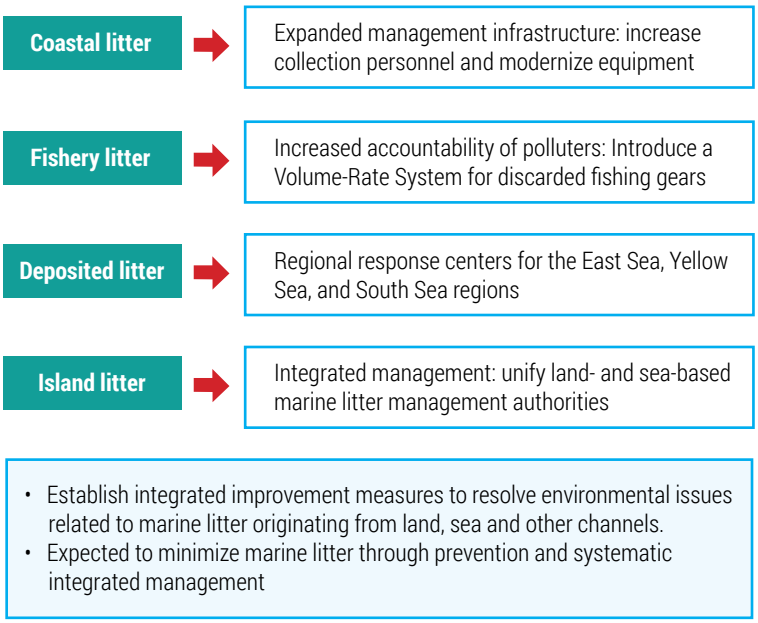


Figure 16. Chungnam Province's Promotional Strategy for Marine Litter Management.

Chungnam Province believes that local government-led response is crucial to address this transboundary concern, highlighting that local measures are able to integrate local considerations, at the same time contribute in realizing international commitments.

In 2018, the Chungnam Province and the Shandong Province of PR China signed an MOU agreeing to cooperate on reduction of marine litter in support of efforts to promote clean beaches as well as sustainable marine leisure and tourism. This milestone agreement highlighted the increasing roles of local governments in addressing marine litter. The partnership is also an expression of support to the building of a Clean Beach City Alliance in the coastal cities of Yellow Sea, which is envisioned to serve as a platform for cooperation among community stakeholders (business, academe, and local NGOs) and to catalyze result-oriented and whole-society approach in addressing marine litter.

Kyo-sik LEE, Marine Policy Division of Chungcheongnam-do of RO Korea and Qingchun JIANG of Ocean Administration of Shandong Province of PR China signed an agreement on December 13, 2018 to promote cooperation and exchange in strengthening marine environment protection and sustainable use of marine resources.

Driving change from the national and regional level

Marine litter is now one of the biggest challenges faced globally and Yellow Sea is no exception. In particular, the proliferation of plastics to coastal and marine environments has become the number one concern on marine litter, with at least 8 million tonnes of plastics ending up in the ocean every year. Should current global plastic production continue at 270 million tonnes per year, there would be more plastic in the ocean than fish (by weight) by year 2050. Recent studies have also shown the emerging challenges of microplastics (fragmented plastics or fibers smaller than 5mm in size) and its potential effects at different biological levels ranging from subcellular to ecosystems.

To address the problem, it is crucial to understand its causes, pathways and impacts. In the YSLME, PR China and RO Korea have put in place their National Marine Debris Monitoring Programs in 2007 and 2008, respectively. Since then, regular monitoring has been carried out to provide key information on status and trends.

Overall, marine litter in the Yellow Sea is found to be largely composed of plastics (60-80% from land-based activities and 20-40% from sea-based activities). More researches are being conducted in both countries to collectively provide a better understanding of the availability, distribution and magnitude of marine litter and microplastics in the Yellow Sea.

These monitoring activities are in line with the countries' policy frameworks on marine pollution management (**Table 5**) and are part of larger national marine litter management programs. In PR China, programs to reduce marine litter include: the Implementation Plan of Domestic Waste Classification System in 2008; the "Green Fence" program in 2010; control and management of plastic waste, etc. While in RO Korea, some notable programs include: the Basic Plan for Marine Litter Management; replacement of expanded polystyrene (EPS) buoys with eco-friendly buoys; installation of marine litter barges at sea ports; compensation for recovered discarded fishing gears; and establishment of Marine Litter Management Center (MALI) and Marine Litter Information System in 2011.


YSLME INFORMATION SERIES

PLASTIC AND MICROPLASTICS: UNDERSTANDING AND MANAGING MARINE LITTER IN THE YELLOW SEA

FOOTNOTE: A more detailed **Information Sheet on Marine Litter and Microplastics in YSLME** is accessible via the YSLME website (**www.yslmep.org**)

Table 5. Legal and Policy Framework Related to Marine Pollution Management.

PR CHINA	RO KOREA
• Marine Environment Protection Law 1999, 2013, 2016 and 2017 (with key provisions on Pollution Prevention and Control) • Law on the Prevention and Control of Environmental Pollution by Solid Waste (1996) • Regulation on the Prevention and Control of Pollution by Land-based Pollutants (1990) • Regulation on Control over Dumping of Wastes in the Ocean • Regulation on the Prevention and Control of Vessel-induced Pollution to the Marine Environment • 13th Five-Year Plan of Ecological Environment (by MEE) • 13th Five-Year Plan for Marine Economy Development (by NDRC and SOA) • Nearshore Coastal Pollution and Prevention Plan/Programme	• Marine Environment Management Act (2008) • The 4th Marine Environment Comprehensive Plan (2011-2020) (2010) • Act on Conservation and Utilization of the Marine Environment (2017) • Conservation and Management of Marine Ecosystems Act (2019) • The 3rd National Marine Litter Management Plan (2019-2023) (2018) • Ballast Water Management Act (2017) • 1st Master Plan on Marine Spatial Management for 2019-2028 (2019) • Special Act on Improvement of Air Quality in Port Areas (2020) • Act on the Promotion of Saving and Recycling of Resources (2017) • Framework Act on Resources Circulation (2018) • The 1st National Resources Circulation Plan (2018-2027)

Marine Litter Initiatives in RO Korea. (Photo by KOEM)

With the imposition of these policies and programs, monitoring data from the baseline surveys completed under the YSLME Phase II Project have shown a decreasing trend on marine litter in PR China and RO Korea (**Figures 17** and **18**)

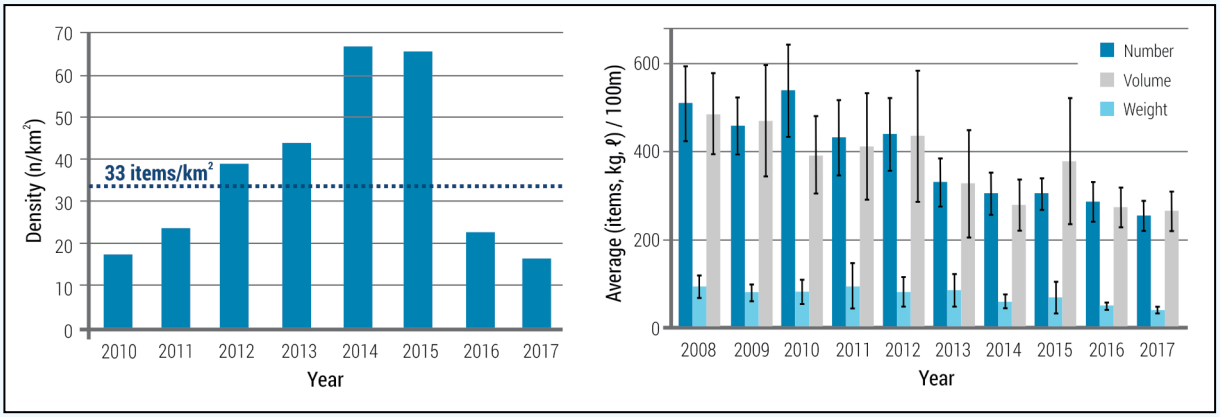


Figure 17. Floating macro (>10cm) and meso (<10cm) litter in surface water of Yellow Sea of PR China from 2010 to 2018. (Zhang, 2019)

Figure 18. Temporal distribution trend of macro litter from 2008 to 2017 in RO Korea. (Hong *et al*., 2018)

The reduction of marine litter in the sea is a result of application of some good practices in both countries, including integrated management of plastic in PR China, and implementation of zero ocean plastic campaign, implementation of comprehensive marine litter reduction plan, and collection of EPS buoys in RO Korea.

Integrated management of plastic waste in PR China

An inter-ministerial coordination mechanism was set up in PR China to address plastic waste from its life cycle. The mechanism is led by the National Development and Reform Commission (NDRC) with membership from industry and information, ecology and environment, housing and urban development, agriculture and rural affairs, commerce, culture and tourism, market supervision, national asset management, post office, supply and sales administration, etc.
The life cycle management approach involves: 1) management and control of production and strengthened law enforcement on illegal production; 2) regulating circulation and monitoring; 3) promoting green supply chain and responsible consumption; 4) development of biodegradable alternatives; 5) implementing classification and recycling mechanisms; and 6) establishing and improving waste collection system in rural and urban areas.

Good practices from RO Korea

(1) Campaign for Zero Marine Plastic
RO Korean Government announced 2019 as 'The first year of the new era of Zero Marine Plastic' and it has pushed forward multiple public awareness campaigns as well as cross-sectoral clean-up activities such as the '2019 International Coastal Clean-up Ceremony' where more than 1,000 people participated from corporations, NGOs and schools.

(2) Comprehensive Plan on Marine Litter Reduction (2019)
'Comprehensive Plan on Marine Litter Reduction' developed in May 2019 to reduce marine plastic litter by half by 2030 through life-cycle management system of marine plastic litter. The

plan will be implemented through close cooperation between MOF, the Ministry of Environment (MOE), and the Ministry of Food and Drug Safety (MFDS).

(3) Establishment of Collection System for Fragmented EPS Buoys

Abandoned EPS buoys in the seas are thought to be a major sea-based source of marine plastic litter, as they easily break into little pieces over time. MOF established EPS Buoys Collection System which provides buoy collection sites to local communities where fishermen can dispose EPS buoys they no longer use.

Regional Collaboration on Marine Litter and Microplastics Monitoring

In addressing microplastics in the Yellow Sea, the YSLME Phase II Project completed a Training Module for Marine Microplastics Monitoring. The module was used for the conduct of training for monitoring personnel and officers in Shandong, Liaoning and Jiangsu Province of PR China in July 2019. Following the training, Jiangsu Provincial Marine Environment Monitoring Center purchased monitoring instruments and designated staff to initiate the monitoring of microplastics in the province. Knowledge exchanges were also facilitated in both countries. In particular, a group of experts from National Marine Environment Monitoring Center (NMEMC) of PR China visited the laboratories of Korea Institute of Ocean Science and Technology (KIOST) and KOEM to exchange experiences on microplastics monitoring. NMEMC and KIOST further led the convening of the Workshop on Marine Litter and Microplastics during the 3rd YSLME Science Conference held in Qingdao, PR China in July 2019.

Workshop on Marine Litter and Microplastics in the YSLME held during the 3rd YSLME Science Conference in Qingdao, PR China. (Photo by YSLME PMO)

It is recognized that marine litter and microplastics will remain as major concerns in the Yellow Sea in the coming years. The initial baseline surveys on marine litter and microplastics in the Yellow Sea region would be useful in developing more systematic researches on the origin, flux into the sea, transmission path and ecological impact of marine litter and microplastics in the region in the coming years.

Critically endangered Chinese Crested Tern (Thalasseus bernsteini) was rediscovered in Qingdao in 2019 and 2020 after last sighting in 1937. (Photo by Tao YU)

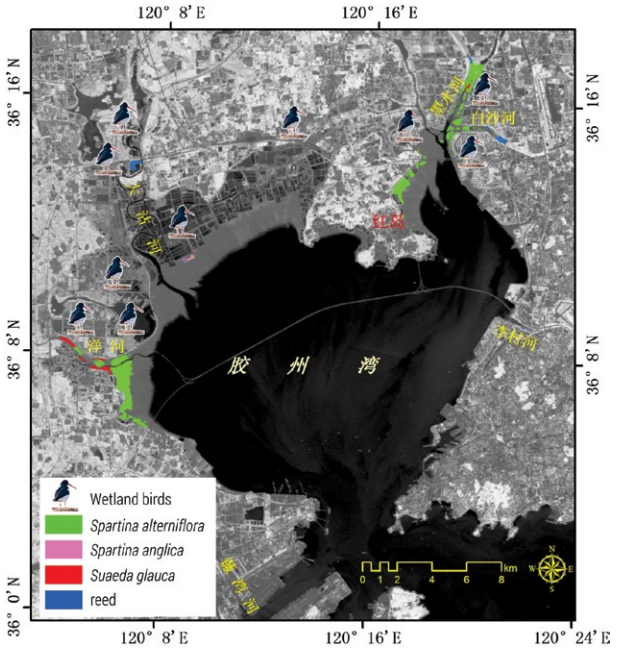
Reducing Nutrients through Investment, Policy Reforms and Nature-based Solutions

Nutrient pollution comes from various sources, either naturally or in majority of cases a result of human activities. Nutrient pollution occurs when there is an excess of nutrients, mainly nitrogen and phosphorus, introduced or discharged to water bodies.

Story of Change: Saving Jiaozhou Bay through Wetland Reconstruction

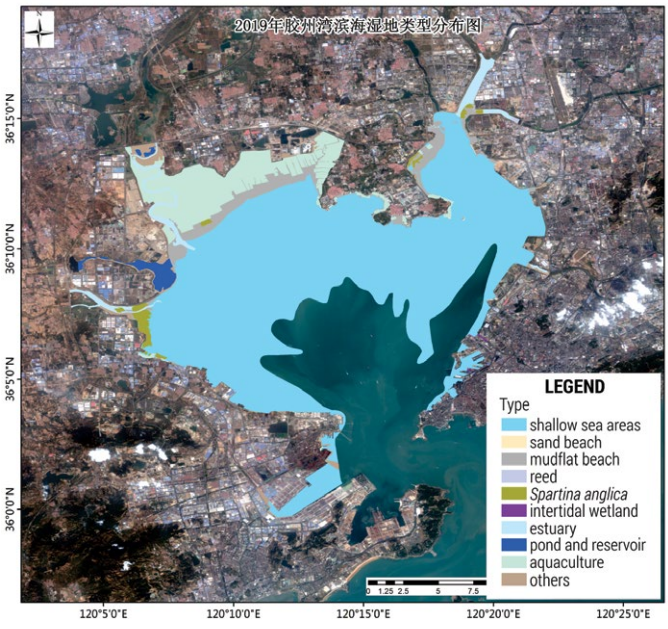
Bordering the west coast of the Yellow Sea is a semi-enclosed and highly productive natural bay—the Jiaozhou Bay. It is known as the largest wetland ecosystem in the southern part of Shandong Peninsula (260 km^2 of total area), serving as an excellent area for mariculture, a spawning, feeding and nursery ground for various economic species, an important stopover site for migratory birds along the EAAF, and a key cultural tourism resource.

But in the past few decades, this precious bay has been subjected to several pressures in view of rapid development in the area. Its natural shoreline was invaded, tidal influx was reduced, fishery resources declined, areas of wetlands were reduced, and remaining wetland functions were degraded. The key cause of the problem was the land-based sewage coming from tributary rivers that led to serious pollution in the northern part of Jiaozhou Bay.



Source: NCSEMC

Figure 19. Distribution diagram of wetland birds in Jiaozhou Bay.



Source: NCSEMC

Figure 20. Distribution map of wetland types in Jiaozhou bay in 2019.

This signaled an alarm, prompting the government of Qingdao Municipality to take the following actions:

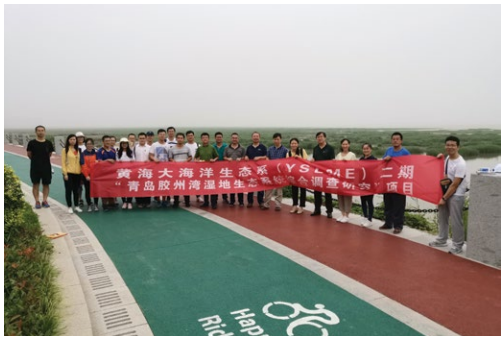
(1) Demarcation of protection control line to prohibit reclamation and protect natural coastline and wetland (2012);
(2) Regulation for Jiaozhou Bay Protection (2014);
(3) Approval of Jiaozhou Bay National Marine Park (2016);
(4) Jiaozhou Bay Conservation and Utilization Plan integrating marine functional zoning, land use, environmental protection, exploration and utilization (2017); and
(5) Implementation of Bay Chief System to hold local executives accountable to environmental quality of bays.

The YSLME Phase II Project demonstrated an integrated assessment of the wetland ecosystem of Jiaozhou Bay. The indicators of monitoring range from birds, vegetation, rare species and their habitat to water quality, sediment quality, marine organisms, intertidal organisms, etc. This collaborative monitoring was carried out by different agencies and civic organizations led by North China Sea Environment Monitoring Center (NCSEMC) with participation of Ocean University of China (OUC), Qingdao Agricultural University (QAU), Qingdao Birdwatching Association, Qingdao Shipowner's Association, and FIO. The integrated monitoring of wetland in Jiaozhou Bay shows diverse wetland vegetation types, and increasing use of the areas by migratory birds as staging sites, and improved water quality in the bay area.

Three Chinese Crested Terns (*Thalasseus bernsteini*) were sighted in Dagukou estuary to Jiaozhiu Bay of Qingdao on September 14, 2020 during the field visit of the terminal evaluation mission

of the YSLME Phase II Project. This was the second observation of species in Qingdao, with last sighting in 2019. This species has not been sighted in this area since 1937 and is now critically endangered with 50 individuals remaining in the wild. Apparently, the wetland restoration around Jiaozhou Bay, gradual disappearance of aquaculture, designation of the bay as an marine park, and improvements in water quality through implementation of Bay Chief System largely account for the return of the species.

Calidris alpina wintering in Dagu estuary beach. (Photo by Xiaoqi ZENG)



Ecological investigation and practice activities of Jiaozhou Bay wetland. (Photo by Zhuonan SUN)

Survey of birds in Jiaozhou Bay wetlands. (Photo by Xiaoqi ZENG)

A Sargassum farm near Chaolian Island. (Photo by Han HAN & Zhe WANG)

Spartina alterniflora in Hongdao mudflat. (Photo by Guangbo REN)

Story of Change: Controlling Coastal Pollution through Total Pollution Load Management System

Economic planning and industrial developments in RO Korea have undergone various phases since the early 1950s: Import Substitution Phase; Labor-Intensive and Light Industry Export-led Phase; Heavy and Chemical Industry Export-led Phase; and Technology-Intensive Industrialization Phase. These developments, however, have impacted key areas. In particular, wastewater from heavy and chemical industries, and sewage from coastal cities resulted in heavy stress on adjacent marine ecosystems on the southeastern coast of RO Korea. As a consequence, most of the coastal waters in the Masan Bay, Gwangyang Bay, Busan and Ulsan, were designated as "Special Management Areas for Controlling Coastal Pollution" in 1982 under the Marine Pollution Prevention Act.

Separate from the MOE's total water pollution load management system, MOF of RO Korea has implemented a total pollution load management (TPLM) system for these special management areas. The TPLM was implemented in Masan Bay, Shiwa Lake, Busan coastal area, Ulsan coastal area in 2008, 2013, 2015 and 2018, respectively, while Gwangyang Bay was designated as special management area in 2019, the TPLM system has not been implemented. (**Table 6**)

Table 6. Total Pollution Load Management in Special Management Areas in RO Korea.

Special management areas	Period of total pollution load management	Pollutants
Masan Bay	• Second Total Pollution Load Management Period(2012-2016) • Third Total Pollution Load Management Period (2017-2021)	COD and TP
Sihwa Lake-Incheon coastal area (TPLM system is implemented only in Sihwa Lake)	• First Total Pollution Load Management Period (2013-2017) • Second Total Pollution Load Management Period(2018-2022)	COD and TP
Busan coastal area	• First Total Pollution Load Management Period (2015-2019)	COD
Ulsan coastal area	• First Total Pollution Load Management Period (2018-2022)	Copper, zinc, and mercury
Gwangyang Bay (TPLM system not implemented)		COD and TP

The TPLM system manages the discharge of pollutants into the target waters within the total allowable pollution load and target areas that are highly contaminated or at high risk of becoming contaminated (including areas on land that directly affect marine pollution). As a result of the application of this system, the water quality (COD level) in the areas for YSLME project under management improved, showing a decrease of COD by 49% in Sihwa Lake. (**Figure 21**).

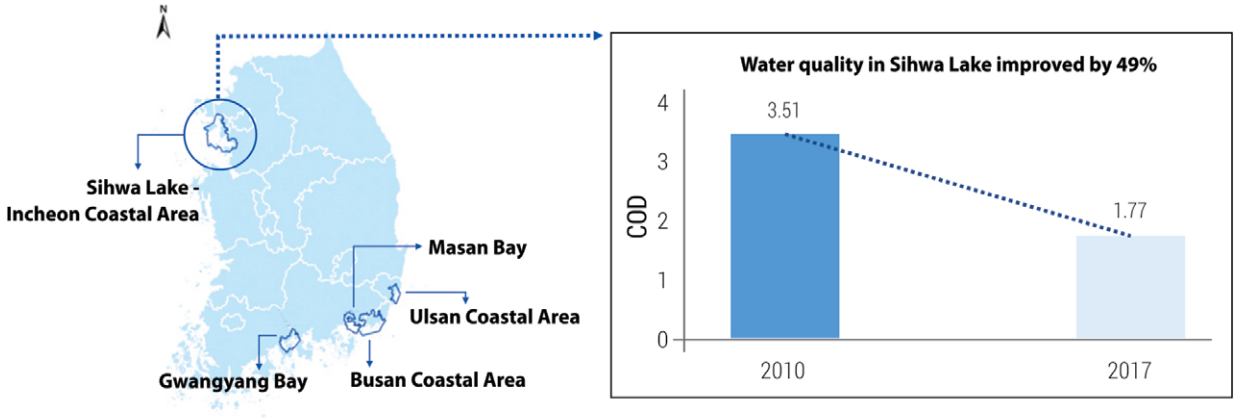


Figure 21. Improvement in Water Quality in Special Management Area for YSLME project (Sihwa Lake).(MOF, Korean Marine Environment Survey Yearbook, 2019)

Driving change from the national and regional level

In the Yellow Sea, the primary cause of increased eutrophication is an increased supply of dissolved nitrogen through riverine and wastewater discharge (TDA 2007), sea-based sources such as mariculture, atmospheric deposition, and from fertilizer use and livestock (YSLME, 2019). The adverse effects associated with eutrophication are excessive algae blooms that severely deplete dissolved oxygen, decrease water transparency and give rise to high concentration of organic matter in surface waters. Such blooms can cause increased mortality of mariculture stocks, kills of wild fish thereby reducing fishery yields, and increased risks to seafood consumers through the incorporation of natural toxins into exploited marine organism, and losses to tourism revenues from landing of drifting macroalgaes such as *Sargassum* on beaches.

In line with objectives to reduce total nutrient loading, several plans were introduced in both PR China and RO Korea (**Table 7**).

Table 7. Notable National Plans, Programs and Laws Related to Nutrient Reduction.

PR CHINA	RO KOREA
• Chinese People's Congress (CPC) Central Committee and the State Council launched Water Pollution Control Action Plan (2015) • Action Plan for Soil Pollution Prevention and Control (2016) • In November, 2016, the General Office of the CPC Central Committee and the General Office of the State Council issued the Opinions on Full Implementation of River Chief System • Special Action Plan for Ship and Port Pollution Prevention and Control (2015-2020)	• Marine Environment Management Act (2008) • National Action Plan for Management of Land-based Sources of Pollutants (2013) • The 4th Marine Environment Comprehensive Plan (2011-2020) • Act on Conservation and Utilization of the Marine Environment (2017) • Water Environment Conservation Act (2018) • Water Quality and Aquatic Ecosystem Conservation Act (2016) • The 5th National Environment Comprehensive Plan (2020-2040)

The primary point sources of nutrients into the Yellow Sea from both PR China and RO Korea are industrial wastewater and municipal sewage. The emphasis of control has been placed on the regulation of heavy-polluting enterprises and the promotion of cleaner production. By the end of 2019, the sewage treatment rates in cities and counties will reach 95% and 85% respectively in PR China. Since 2012, RO Korea has installed 173 wastewater treatment facilities in the major river basins, and the sewage treatment rates in cities and rural areas in 2018 were 96% and 72% respectively.

Non-point sources of pollution to the Yellow Sea consist primarily of atmospheric deposition and release of pollutants from agriculture. In terms of atmospheric deposition, China's revised law on Prevention and Control of Atmospheric Pollution in 2018 has helped improve atmospheric quality in 2019, resulting to: ultra-low emission of coal generating units of about 810 million KW or accounts for about 80% of total installed capacity of coal-fired power plants; proportion of excellent days in 338 cities was 79.3% (an increase of 1.3% over the same period from previous year); and PM2.5 concentration was 39 mg/m^3, down by 9.3% from the same period the previous year.

Agricultural run-off is the primary non-point source of pollution to the Yellow Sea. PR China has a high application rate of fertilizers (22 kg/acre), far in excess of the world average (8 kg/acre), due to farmers' lack of knowledge in proper use of fertilizers. The strategy for China is to control the annual growth rate in the use of fertilizer over the period from 2015 to 2020, with the objective of zero growth by 2020.

As for overall seawater quality along coasts of PR China, the areas polluted in the Yellow Sea have been fluctuating between 2001 and 2018 (**Figure 22**). In 2018, the average areas of seawater that had not reached the 1st grade of seawater quality standard was about 26,090 km^2, with the most polluted areas at 1,980 km^2.

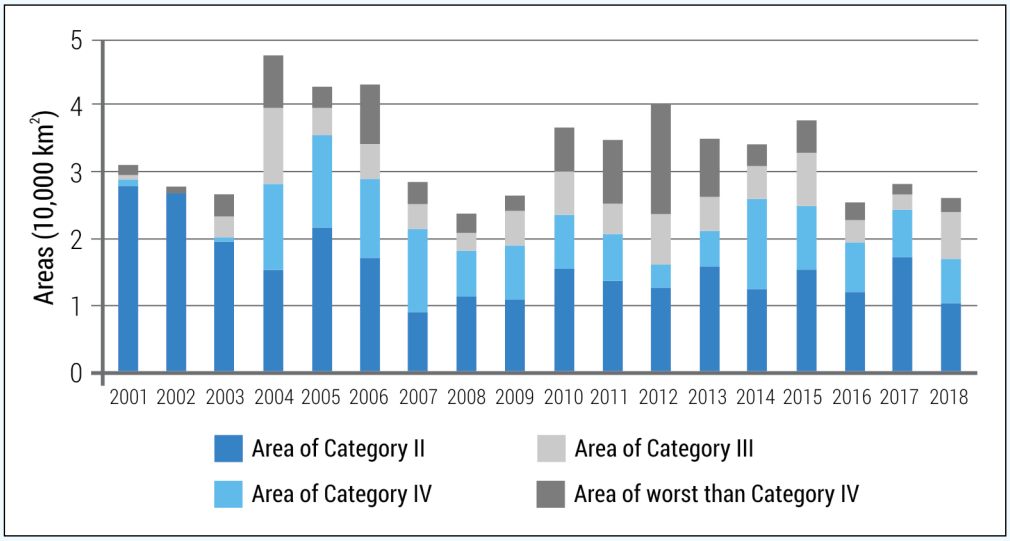


Figure 22. Annual Change of Seawater Quality in the Yellow Sea (2001-2018).

The approach in RO Korea for managing non-point sources has been to establish total water pollutant load system for river basins. The technologies in use include vegetated swales or buffer strips, wetlands, infiltration trenches, ecological ponds, and detention facilities. Through application of the system, the water quality improved by 9% to 34% in three monitored locations.

At the national level, the YSLME Phase II Project supported the conduct of various studies to enable better understanding of nutrient status and trends:

- Report on Marine Environmental Status and Trends of the Yellow Sea focusing on seawater quality, sources and spatial distribution of pollutants in the Yellow Sea area of PR China
- Land-based Nutrient Loading in Haizhou Bay
- Assessment of Pollution from Mariculture and Ship-based Pollution in the Yellow Sea in PR China
- Review Report on the Regional Strategy for Using Wetland as Nutrient Sink
- Monitoring and Data Acquisition for Sharing on Fertilizer Use in the Yellow Sea Coastal Provinces of PR China
- Estimation of Land-Based Pollution Loads to the Yellow Sea from the Han River Watershed (2018)
- Estimations of Fertilizer Application Rates in South Korea and Nutrient Loads to the Yellow Sea (2019)

The studies indicate that both PR China and RO Korea have implemented various programs, plans and investments to mitigate the discharge of pollutants to the Yellow Sea from land- and sea-based sources. In 2018, the level of pollution and areas of worst polluted sea were significantly reduced compared to five year ago. For the levels to be maintained within the carrying capacity of the YSLME with reduction in sea areas classified under eutrophication, better understanding of the atmospheric deposition, reduction of fertilizer use, adoption of nature-based solutions to absorb nutrients from agriculture are needed, along with implementation of pollutant emission control measures in mariculture, and scaling up of environment-friendly mariculture technologies.

Studies conducted under the YSLME Phase II Project also proposed some recommendations for inclusion in the future implementation of SAP 2021-2030: (1) extending the geographical range of watershed modelling and loading studies to other major river watersheds PR China, RO Korea, and DPR Korea; (2) establishing an inter-sectoral coordination system between the ocean and environment, agriculture and other ministries to manage land-based pollution sources more efficiently and effectively; (3) establishing a marine atmospheric monitoring network for the Yellow Sea; and (4) targeted regional assessment and solutions on nutrients from land-based sources, atmospheric deposition and maritime sources in the coastal waters of Yellow Sea.

Understanding Ecosystem Changes and Interlinkages with the Climate and Environmental Factors

In the TDA 2007, significant increase in the abundance of jellyfish and incidence of intense algal blooms was identified as key indicators of ecosystem changes in the Yellow Sea. In the updated TDA (TDA, 2020), new algal blooms caused by *Sargassum* have resulted in direct losses in tourism in RO Korea and mariculture in PR China.

This section will review the state of the art knowledge on Jellyfish and algal blooms and impacts of climate change and environmental factors to the changes in ecosystem structure.

Research and Management of Unabated Jellyfish Blooms

The occurrence of jellyfish blooms has been increasing in frequency and geographical range, impacting the maritime economy in many ways. The blooms cause huge economic damages in fisheries, affect coastal tourism, and even reduction in electric power production due to blocking of cooling water intake systems in nuclear and thermal power plants. At the ecosystem level, jellyfish blooms can alter the function of marine ecosystems and structure of marine food web that may induce "non-productive" or unsustainable marine ecosystems. This altered ecosystem may be vulnerable to global warming (regime shifts) and to marine pollution.

The IOCAS researcher was observing the movement of Aurelia coerulea medusae *in the sea. (Photo by Song FENG and Shiwei WANG)*

IOCAS Jellyfish Research Project

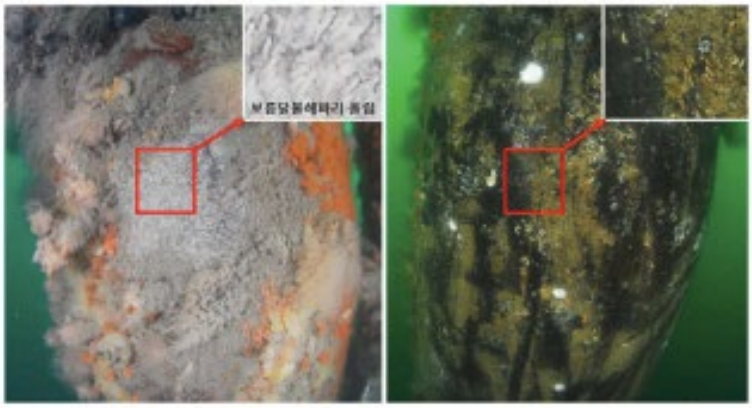
To monitor the jellyfish populations and to evaluate their impact on the Yellow Sea, PR China undertook the national basic research program on giant jellyfish blooms in Chinese seas from 2012 to 2015. From 2017, the second project was undertaken to understand the formation mechanism, monitoring, prediction and control technology of jellyfish disaster in offshore waters of China. The study conducted by the Institute of Oceanology, Chinese Academy of Sciences (IOCAS) found that sea surface temperature is positively correlated with jellyfish abundance from winter to summer, and sea surface temperature (SST) increase is significant at 95% level, and sea bottom temperature (SBT) at 99%. Furthermore,

the number of fish eggs and larvae is relatively small in the giant jellyfish concentrated area. Whereby, in the Yangtze River estuary areas where the giant jellyfish are rare, fish eggs and larvae are found to be abundant. The distribution of jellyfish is influenced by the distribution of zooplankton functional group. For example, small copepods and giant jellyfish *Nemopilema nomurai* show similar geographical distribution patterns. It reveals that small copepods provide food supply for *N. nomurai*.

Research and Management of Giant Jellyfish in RO Korea

In 2003, a population surge of the giant jellyfish *N. nomurai* occurred in RO Korean waters. Immediately following the jellyfish bloom, NIFS, KIOST and KOEM developed programs to determine the sources, and ecological and physiological characteristics of the bloom. NIFS and KOEM conducted polyp habitat mapping and KOEM has used underwater jet to remove polyps in line with the jellyfish management plan. In addition, NIFS has established a system for monitoring the weekly occurrence of *N. Nomurai* in water around the Korean Peninsula.

Underwater jet machine and its use in jellyfish polyp removal.



Polyps on mussel shell before (left) and after appliance of underwater jet. Boxes indicate A. aurita's polyps (left) and removed by underwater jet (right).

NIFS and KOEM carried out projects, beginning in 2017 and 2018 respectively, to monitor the occurrence of jellyfish in the Yellow Sea using **ships of opportunity**. Similar methodologies were also used by NMEMC of PR China. Three MOUs were signed to exchange data and experts, to hold annual workshop, and to develop cooperative countermeasure plans, one among NIFS, East China Sea Fisheries Research Institute of Chinese Academy of Fishery Sciences, and Japan Fisheries Research and Education Agency in 2006, another between KOEM and IOCAS in 2014, and the other between NIFS and Liaoning Fisheries Science Research Institute of PR China in 2015.

These projects were able to identify the temporal and spatial distribution of *N. nomurai* in the central and northern Yellow Sea, Jeju Strait, Korea Strait, and eastern Bohai Sea and Bohai Strait. New technologies have also been applied for monitoring of jellyfish, such as: underwater photography, sonar imaging and aerial image. PR China has also set up monitoring and early warning system in three pilot sites or typical jellyfish bloom areas: Qingdao, Qinhuangdao and Xiamen. In Qingdao, for instance after the moon jellyfish bloom in 2012, no further jellyfish bloom was observed. On the part of RO Korea, since 2006 over 1,120 jellyfish blooms have already been monitored by NIFS. Data gathered in both countries have been useful to establish policies and related measures for identifying the characteristics of jellyfish, predicting their movement, and preventing damages to fisheries.

Monitoring *Ulva* Outbreaks in Western Yellow Sea Coasts

Several weeks before the 29th Summer Olympic Sailing Games in Qingdao, PR China in 2008, organizers were caught by the sudden spread of green tide caused by *Ulva* that carpeted 600km^2 of Qingdao's coast. The thick algal bloom persisted for more than two weeks and required over 10,000 people to remove one million tons of algae in time for the Olympics. While these algae blooms do not pose health risks, the challenges and cost of maintaining clear waters are enormous.

Based on years of research of FIO, it was concluded that the *Ulva* bloom originated from the western coasts of southern Yellow Sea, drifting and growing northward in summer due to suitable temperature, high concentration of nutrients and seasonal monsoon. Management measures are being taken each year to prevent the *Ulva* blooms. Outbreaks of green tide in the Qingdao coasts have become less frequent over the years (**Figure 23**). In early 2010s, the occurrence and areas of green algae were limited and small in scale. From 2015 on, green tide occured in Bohai Sea and the outbreaks of green tide remain widespread compounded by changing marine environments in the Yellow Sea.

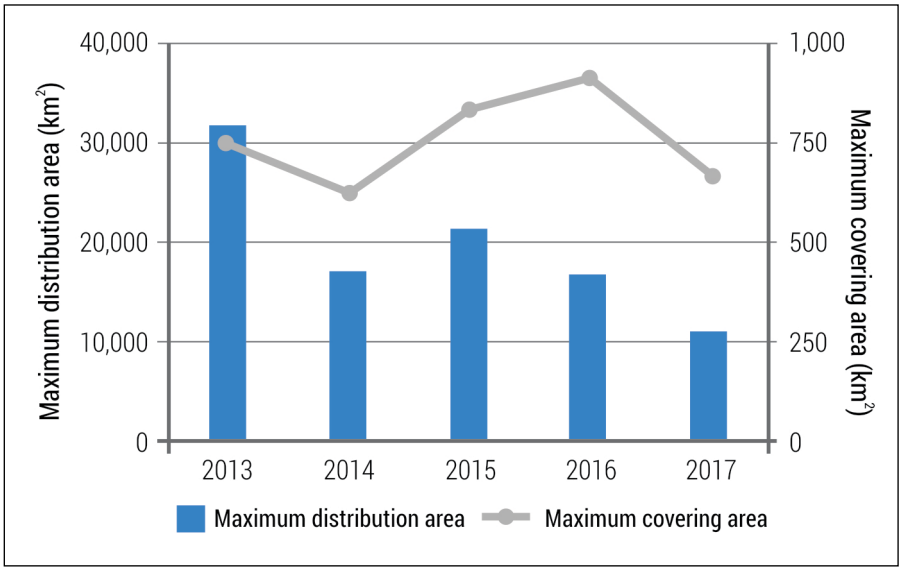


Figure 23. Maximum Distribution Area and Maximum Covering Area of Green Tide from 2013 to 2017 in Shandong Province, PR China.

Close monitoring and evaluating the occurrence of harmful algal blooms (HABs) in the Yellow Sea is one of the challenges in this region. In RO Korea, the NIFS has carried out HAB monitoring. Regular monitoring in the Yellow Sea coast has been conducted since 1997 under a project called, "Study on HABs Monitoring and Outbreak Mechanism". Through this project, the NIFS is able to evaluate ecosystem-based water quality and identify environment conditions under HABs and understand long-term variations of the fishing ground environment. For the HAB monitoring in the Yellow Sea, 9 surveys have been carried out at 82 stations until 2017. According to the results of this monitoring, the number of HAB occurrences in the Yellow Sea declined from 2014 and no red tide appeared in 2016 and 2017 (**Figure 24**).

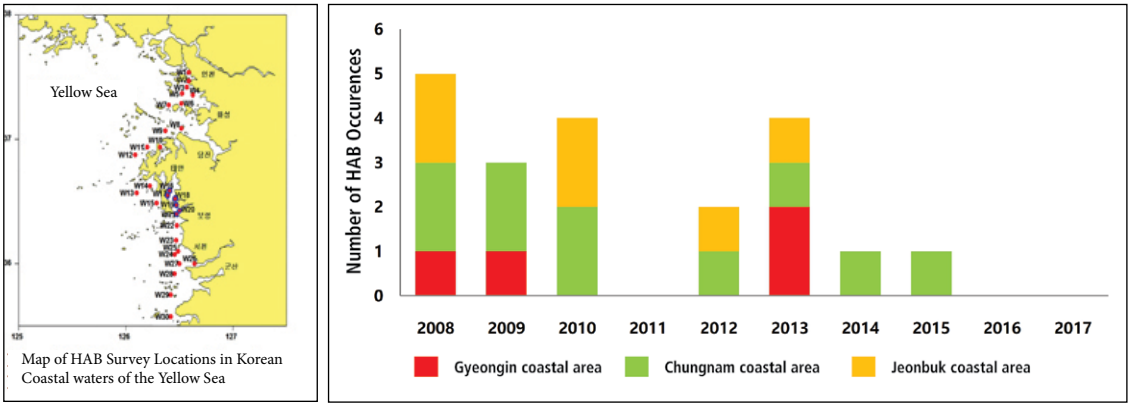


Figure 24. Map of HAB Survey Stations and Number of HAB Occurences in the Korean coastal waters in the Yellow Sea (2008-2017).

Tracking and Understanding *Sargassum* Blooms in Yellow Sea

In recent years, a new macroalgal bloom, rapidly expanding, has been detected through series of high-resolution satellite images and field surveys. The surveys found two distinct *Sargassum* blooms in the East China Sea (ECS) and in western Yellow Sea.

The winter bloom originated from the southeastern coast of Shandong Province, drifted southward and reached the southeastern coast of Jiangsu Province (including Subei Shoal) which resulted in significant damage to half of *Pyropia* aquaculture production in the area. (**Figure 25**)

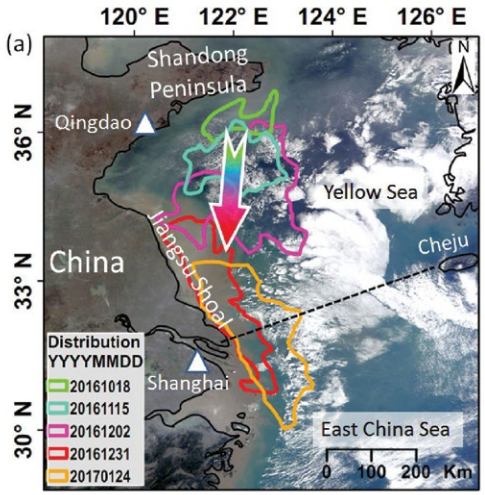


Figure 25. Southward Drifting of *Sargassum* from October 2016 to January 2017.

The spring bloom of the *Sargassum* was initiated along the coasts of Zhejiang Province, drifted offshore and northward, and intruded into the Yellow Sea. The biomass from both blooms contributed for the bi-macroalgal bloom in western Yellow Sea during the spring to summer of 2017. (**Figure 26**)

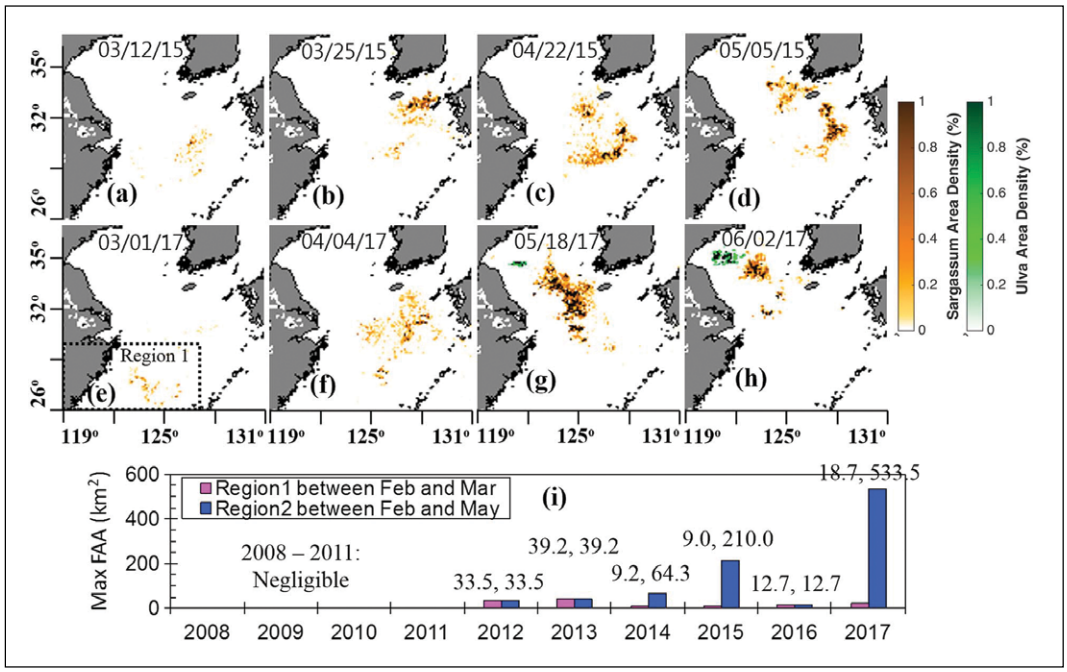


Figure 26. Northward Drifting of *Sargassum* in 2015 and 2017 (Qi *et al.*, 2017). Yellow to brown colors represent the floating *Sargassum*, while green color indicates the floating *Ulva*.

Through genetic screening, it was confirmed that the pelagic *Sargassum* biomass in the ECS and Yellow Sea comprised a single species *S. horneri*, and could be derived from multiple benthic populations. Four discrete benthic populations of *S. horneri* have been identified along the coasts of Liaoning, Shandong and Zhejiang provinces. The *S. horneri* seaweeds attached on the mussel aquaculture rafts along the coast of Gouqi island to the south of Yangtze River estuary contributed to the initial floating biomass in the ECS. Various environmental factors are also being considered to regulate or influence blooming dynamics, such as, seawater temperature, light availability, water circulation and nutrients. The progress reports from the YSLME Phase II Project, generated from the satellite remote sensing, provided important insights on various factors driving the *Sargassum* bloom occurrences in the Yellow Sea.

In general, floating *Sargassum* is considered to be a unique marine ecosystem that provides habitat for significant variety of marine species (Sissini, et al., 2017). Offshore *Sargassum* blooms also have the potential to provide floating conservation area for marine animals, with ecological and economic benefits. But the unusual drifting trajectory of *Sargassum* blooms signals an important change in the marine environment, requiring more studies (J. Zhang, et al., 2019). Apart from understanding the environmental drivers, as well as the genetic diversity and seasonal variability of *Sargassum* blooms, several researches have also begun using macroalgae as raw material that can be processed into high value products such as, food, fertilizer, and animal feed, etc.

Impacts of Climate Change and Environmental Factors to Ecosystem Structure in the Yellow Sea

Climate change has profound effects on ecosystems, either as a direct driver or through indirect mechanisms. China Sea Level Bulletin (2018) reports that from 1980 to 2018, the Sea Surface temperature (SST) of China's coastal waters increased by 0.23°C. Over the past 47 years (1968-2014), the SST of the Korean waters has risen by about 1.18°C (~0.25°C over the ten-year period) and it is expected to rise by 2-3°C in 2050 and 4-5°C in 2100.

Recent observation and modeling studies suggest that ecosystem changes attribute to climate change. According to research conducted in northern Yellow Sea, the plankton structure has greatly changed from 1959 to 2011. Some warm water species, such as *Sagitta enflata* and *Doliolum denticatum*, which were distributed in the southern Yellow Sea in 1959, are now distributed in the northern Yellow Sea and have become the dominant species (Zou et al. 2013). Under four climate change scenarios with varying assumptions on atmospheric CO_2 concentrations, the wintering anchovy stock showed a clearer northward trend, by as much as 2.7° latitudinal northward in the next 30 years. Rising SST is expected to widen the incubation and dead zone due to stratification in the sea, which poses risk of loss of indigenous life, including reduction of marine resource habitat, increased harmful algal blooms and the advantage of invasive/exotic species.

> *"Take our Working Group on Monitoring and Assessment as an example, through the joint cooperation of Chinese and Korean scientists, we have identified some of the major problems facing the YSLME. The two sides will work together to formulate strategies and make preparations to adapt to climate change."*
>
> - **Shouqiang WANG**
> The First Institute of Oceanography, Ministry of Natural Resources, PR China

The varying pressures in the Yellow Sea have been changing the sea's ecosystem. The warming of the sea is showing linkage to increased precipitation and acceleration of eutrophication in the Yellow Sea. Excessive discharge of nutrients to the sea contributes to changes in the ratio of nutrients which impacts on the marine ecosystem by triggering changes in the species composition and biomass of phytoplankton, zooplankton, and fish, as well as contributing to blooms of nuisance species, as evidenced from the unabated outbreaks of *Ulva* and *Sargassum*. In the causal chain analysis of the TDA 2020, it is confirmed that the root causes of changes in ecosystem structure include climate change and rapid development of coastal zones, etc.

Participants of the 3rd YSLME Science Conference held in Qingdao, PR China. (Photo by Dongming LI)

Strengthening Regional Ocean Governance: Multi-stakeholder Engagement and Partnerships

From Phase I to Phase II, YSLME has applied and demonstrated the effectiveness of partnerships through various facets (science and technology, capacity and awareness building, sustainable livelihoods and investments, communities of citizen science, local ocean governance, and regional cooperation) at various levels (local, national, regional and international). These partnerships were key to advancing the implementation of SAP and good governance of the YSLME.

> *"The challenge is large. The science, technology and management experience the two countries bring to the task is equally formidable. And it is in this spirit of meeting-the-challenge of ecosystem productivity and sustainability that NOAA is pleased and honored to support the YSLME project."*
>
> - **Kenneth SHERMAN**
> (NOAA Statement of Support at the Launch of YSLME Phase I Project)

Under the YSLME Phase I Project, a total of 118 meetings, workshops, conferences and training courses were conducted benefiting a total of 1,977 individuals. Under the second phase, a total of 1,845 individuals have benefited from 67 events including capacity building initiatives that were undertaken in partnership with various entities: 21 technical workshops; 17 Interim Commission Council (ICC) and Regional Working Groups (RWGs) meetings; 8 training courses; 6 study visits; as well as 15 public awareness initiatives. In total, activities from both phases have capacitated close to 4,000 individuals.

"Over the past 14 years, our achievements have benefitted from the recognition and support of Korean and Chinese experts and civil society for the preservation of the Yellow Sea. These efforts will bear friuts in the future. And the future generations will connntinue to promote the preservation of the Yellow Sea, so that a variety of marine organisms in the Yellow Sea can enjoy a healthy marine environment."

- **Hyung Won KIM**
  Deputy Director, Marine Environment Policy Division Ministry of Oceans and Fisheries RO Korea

Partnerships for Enhancing Use of Science and Innovative Technologies

Typically, the LME approach entails the TDA and SAP process where the former is primarily a scientific exercise while the latter include various negotiations. Under Phase I, two regional science conferences were convened in support of TDA and SAP. The 1st Regional Science Conference on Ecosystem Carrying Capacity of the Yellow Sea: Scientific Approaches for Marine Environment Management was organized in 2007. The Conference produced useful knowledge and information following the completion of the TDA, linking it to the preparation of the SAP. The 2nd Yellow Sea Regional Science Conference was convened in 2010 to summarize the knowledge and experience obtained through the project in application of science and ecosystem-based management. Since then, the YSLME Science Conference has become one of the innovative platforms of UNDP/GEF for cooperation and partnerships, as well as knowledge sharing in the region.

In July 2019, almost 200 stakeholders coming from government, non-government organizations, scientific and learning institutions, conservationist groups, business sector, regional and international agencies converged in Qingdao, PR China for the **3rd YSLME Science Conference**. It was heralded as one of the biggest convergence of stakeholders to share knowledge about YSLME, and experiences in addressing management and technological challenges while contributing to mapping the future course of the Yellow Sea region.

Prior to GEF/UNDP intervention in 2004, there was a lack of platform and a formal infrastructure to bring about international or regional collaboration and cooperation,

3rd YSLME Science Conference (Qingdao, July 2019)

- 3 Plenary Keynote presentations and 4 Parallel Events focusing on fisheries, biodiversity, marine litter including microplastics, and nutrient reduction
- Facilitated scientific exchange and collaborative research within the scientific communities bordering the YSLME, and gathered inputs for the updating of the TDA and SAP.

particularly in monitoring and research activities on YSLME-shared marine resource issues. The lack of a formal structure prevented the development of well-coordinated cooperative resource assessments, baseline studies and coordination in emergencies. Monitoring and research programs were not as effective as they should be because they stopped at governmental borders rather than at some ecosystem or natural boundary.

The partnerships with KOEM, NIFS, KIOST, MABIK and KMI of RO Korea and FIO, YSFRI, NMEMC, NCSEMC and IOCAS of PR China and other institutions in the two countries and in the region have greatly helped promote the science-based approach in SAP implementation through exchanges in scientific and technological advancement and management among academia, ocean managers, private sector and NGOs. The strong collaboration with academic and scientific institutions has enabled the completion of significant studies to better understand the status or condition of the Yellow Sea ecosystem. These studies or reports also provided good guidance to both national and local governments in designing response plans and actions related to HABs, jellyfish blooms, N/P/Si/ ratio and climate change impacts.

Through engagement of these scientific institutions, assessment of effectiveness of fishing closure, fishing vessel buy-back scheme, fishing license system, design of monitoring programs for jellyfish and HAB monitoring, assessment of conservation gaps to help save globally and regionally important ecological and biological areas were able to be conducted with results feeding into future sector strategic planning and investment.

Partnerships for Capacity Development and Awareness Building

Implementation of SAP management actions requires building and development of institutional and individual capacities, such as, in: (1) monitoring of marine litter and microplastics, (2) use of biophysical connectivity principles in building MPA networking, and (3) application of IMTA across mariculture businesses.

Students engaged in bird-watching as part of nature education organized by IGSNRR. (Photo by Xiubo YU)

The support of academic and scientific institutions, often together with civil society organizations (CSOs) and NGOs facilitated the conduct of various trainings or workshops, community learning activities, and advocacy work that led to building of awareness and capacities. Both in PR China and RO Korea, interesting innovative capacity building initiatives that utilize art, culture, and modern technologies accessible by the public have been introduced to widen information reach from youth to government officials.

Stakeholders from PR China, RO Korea, EAAFP, and YSLME discuss the criteria for MPA networking in a MABIK-facilitated workshop held in Seocheon, RO Korea. (Photo by Minsoo KIM)

YSLME Phase II Project facilitated a series of training, workshops and webinars to support the establishment of the YSLME MPA Network. (Photo by YSLME PMO)

As part of capacity and awareness building efforts, the following modules or toolkits were completed with the support of various entities:

(a) **Training Module for Marine Microplastics Monitoring** was completed with support from NMEMC of Ministry of Ecology and Environment (MEE) of PR China, and inputs from RO Korean experts through peer review.

(b) **Training Module for IMTA** was developed and applied with the support of YSFRI of PR China. Learnings on IMTA were shared in RO Korea as well as in other countries outside of YSLME.

(c) **MPA Network Development Training Toolkit** was put together with the help of MERITO Foundation, USA. MABIK of RO Korea facilitated the regional training workshop on designing a network of MPAs held in Seocheon, RO Korea in 2018.

Partnerships for Promoting Sustainable Livelihoods and Investments

As cited in the preceding sections, the introduction and implementation of alternative and innovative fish farming technologies (i.e., marine ranching or forestation) was made possible with the collaboration of private entities. Investments by private or business entities were integral in the operations of marine ranching sites in PR China. These initiatives are now providing alternative livelihoods for communities where they operate, as well as contributing to better and healthier management of marine ecosystems in the area.

Related to promotion of responsible mariculture, the launching of the YSLME Responsible Mariculture Initiative in collaboration with China Aquatic Products Processing and Marketing Alliance (CAPPMA), Aquaculture Stewardship Council (ASC) and Qingdao Marine Conservation Society (QMCS) in 2019 is one crucial development in engaging business groups in the responsible production, processing and selling of aquatic products.

As highlighted under the marine litter section of this report, support by private entities in waste collection and recycling have also been crucial not only in marine litter reduction, but most importantly in putting in place a working relationship with the communities in promoting good waste management.

Establishment of YSRMI and Voluntary Alliance. (Photo by CAPPMA)

Partnerships for Building Communities of Citizen Science

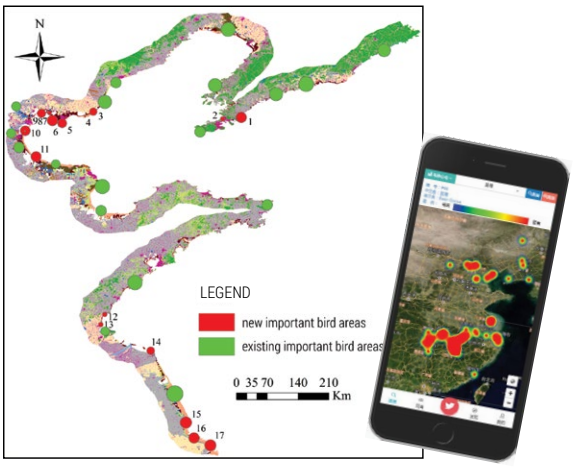
Through the YSGP, the YSLME Phase II Project was able to support eligible non-for-profit social welfare organizations, fisheries associations and societies, research institutes, colleges and universities in creating bigger impacts on the ground and in building communities of citizen science. Key facilitators of citizen science of the YSGP included: the Institute of Geographic Science and Natural Resource Research of the Chinese Academy of Sciences (IGSNRR/CAS), BROCA, Beijing Chaoyang District Yongxu Global Environmental Institute (GEI), and OSEAN of RO Korea.

These grantees of YSGP spearheaded the following:

- Survey of marine litter from fishery and mariculture in a fishery village by BROCA in partnership with local civic groups, and OSEAN of RO Korea as support to training on fishing debris and marine litter monitoring methods.
- Waterbirds census and development of birding APP were conducted by IGSNRR of CAS. The APP allows establishing an individual birding portfolio, species identification, search, and discovering of bird species in a specific location, etc.

As showcased in the earlier sections of this report, these local-based efforts have inspired change to a number of local communities and ushered in stronger public participation through monitoring (marine litter, Spoon-billed Sandpipers and other waterbirds), coastal clean up activities, educational or awareness campaigns, among various activities.

Oath-taking of volunteers of BROCA-University of Petroleum before conducting litter survey at Silver Beach of Huangdao District, Qingdao, PR China. (Photo by Yinfeng GUO)



The Birding App developed by IGSNRR allows to search for distribution of waterbirds based on the birding records of registrants. (Photo by Xiubo YU)

> *"We've come to the beach to use our hands to clean the marine litter, to use pencils and electronic balance to document the types and quantities of marine litter. We use scientific data to communicate the magnitude of pollution to the sea by human beings. Our mission is to safeguard the origins of life!"*
>
> - *Oath of volunteers of China Petroleum University, a Member of the BROCA Volunteer Initiative*

Partnerships for Enhancing Local Ocean Governance

Local governments who are the most impacted by issues related to overfishing and marine litter have been engaged and are now at the forefront in addressing such issues. The demonstration sites established for IMTA and marine litter management from household and fishery wastes have shown that good progress can be achieved if there is strong local government support.

With technical assistance from YSFRI, the Dongchu Island Fishery Cooperation constructed a training center on IMTA. The cooperation is a community-based enterprise specializing in aquaculture of kelp, abalone, scallop, sea urchin and sea cucumber.

The signing of an MOU between Chungcheongnam-do of RO Korea and Shandong Province of PR China in 2018, signified local commitment to cooperate on reduction of marine debris or maintenance of clean beaches and promotion of marine leisure and tourism. Weihai City of Shandong Province was also selected as a city to assess the marine litter situation and develop incentive policies to support investment in reducing marine litter at their sources.

Partnerships for Strengthening Regional Cooperation

Recognizing the value of knowledge and experience sharing with similar regional entities and LMEs, the YSLME Project also actively engaged with key regional entities within the North and East Asian Seas region, including the: NEAMPAN of UNESCAP, UNEP/NOWPAP, UNEP/GEF Refugia Project, Partnerships in Environmental Management for the Seas of East Asia (PEMSEA), and East Asia and Australasian Flyway Partnership (EAAFP).

Through participation in various project meetings, forums and conferences, YSLME was not only able to share its experiences and knowledge, but was able to gain new insights, best practices and approaches from these regional entities.

The NEAMPAN of UNESCAP and Yellow Sea Partnership share the same goal of building an effective, functional representative network of MPAs in YSLME and North-East Asia, particularly for the protection of Spotted Seals found in east of Korean Peninsula and the coastal areas of Russia. In 2017, the two partners jointly organized the Seminar on Marine Protected Areas in YSLME and North-East Asia in collaboration with KOEM and Ganghwa County government of RO Korea. Collaboration with NEAMPAN of UNESCAP would provide a chance to enlarge the MPA network to entire distribution ranges for protection of the threatened populations of Spotted Seals in Liaodong and Yellow Sea.

A joint effort of NEAMPAN of UNESCAP and YSLME Phase II Project to support networking of MPAs in YSLME and North-East Asia region. (Photo by Kyungsuk LEE)

Collaborative activities with NOWPAP contributed to better synergy of mutual efforts related to marine litter in the Yellow Sea. NOWPAP has also facilitated knowledge access for YSLME community to discourse of marine litter issues at the Trinational Meetings of Environment Management (TEMM) , as well as in expanding MPA network for the protection of Spotted Seals in the NOWPAP member countries.

In the case of PEMSEA, YSLME has served as a formal Non-Country Partner of PEMSEA's Partnership Council since 2008. As a Non-Country Partner, YSLME's initiatives in PR China and RO Korea are also contributing to the achievement of PEMSEA's Sustainable Development Strategy for the Seas of East Asia (SDS-SEA). Both parties benefited from participating in each other's knowledge and dialogue events. To further disseminate YSLME Project's knowledge materials, UNDP China Office and PEMSEA also entered into an agreement to link YSLME's publications and studies via the SEAKnowledgeBank that is being managed by PEMSEA.

The MPA connectivity efforts of the YSLME Phase II Project benefited from the generous support and partnership with EAAFP in the protection of the Spoon-billed Sandpipers. With the assistance of the EAAFP Science Unit, the YSLME Phase II Project was able to produce a one-minute video calling for protection of all the critical breeding, stop-over and wintering sites of the Spoon-billed Sandpipers along the EAAF in partnership with EcoHorizon Institute of RO Korea, the Spoon-billed Sandpiper in China, the Task Force of Spoon-billed Sandpiper, and the Spoon-billed Sandpiper Conservation Alliance hosted by the City of Yancheng, PR China.

Partnerships for Strengthening National Legal Framework

In close collaboration with Ocean University of China, YSFRI and FIO of PR China and Korea University, KMI and KIOST of RO Korea, activities and assessment related to ocean governance and alignment with international instruments were undertaken, including:

- Development of the Guidelines for Strengthening Yellow Sea Partnership (2017)
- Conduct of the International Seminar on the Law and Policy to Promote Regional Ocean Governance in the YSLME Region in Qingdao, China (2018)
- Development of Report on Implementation of CBD and RAMSAR with Recommendations for Integration of SDG14, CBD and RAMSAR Targets into YSLME SAP (2019)
- Development of Regional Guidelines for Responsible Fisheries in YSLME (2020)

As part of the commitment to improve national capacity and compliance to international/ regional legal frameworks in line with YSLME SAP, PR China also undertook an assessment and released its "Report on China's Legal Framework in Compliance with the International and Regional Legal Instruments for the Implementation of SAP" in 2018.

KEY PRIORITIES ON LEGAL REFORM IDENTIFIED IN PR CHINA'S ASSESSMENT

- Develop a cross-sector implementation mechanism
- Enhance legal system on risk assessment
- Establish regulations on prevention and control of marine debris
- Establish rules in building MPA network and selection of Marine National Park
- Upgrade laws on wetland protection
- Enhance rules on mariculture
- Strengthen laws on climate change adaptation
- Improve cooperation in developing laws, policies and guidelines with neighboring countries

At the international level, both PR China and RO Korea have committed to key instruments in support of sustainable ocean development, including the UN SDGs, Convention on Biological Diversity's Aichi Targets, RAMSAR Convention, IMO-related conventions on marine pollution, etc. **Table 8** provides an update of the status of participation in key international instruments related to sustainable ocean development by PR China and RO Korea based on a regional review conducted by PEMSEA in 2015.

Table 8. Key International Instruments Related to Sustainable Ocean Development Supported by YSLME Countries.

Ratification of International Conventions & Adoption of Instruments related to Coastal and Marine Environment

Country	UNCLOS 1982	UNFCCC 1992	Kyoto Protocol 1997	UNCBD 1992	Ramsar 1971	CITES 1973	World Heritage 1972
PRC	1996r	1993	2002	1993	1992	1981r	1985
ROK	1996r	1993	2002	1994	1997	1993a	1988

Country	Whaling 1946	Basel Convention 1989	UNCCD 1994	Rotterdam Convention	GPA on LBS 1995	Biosafety Protocol 2000	Stockholm Conv on POPs 2001
PRC	1980	1991	1997	2005	Y	2005	2004
ROK	1978	1994	1999	2003	Y	2007	2007

Country	Montreal Protocol 1987	Vienna Convention (Ozone Layer)	Treaty on Plant Genetic Resources	Fisheries Convention	Hyogo Framework for Actions	Nagoya Protocol	Mercury Convention
PRC	1991a	1989a		Y	2005Ad	2011s; 2013r	2013s, 2016r
ROK	1992a	1992a	2009a	Y	2005Ad	2011s	2014s, 2019r

Ratification of International Conventions Relating to IMO Conventions

Country	MARPOL 73/78					London Convention		COLREG Convention
	ANNEX					Convention	Protocol	
	I/II	III	IV	V	VI	72	96	72
PRC	83	94	06	88	06	85	06	80
ROK	84	96	04	96	06	93	09	77A

Country	Intervention		CLC			FUND		
	Convention	Protocol	Convention	Protocol	Protocol	Convention	Protocol	Protocol
	69	73	69	76	92	71	92	03
PRC	90	90	D	D	00	D	00	
ROK			D	93	98	D	98	10

Country	SUA		SOLAS			LL	Salvage	OPRC	HNS	
	Convention	Protocol	Convention	Protocol	Protocol	Protocol			Conv	Prot
PRC	92	92	80	83	00	00	96	98		
ROK	03	03	81	83	00	00		00		

Country	OPRC HNS	Bunker Oil	Anti-Fouling	Ballast Water	Nairobi WRC	Hongkong Convention	Ballast Water Management
	00	01	01	04 adoption	07		17 entry to force
PRC	10	09	11				18
ROK	08	09	08	09			09

Legend: r- ratification, a- accession, Ad- adoption, s- signature

Legal reforms in the areas of marine litter, wetland, environmental risk assessment, fisheries and climate change adaptation are needed in accordance to the assessment of legal compliance with international legal instruments. In partnership with YSFRI of Chinese Academy of Fishery Sciences, the Phase II Project acted upon the gaps on implementation of the FAO Code of Conduct for Responsible Fisheries (CCRF) through drafting of regional guidelines for responsible fisheries in YSLME; supporting the development of the national responsible fisheries certification standards; and preparing the criteria and regulation for assessment of performance of conservation areas for aquatic genetic resources in PR China. Activities were also undertaken to develop local capacity in implementation of the CCRF, including organization of trainings to fishermen displaced from fishing vessel reduction program, support to strengthen the management capacity of marine germplasm resources conservation areas, etc.

Given the relevance and transboundary nature of marine environmental issues, strengthening the implementation of international conventions and legal documents at the regional level will promote the development of regional marine environmental governance and the resolution of regional marine environmental issues. There is also a need to promote the formulation and adoption of technical standards, regional guidelines, or joint management plans within the framework of YSLME regional mechanism in fulfilling their respective responsibilities under international conventions and agreements collaboratively and effectively. Within the emerging areas where gaps exist, further efforts need to be taken to transform the obligations under international conventions through national legal processes.

Sunset in Asan Bay of RO Korea. (Photo by KOEM)

Onward To A New Decade

Over the course of 15 years, the YSLME region has gone through a number of challenges as well as successes. From then till now, the common aspiration of YSLME's littoral countries to save and restore the Yellow Sea as their shared heritage remains the key reason that drives and motivates this region to continuously move forward.

The YSLME journey has shown that interventions made through the implementation of the YSLME SAP 2009 have borne fruit on several aspects, including: reduction in fishing efforts measured by decrease in the number of fishing vessels and increase in body sizes of capture fisheries landings, successful scaling-up of IMTA, increase in number and expansion of marine protected areas, as well as successful application of science and ecosystem-based management in planning and programming, among others. The YSLME SAP has also proven to be a useful platform for aligning and contributing to bigger goals (i.e., SDGs, CBD, RAMSAR, etc.), as well as in enabling a wide range of innovative partnerships across governments, UN agencies, business associations, NGOs, and academia.

Building on the lessons, experiences, and scientific studies generated by the YSLME Project in the implementation of the YSLME SAP 2009 and as a result of collaborative work, the **YSLME Transboundary Diagnostic Analysis (TDA) 2020** was completed in July 2020 and formally endorsed in October 2020 by the 5th Meeting of the YSLME Interim Commission Council (ICC). This milestone document provides the current state of knowledge and trends in the Yellow Sea ecosystem.

In assessing the primary transboundary issues in the region, it was found that challenges identified in the original TDA remain to be crucial in the coming years, namely fishing effort exceeding ecosystem carrying capacity; unsustainable mariculture; pollution and contaminants; eutrophication; change in ecosystem structure; habitat loss and degradation; and climate change. In addition, the updated TDA highlights several emerging issues, such as:

- Microplastics
- Seasonal acidification
- Broadening range of climate change impacts
- Changes in HAB patterns and possible increase in frequency of toxic algal blooms
- Impact of drifting macroalgae *Sargassium* on mariculture farming and tourism in key areas

The concrete scientific findings of the updated TDA was integral in the formulation of the YSLME SAP 2021-2030 (**Figure 27**), which will be adopted in early 2021. Both of these documents will be setting the course for future interventions in the region and in scaling up actions to secure the ecosystem carrying capacity of the Yellow Sea LME.

"The YSLME TDA/SAP updates being delivered for the benefits of the peoples of the YSLME provide tangible example of the utility of this science-based strategic planning approach to LME management and governance, as supported by the Global Environment Facility, not only in Asia but globally."

- **Andrew Hudson**
Head Water & Ocean Governance Program, Nature, Climate & Energy Team, Bureau for Policy and Programme Support, UNDP

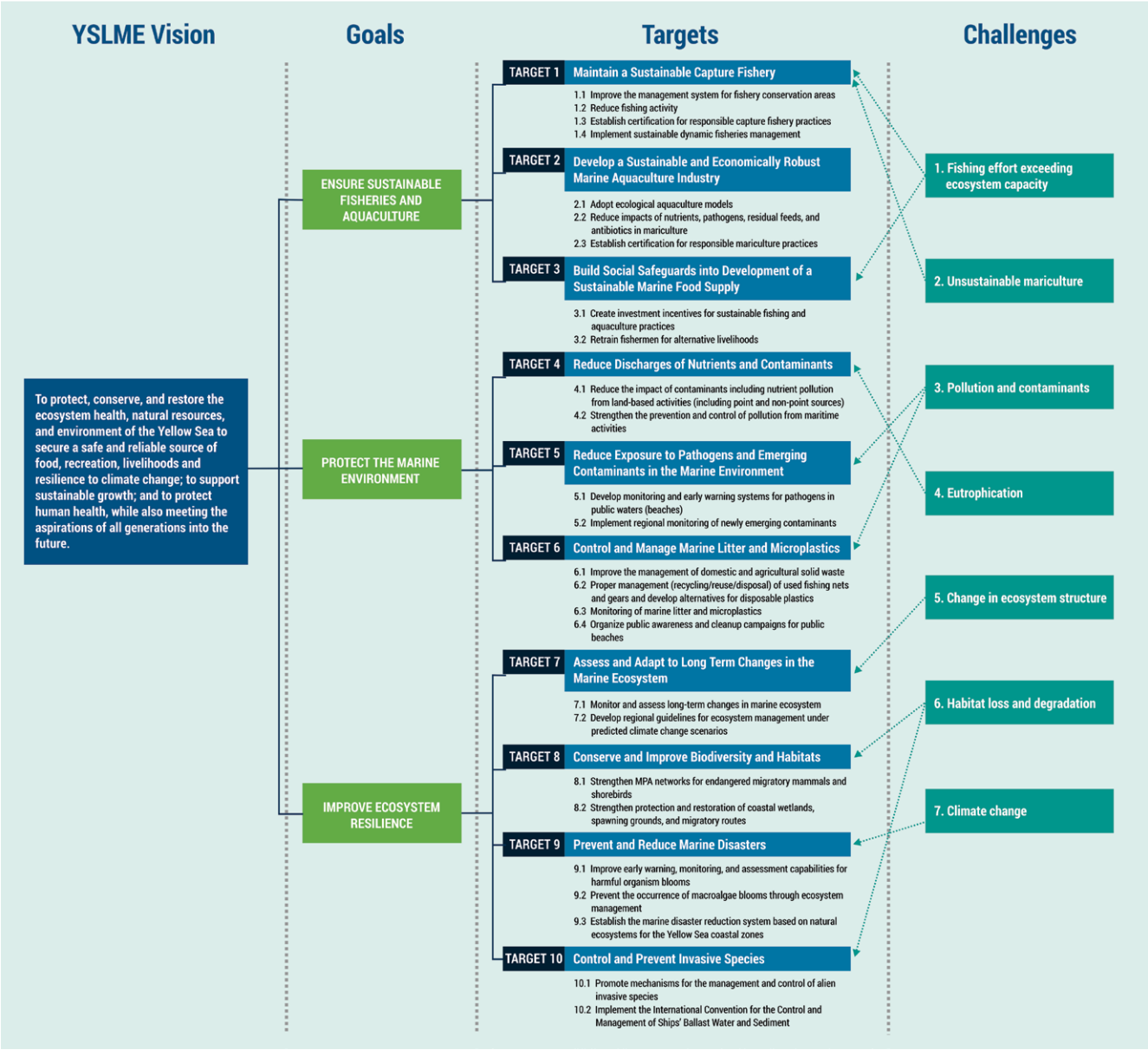


Figure 27. Framework of YSLME SAP 2021-2030 (Bottom-up Approach).

Setting these key roadmaps for the next decade of YSLME signifies the strong commitment from the Yellow Sea countries and various partners in sustaining the science-based LME approach and in finding joint solutions to the persistent and emerging challenges of the region.

"The update of the YSLME SAP has adopted ecosystem-based management and nature-based solution as the overarching concepts to address existing and emerging challenges to fisheries, environment and ecosystems of Yellow Sea. It has charted the roadmap towards science-based good governance of the YSLME in the coming decade."

- **Bin WANG,**
Director General, Department of Marine Strategic Planning and Economy, Ministry of Natural Resources, PR China

Regional Governance in YSLME

With a regional SAP in place, the call for the establishment of a more formal regional platform became stronger so as to sustain coordination and facilitate the implementation of the SAP 2021-2030 to be adopted. Thus, under the YSLME Phase II Project one of the key targets is to support the establishment of a regional governance mechanism for the YSLME.

> *"YSLME is something too valuable for us to leave alone. We have to continue to engage among the regional parties, so that we can not only protect but also make sure that it is well conserved for the future generation. And in order to do so, we need some kind of a governance mechanism. We've been making a lot of progress and I'm very happy with the results of these outcomes. And I look forward to the next step that we are envisioning for YSLME."*
>
> - **Changsoo KIM**
> Director, Global Environment and Science Division, Ministry of Foreign Affairs, RO Korea

In line with this, under the YSLME Phase II Project, the interim infrastructure of the Yellow Sea governance mechanism was operated consisting of an Interim Commission Council (ICC), supported by subsidiary bodies such as the Regional Working Groups (RWGs) and National Working Groups (NWGs), and the Secretariat serviced by the Project Management Office (PMO). The ultimate objective is to foster good ocean governance in the Yellow Sea region and achieve a sustainable Yellow Sea through YSLME SAP implementation aligned with international and regional ocean-related commitments and targets.

In support of this, the YSLME Phase II Project assisted in operationalizing the interim YSLME governance mechanism by servicing the conduct of five meetings of the ICC and 11 meetings of the RWGs on governance, monitoring and assessment, fish stocks, sustainable mariculture, pollution reduction and habitat.

PR China and RO Korea have planned to sign the MOU establishing the regional governance mechanism for the YSLME to coordinate the implementation of the YSLME SAP 2021-2030. While further detailed arrangements of the YSLME regional governance mechanism will be discussed and finalized through bilateral negotiations, the signing of the MOU signals commitment for continuity and further strengthening of cooperation for the future of YSLME.

> *"The completion of the YSLME Phase II Project this year provides a good starting point, and signals a new beginning for the Yellow Sea region."*
>
> - **Danhong CHEN**
> Deputy Director General of the Department of International Cooperation, Ministry of Natural Resources, PR China

Family outing in tidal flat. (Photo by KOEM)

YSLME Partnership Timeline

PREPARATORY PHASE

1994
- YSLME project preparation initiated

2000
- YSLME Project brief (PDF-B) approved by the GEF Council
- **PR China:** Marine Environment Protection Law implemented

2001
- **RO Korea:** Fishing vessel buy-back scheme implemented

2002
- YSLME Project Proposal endorsed by the CEO/GEF

2003
- **PR China**: Control system of marine fishing vessels and governmental buy-back program implemented

2004
- YSLME Project document signed

PHASE 1

2005
- Official launch of GEF/UNDP YSLME Phase I Project
- **RO Korea**: National Implementation Plan for Marine Ranching established
- 1st and 2nd Meetings of the Project Steering Committee (PSC)
- MOU between YSLME and YSEPP signed

2006
- 1st Regional Conference on Parliamentary Roles of Marine Environment and Sustainable Use of Marine Resources in Sea
- Special Meeting and the 3rd Meeting of the PSC
- **PR China**: Action Outline of Aquatic Germplasm Resources Conservation issued
- **PR China**: IMTA demonstration initiated in Chudao, Rongcheng of Shandong

2007
- 1st YSLME Science Conference
- YSLME TDA adopted
- 4th Meeting of the PSC
- 2nd Regional Conference on Parliamentary Roles in Protection of Marine Environment and Sustainable use of Marine Resources in the Yellow Sea
- **RO Korea**: Marine Environment Management Act established
- **PR China**: National Marine Debris Monitoring Programs initiated

2008
- 1st and 2nd Stock Assessment Workshop
- 1st Mariculture Conference
- Special Meeting and 5th Meeting of the PSC
- Two joint co-operative environmental research cruses conducted
- **RO Korea**: Marine Environment Management Act established
- **RO Korea**: National Marine Debris Monitoring Programs initiated
- **PR China**: Implementation Plan of Domestic Waste Classification System implemented

2009
- 2nd Mariculture Conference
- 3rd Stock Assessment Workshop
- YSLME SAP 2010-2020 adopted
- 6th Meeting of the PSC
- **RO Korea**: Use of biodegradable fishing gear introduced

2010
- 2nd YSLME Science Conference with presentations of DPR Korean experts
- Endorsement letter received from DPRK to participate in second phase
- Monitoring assessment and symposium workshop
- MPA Network workshops
- 3rd Mariculture Conference
- Terminal evaluation of Phase I Project
- **RO Korea**: Microplastic monitoring initiated
- **PR China**: "Green Fence" program launched
- ROK-UNDP cost-sharing agreement to support bridging phase

2011
- 7th Meeting and Special Meeting of the PSC
- **RO Korea**: IMTA technology development project initiated
- **RO Korea:** Marine Environment Comprehensive Plan (2011-2020) started implementation

2012
- 8th Meeting of the PSC
- Approval of the PIF of the Phase II Project by the GEF Council
- Amendment of the ROK-UNDP cost-sharing agreement to support bridging phase
- **PR China**: National Marine Functional Zoning (2011-2020) authorized by State Council

BRIDGING

2020

- YSLME TDA 2020 adopted
- 5th Meeting of the ICC (October 19, Virtual)
- YSLME SAP 2021-2030 agreed (March 2021)
- MOU on regional governance mechanism of YSLME confirmed by PR China and RO Korea (December 2020)
- **PR China**: 'Five Major Actions' for green and healthy aquaculture issued

2019

- 3rd Meeting of the ICC (March 11-12, Qingdao/PRC)
- 3rd YSLME Science Conference (July 25-29, Qingdao/PRC)
- Ad hoc ICC Meeting (July 26, Qingdao/PRC)
- 4th Meeting of ICC (November 27-29, Jeju/ROK)
- Review of implementation of National Strategic Action Plan of YSLME SAP 2009-2020 completed by PR China and RO Korea
- Regional Guidelines for Responsible Fisheries in YSLME completed
- Spoon-billed Sandpipers Conservation Alliance initiated
- Regional Baseline Survey completed jointly by PR China and RO Korea
- YSLME Biodiversity Conservation Plan (2019-2030) prepared
- Conservation and Management Plan for Spotted Seal in YSLME prepared
- Regional Jellyfish Monitoring Program prepared
- **RO Korea**: Marine Spatial Planning and Management Act took effect
- **RO Korea**: Comprehensive Plan on Marine Litter Reduction implemented
- **PR China**: YSLME Responsible Mariculture Initiative (YRMI) launched
- **PR China**: Tiaozini wetland designated as UNESCO World Heritage Site

2018

- Mid-term review of the Phase II Project, March
- 2nd Meeting of ICC (July 27-29, Dalian/PRC)
- **PR China**: Limit of catchable size of 15 commercial fishery species and limit of their juveniles and young fish proportion in the total catch announced
- **PR China**: Moratorium on coastal reclamation in Bohai Sea and Yellow Sea implemented
- **PR China**: Law on the Prevention and Control of Atmospheric Pollution amended
- **RO Korea**: Framework Act on Resources Circulation implemented

PHASE 2

2017

- Preparatory meeting for the Inception Workshop (January 23-24, Incheon/ROK)
- Launching of YSLME Phase-II Project and 1st Meeting of MSTP/ICC (July 13-15, Seoul/ROK)
- **PR China**: Comprehensive fishing ban for 4 to 4.5 months implemented annually
- **PR China**: Total Allowable Catch (TAC) Program and Quota management initiated
- **PR China**: Marine Environment Protection Law updated
- **PR China**: Opinions on Full Implementation of River Chief System released
- **RO Korea**: Act on the Promotion of Saving and Recycling of Resources implemented

2016

- **RO Korea**: IMTA initiated in Tongyeong City
- **PR China**: Microplastics monitoring program initiated
- **PR China**: Marine Environment Protection Law amended
- **PR China**: Action Plan for Soil Pollution Prevention and Control

2015

- Project revision workshop
- **PR China**: Water Pollution Control Action Plan launched
- **PR China**: Special Action Plan for Ship and Port Pollution Prevention and Control (2015-2020) implemented

2014

- YSLME Phase-II Project Document approved by GEF and signed by China, UNDP and UNOPS
- **PR China**: Regular monitoring survey on fisheries on coastal waters and inland launched
- **RO Korea**: Five-Year Plan for Reducing Fishing Vessels Phase I (2014-2018) implemented

2013

- Special Meeting of the PSC
- **PR China**: Fisheries Law revised
- **PR China**: Marine Environment Protection Law updated
- **RO Korea**: Fisheries Resources Management Act took effect
- **RO Korea**: National Action Plan for Management of Land-based Sources of Pollutants implemented

PHASE

Together, We Make A Difference: Recognizing the Backbone of YSLME

Guided by **One Vision** working with and for **One Yellow Sea** towards **a Shared Future**. This is YSLME's ultimate guiding principle. From YSLME Project Phase I to Phase II, the YSLME has brought together different stakeholders from different backgrounds to rally behind this principle and to deliver transformation for the good of the Yellow Sea region. Indeed, YSLME would not reach this far without the dedication and support from various partners and collaborators. For 15 years of project implementation, the YSLME project has established numerous partnerships and has entered into several understanding, project cooperation and grant agreements from partners within and outside the Yellow Sea region.

In this section, we would like to give credit and gratitude to all our key Partners and Collaborators, for without them none of this would have been possible.

Executing and Implementing Partners

GEF- The GEF unites 183 countries in partnership with international institutions, civil society organizations (CSOs), and the private sector to address global environmental issues while supporting national sustainable development initiatives. Today the GEF is the largest public funder of projects to improve the global environment. www.thegef.org

UNDP- UNDP partners with people at all levels of society to help build nations that can withstand crisis, and drive and sustain the kind of growth that improves the quality of life for everyone. On the ground in 177 countries and territories, UNDP offers global perspective and local insight to help empower lives and build resilient nations. www.undp.org

UNOPS- The United Nations Office for Project Services (UNOPS) is an operational arm of the United Nations, supporting the successful implementation of its partners' peacebuilding, humanitarian and development projects around the world. UNOPS supports partners to build a better future by providing services that increase the efficiency, effectiveness and sustainability of peace building, humanitarian and development projects. Mandated as a central resource of the United Nations, UNOPS provides sustainable project management, procurement and infrastructure services to a wide range of governments, donors and United Nations organizations. www.unops.org

Country Focal Ministries

Ministry of Natural Resources (MNR), PR China – The Ministry of Natural Resources is responsible for managing the use of natural resources, e.g. land, minerals, forests, grasslands, wetlands, water, and oceans, as well as polar, high sea, and international seabed affairs. The Ministry was restructured in 2018. www.mnr.gov.cn.

Ministry of Oceans and Fisheries (MOF), RO Korea- The Ministry of Oceans and Fisheries is responsible for maritime and fisheries sector in general, ranging from the promotion of maritime safety ad security, protection of the marine environment, development of port and fishing ports, research and development on polar issues, to the management and sustainable use of fishery resources and promotion of marine leisure activities. The Ministry was re-established in 2013 in line with government reorganization. www.mof.go.kr.

Technical Cooperation Partners

PR CHINA

- Beijing Chaoyang District Yongxu Global Environment Institute (GEI)
- Blue Ribbon Ocean Conservation Association (BROCA)
- China Aquatic Products Processing and Marketing Alliance (CAPPMA)
- China Biodiversity Conservation and Green Development Foundation (CBCGDF)
- Chinese Academy of Fishery Sciences (CAFS)
- First Institute of Oceanography (FIO)
- Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences (IGSNRR)
- Institute of Oceanology, Chinese Academy of Sciences (IOCAS)
- Liaoning Ocean & Fisheries Science Research Institute
- Modern Fisheries Institute of Yantai University
- Nanjing University
- National Marine Environment Monitoring Center (NMEMC)
- North China Sea Environmental Monitoring Center (NCSEMC)
- School of Law & Political Science, Ocean University of China
- Shandong Marine Resource and Environment Institute
- Shanghai Rendu Ocean NPO Development Center (RENDU)
- Qingdao Marine Conservation Society
- Yellow Sea Fisheries Institute (YSFRI)

RO KOREA

- Anyang University
- Chungnam National University
- Eco-Horizon Institute
- Gyungsang National University
- Human and Marine Environment Research Laboratory
- Hydrocore
- Incheon National University
- Korea Fisheries Resources Agency (FIRA)
- Korea Institute of Ocean Science and Technology (KIOST)
- Korea Marine Environment Management Corporation (KOEM)
- Korea Maritime Institute (KMI)
- Korea University
- Marine Biodiversity Institute of Korea (MABIK)
- National Institute of Fisheries Science (NIFS)
- Our Sea of East Asia Network (OSEAN)
- World Heritage Promotion Team of Korean Tidal Flats

Collaborators

PR CHINA

- Chongqing Bird Watching Club
- Dalian Modern Marine Ranching Research Institute
- Fuhan Aquaculture, Haiyang, Shandong
- Haiyang Municipal People's Government of Shandong Province
- International Wetlands and River Beijing (IWRB)
- Mangrove Conservation Foundation
- Marine and Fishery Bureau of Lianyungang City
- Ministry of Agricultural and Rural Affairs (MARA)
- Ministry of Ecology and Environment (MEE)
- National Forestry and Grassland Administration (NFGA)
- National Park Administration
- Nature Reserve College, Beijing Forestry University
- Ocean and Fisheries Bureau of Jiangsu Province
- Ocean and Fisheries Bureau of Rongcheng, Shandong
- Qingdao Municipal Ocean Development Bureau
- Shandong Ocean and Fisheries Department
- Spoon-bill Sandpiper in China
- Weihai IVY International School
- Xiamen Coastal Wetland and Bird Research Center
- Yancheng Wetland World Heritage Application Office

RO KOREA

- Chungnam Institute
- Chungcheongnam-do (province)
- Eco-Horizon Institute
- Eco-Hub Mool-Se-Al
- Gwangju Jeonnam Research Institute (GJERI)
- Human and Marine Ecosystem Research Laboratory
- Incheon Metropolitan City
- Marine Environment Education 'Bom the Sea'
- Ministry of Foreign Affairs (MOFA)
- Ministry of Oceans and Fisheries (MOF)
- Seocheon Eco-Culture Association
- Seocheon-Gun Tourism Festival Department
- Seosan Taean Marine Environment Education Center
- World Heritage Promotion Team of Korean Tidal Flats
- Yellow Sea Spotted Seal Savers (YESSS)

Global and Regional Collaborators

- Asian Institute of Technology
- Caribbean Regional Fisheries Mechanism Secretariat (CRFM)
- East Asian-Australasian Flyway Partnership (EAAFP)
- Hanns Seidel Stiftung, Korea Office
- International Union for Conservation of Nature (IUCN) China
- IOC Sub-Commission for the Western Pacific (IOC/WESTPAC)
- IW:Learn
- National Oceanic and Atmospheric Administration (NOAA) Large Marine Ecosystems Program
- Partnerships in Environmental Management for the Seas of East Asia (PEMSEA)
- Southeast Asian Fisheries Development Center (SEAFDEC)
- The World Wide Fund for Nature (WWF)
- UNEP/Northwest Pacific Action Plan (NOWPAP)
- UNESCAP-East and North-East Asia Office
- Wetland International China

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