An Analytical Study on the Implementation of the National Strategic Action Plan (NSAP) for the Yellow Sea Large Marine Ecosystem (YSLME) of the Republic of Korea

By the
Working Group on Governance of the Republic of Korea

June 2019

Implementing the Strategic Action Programme for the Yellow Sea Large Marine Ecosystem: Restoring Ecosystem Goods and Services and Consolidation of a Long-term Regional Environmental Governance Framework (UNDP/GEF YSLME Phase II Project)

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 1 7/4/2019 5:39:27 PM

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 2 7/4/2019 5:39:27 PM

An Analytical Study on the Implementation of the National Strategic Action Plan (NSAP) for the Yellow Sea Large Marine Ecosystem (YSLME) of the Republic of Korea

By the
Working Group on Governance of the Republic of Korea

June 2019

Implementing the Strategic Action Programme for the Yellow Sea Large Marine Ecosystem: Restoring Ecosystem Goods and Services and Consolidation of a Long-term Regional Environmental Governance Framework (UNDP/GEF YSLME Phase II Project)

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 3 7/4/2019 5:39:27 PM

An Analytical Study on the Implementation of the National Strategic Action Plan (NSAP) for the Yellow Sea Large Marine Ecosystem (YSLME) of the Republic of Korea

June 2019

This publication was made possible through the support provided by the UNDP/GEF Yellow Sea Large Marine Ecosystem (YSLME) Phase II Project.

YSLME Phase II Project
Incheon Secretariat
5th floor, G-Tower
175 Art center-daero, Yeonsu-gu
Incheon 22004 RO Korea

Beijing Office
6 Qiwang Fen Bei Road,
Beianhe Sujiatuo, Haidian District,
Beijing, PR China
Telephone: 010-6249 2548
Cel no.: 13552538239

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 4 7/4/2019 5:39:27 PM

Table of Contents

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 1 7/4/2019 5:39:27 PM

List of Figures

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 2 7/4/2019 5:39:27 PM

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 3 7/4/2019 5:39:27 PM

List of Tables

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 4 7/4/2019 5:39:27 PM

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 5 7/4/2019 5:39:27 PM

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 6 7/4/2019 5:39:27 PM

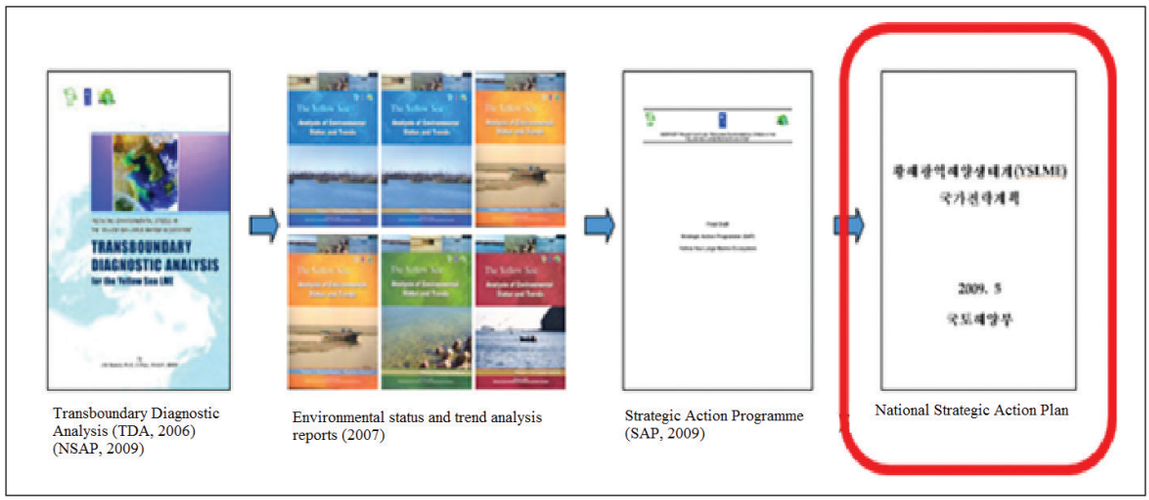
1

Status of the NSAP (National Strategic Action Plan)

- The National Strategic Action Plan (NSAP) for the preservation of the Yellow Sea Large Marine Ecosystem (YSLME) is an important achievement of the YSLME Phase I Project and a national action plan established through an evaluation and analysis of the project using scientific data.

  - The NSAP was established based on the Strategic Action Programme (SAP), which was based on the transboundary diagnostic analysis (TDA, 2006) and the environmental status and trend analysis reports (2007) from the YSLME Phase 1 Project.

Figure 1.1 Establishment Process of the YSLME NSAP.



- Both Korea and China decided to make efforts to preserve and manage the YSLME by establishing NSAPs, based on the SAP, and implementing them.

  - Therefore, the implementation of the NSAP could be considered an effort made by a country to preserve the YSLME, and the assessment of the implementation of each management goal and task proposed in the NSAP is significant.

- The vision of the NSAP involves the scientific management and resolution of environmental issues in the Yellow Sea with the aim of guaranteeing the sustainable use and conservation of the Yellow Sea. At the national level, the NSAP is a crosscutting, comprehensive national plan for the improvement,

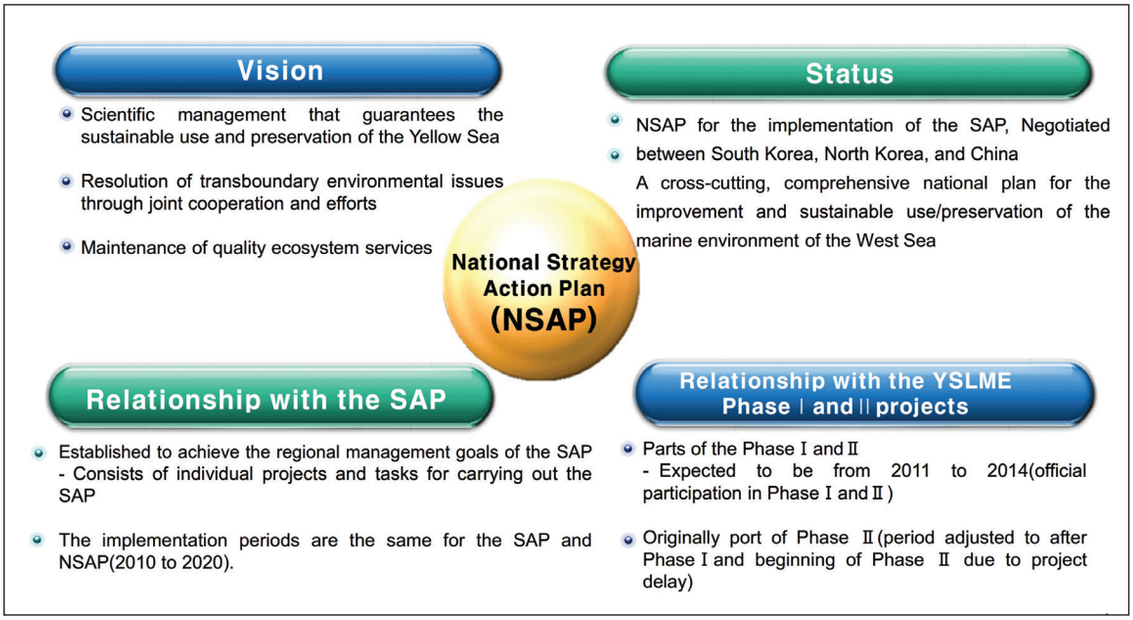
YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 1 7/4/2019 5:39:28 PM

sustainable use, and preservation of the marine environment of the West Sea in the Republic of Korea.

- In this context, the assessment and analysis of the implementation of the NSAP is an assessment of RO Korea's efforts toward improving and ensuring the sustainable use and preservation of the marine environment, including that of the Yellow Sea. In addition, it is also an assessment of both RO Korea and PR China's efforts to implement the YSLME Project.

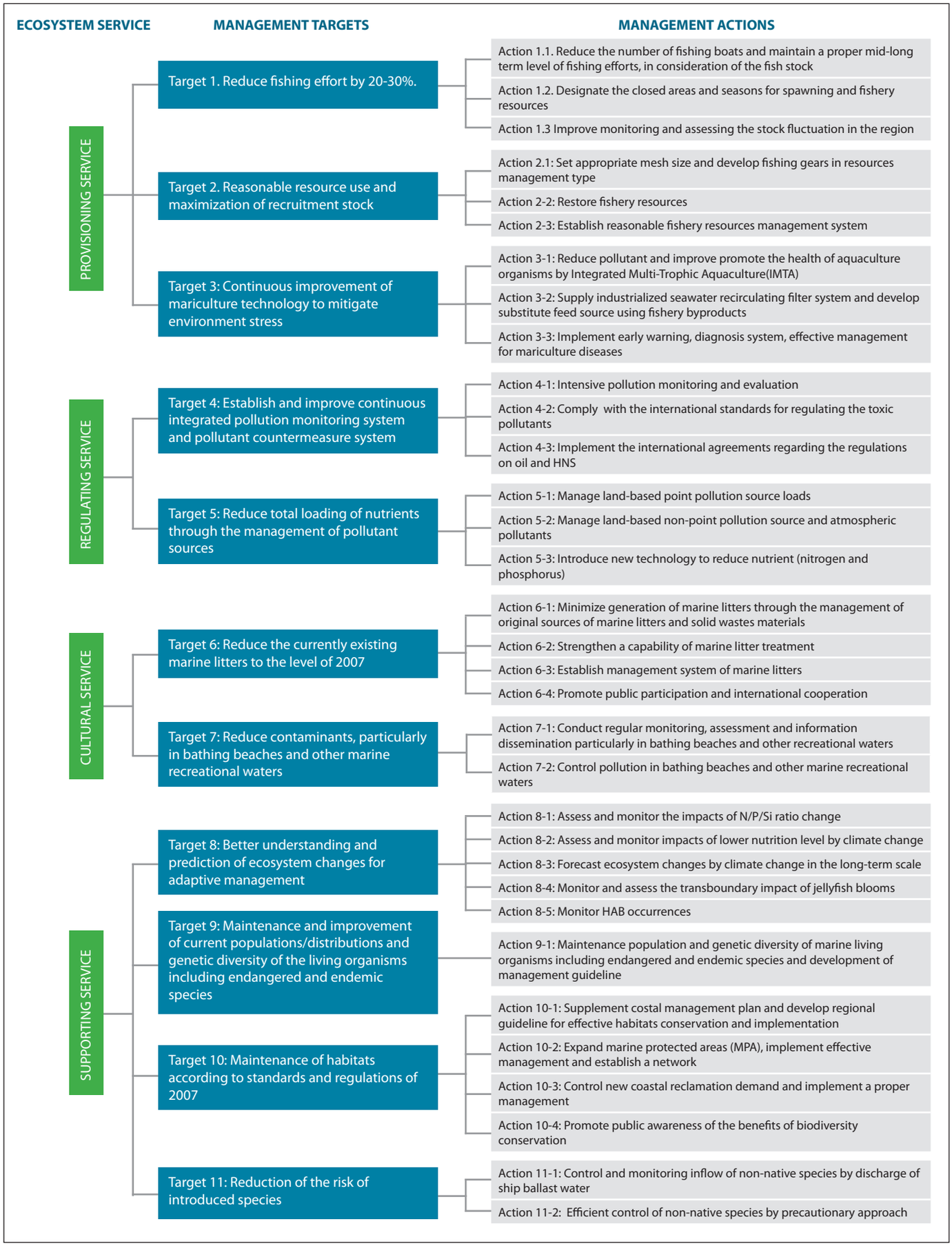
The NSAP is made up of 11 goals and 33 actions.

Figure 1.2 Main Issues and Status of the NSAP.



YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 2 7/4/2019 5:39:29 PM

Figure 1.3 RO Korea's NSAP.



YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 3 7/4/2019 5:39:29 PM

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 4 7/4/2019 5:39:29 PM

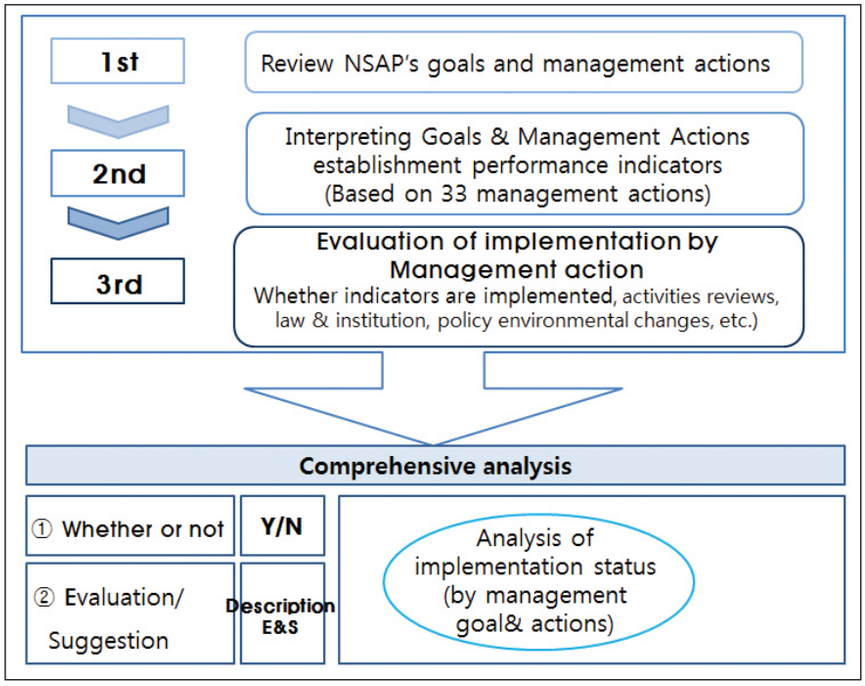
2

System for Assessing the Implementation of the NSAP

- The assessment of the implementation of the NSAP proceeded as follows:
  - First, to gain a better understanding of the background against which the goals and management actions were established, this study conducted a comprehensive review and analysis of the NSAP to interpret its goals and management actions.
  - Indicators were created to assess the implementation of the goals and management actions based on their purpose and significance.
  - All assessments have been conducted based on management actions, and indicators were also created for each management action.

- The implementation of the NSAP was assessed using indicators for each management action. Whether the task was implemented or not was indicated using "Y (yes)" or "N (no)." When necessary, separate assessments were conducted and suggestions made.
  - Going beyond providing a simple assessment of whether the management actions were implemented, this study also offers a comprehensive outline of the significance of the management actions and suggestions.

Figure 2.1 Flowchart of the Implementation of the NSAP.



YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 5 7/4/2019 5:39:29 PM

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 6 7/4/2019 5:39:29 PM

3

Results of the Assessment of the NSAP and Suggestions

3.1. Results of the Assessment of the Implementation of the NSAP

- In assessing the 33 management actions that were established to achieve the management goals, it was found that all management actions resulted in favorable outcomes with the exception of two.

  - In particular, all of the management actions were assessed to have been carried out in a systematic manner, as each task consisted of reforming the legal system, operating a management organization, developing relevant activities, and establishing an information system.

- The two management actions that were found to have not been implemented were: (i) reduce waterborne pollution from integrated Multi-Trophic Aquaculture (IMTA) and improve the health of cultured organisms; and (ii) monitor and evaluate the lower trophic level effects due to climate change.

- Rather than not being fully implemented, the above three management actions were executed poorly. This means that the projects for the West Sea were not carried out.

  - In the case of the management action of reducing waterborne pollution from IMTA and improving the health of cultured organisms, IMTA technique project for the West Sea was not carried out, but vaccines for improving the health of cultured organisms were developed and distributed. As a result, the implementation of this management action was assessed as having been somewhat insufficient.
  - In terms of the management action of monitoring changes in the ratio of nitrogen, phosphoric acid, and silicon, monitoring and inspection were conducted regularly, but in-depth analysis and management of the changes in the ratio of nitrogen, phosphoric acid, and silicon and their influence relationship have not been implemented. As a result, the implementation of this management action was assessed as having been somewhat insufficient.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 7 7/4/2019 5:39:29 PM

- In terms of the management action of monitoring and evaluating the lower trophic level effects due to climate change, related projects, research, and development were carried out, but only for the South Sea. As a result, the implementation of this management action was assessed as having been somewhat insufficient.

- Overall, the 33 management actions, established to achieve the 11 goals of RO Korea's NSAP, have been implemented relatively well.

Table 3.1 Implementation of the 33 Management actions of the NSAP.

No.	Management actions	Implemented
1	1.1: Reduce the number of fishing vessels and maintain a proper mid/long term level of fishing efforts in consideration of the fish stock	Y
2	1.2: Designate the closed areas and seasons for protection of spawning and recruitment stock resources	Y
3	1.3: Improve monitoring and assessing the stock fluctuation at the regional level	Y
4	2.1: Set appropriate mesh size and develop fishing gears in resources management type	Y
5	2.2: Restore fishery resources	Y
6	2.3: Establish reasonable fishery resources management system	Y
7	3.1: Reduce waterborne pollution and enhance the health of farmed organisms by Integrated Multi-Trophic Aquaculture (IMTA)	Y or N (insufficient)
8	3.2: Supply industrialized seawater recirculating aquaculture system and develop alternative feed sources using fishery byproducts	Y
9	3.3: Implement early warning, diagnosis system, effective management for mariculture diseases	Y
10	4.1: Intensive pollution monitoring and evaluation	Y
11	4.2: Comply with the international standards for regulating the toxic organic pollutants	Y
12	4.3: Implement the international agreements regarding the regulations on oil and HNS	Y
13	5.1: Manage land-based point pollution source loads	Y
14	5.2: Manage land-based nonpoint pollution source and atmospheric pollutants	Y
15	5.3: Introduce new technology to reduce nutrients (nitrogen and phosphorus)	Y
16	6.1: Minimize generation of marine litter through the management of original sources of marine litter and solid waste materials	Y
17	6.2: Strengthen capability of marine litter collection and treatment	Y
18	6.3: Establish management system of marine litter	Y
19	6.4: Promote public participation and international cooperation	Y

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 8 7/4/2019 5:39:30 PM

Table 3.1 Implementation of the 33 Management actions of the NSAP. (cont.)

No.	Management actions	Implemented
20	7.1: Conduct regular monitoring, assessment and information dissemination particularly in bathing beaches and other recreational waters	Y
21	7.2: Control pollution in bathing beaches and other marine recreational waters	Y
22	8.1: Monitor and evaluate the effects of the ratio of nitrogen, phosphoric acid, and silicon	Y
23	8.2: Monitor and evaluate the lower trophic level effects due to climate change	Y or N (insufficient)
24	8.3: Predict long-term changes of the Yellow Sea's ecosystem due to climate change	Y
25	8.4: Monitor and evaluate the transboundary impact of jellyfish blooms	Y
26	8.5: Monitor the occurrence of harmful algal blooms (HABs) and evaluate their effects	Y
27	9.1: Conserve the genetic diversity and population of endemic species and marine organisms under protection and develop regional guidelines	Y
28	10.1: Supplement and effectively implement plans for coastal management areas and develop guidelines for the preservation of coastal habitats	Y
29	10.2: Expand, effectively manage MPAs and establish a network of MPAs	Y
30	10.3: Control new coastal reclamation demand and implement a proper management	Y
31	10.4: Promote public awareness of the benefits of biodiversity conservation	Y
32	11.1: Control and monitor inflow of non-native species by discharge of ship ballast water	Y
33	11.2: Control non-native species efficiently with precautionary approach	Y

- In the case of RO Korea, special departments and institutions were established under relevant ministries, such as the Ministry of Oceans and Fisheries, to focus on the implementation of related management actions and establishment of a long-term plan. This made it possible for RO Korea to conduct management actions in a more systematic and consistent manner.

  - The Ministry of Oceans and Fisheries has been central to the implementation of the goals and various management actions of the NSAP that seek to preserve the marine ecosystem of the Yellow Sea. Its activities include marine environment preservation, coastal area management, fishery resource management, promotion of the fishing industry, and development of fishing villages.
  - In addition, the National Institute of Fisheries Science (NIFS), Korea Institute of Ocean Science & Technology (KIOST), Korea Marine Environment Management Corporation (KOEM), and National Marine Biodiversity Institute of Korea (MABIK) have each played

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 9 7/4/2019 5:39:30 PM

a key role in developing the technologies and policies necessary to carry out the tasks, preserve the environment and ecosystem, and protect marine biodiversity.

3.2. Conclusion and Suggestions

- The implementation of Korea's NSAP appears to have been carried out systematically with the exception of two management actions whose implementation was deemed to have been somewhat insufficient.
  - At the national level, this means that significant efforts are being made to preserve the YSLME.
- In particular, since Korea has established a certain level of organization, legal system, institutions, and technological development to address various issues, related activities in Korea are expected to be conducted in a systematic manner.
- However, the ultimate goal and purpose of the NSAP is to pursue cooperative efforts toward preserving the common environmental foundation of the YSLME, rather than focusing on activities within the country. It is thus essential to further consolidate the cooperative system between Korea and China.
  - The YSLME is directly shared by, and thus needs to be preserved by, RO Korea, DPR Korea, and PR China. Therefore, a cooperative system between the countries needs to be established to address issues that require joint efforts.
- While the NSAP has been faithfully implemented, the YSLME is still plagued by many issues and problems, which must be resolved in order to ensure the sustainable use of the YSLME.
  - In particular, overfishing in the Yellow Sea (resulting in the reduction of fishery resources), jellyfish blooms, generation and movement marine waste, and inflow of pollution from various channels have now become major issues.
- In this regard, joint efforts based on cooperation among the surrounding countries is more important for the preservation of the YSLME than efforts made by individual countries. It is thus desirable to expand joint projects (cooperation) between RO Korea and China.
- In addition, based on the results of the assessment of the NSAPs of RO Korea and China, it is necessary to analyze the various aspects of NSAP implementation by studying environmental changes, the results of the YSLME Project, and the various effects that have emerged since the implementation of the NSAP.
  - For instance, after conducting activities to reduce the number of fishing vessels in both countries, it will be necessary to analyze the YSLME in order to measure the impact of said activities on the preservation of fishery resources, reduction of pollution, and changes in the marine ecosystem of the Yellow Sea.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 10 7/4/2019 5:39:30 PM

3.3. Details

- Here, we provide information on the assessment of the 33 management actions of RO Korea's NSAP and the status of related activities.

Management Goal 1	Reduce fishing effort by 20-30%
Background	Reduction of fishing effort for a transition to sustainable fishery in the YSLME (2004-2020)

1. Implementation Assessment Indicators and Content

- The purpose of Management Goal 1 is to reduce the current level (as of 2011) of fishing effort by 20% to 30% in order to transition to a sustainable fishery.

  - The management activities involved in achieving this goal include: reducing the number of fishing vessels, maintaining an adequate level of fishing effort, establishing no-fishing zones and no-fishing seasons, monitoring and improving assessment in fishery resources at the regional level.

- For the assessment of the implementation of each management action the reduction of the number of fishing vessels, number of no-fishing zones, number of target fish species designated for recovery, and status of the expansion of survey areas are set as indicators.

Table 3.2 Management actions and Indicators of Management Goal 1.

Management action	Indicators	Content
1.1: Reduce the number of fishing vessels and maintain a proper mid-/long-term level of fishing efforts in consideration of the fish stock	Reduction in the number of fishing vessels	Assess the degree of fishing efforts maintained at an appropriate level using statistics on the extent of the number of fishing vessels that was reduced from 2011 to 2017
1.2: Designate the closed areas and seasons for protection of spawning and recruitment stock resources	Establishment of no-fishing zones and seasons (status of the designated fishery resource protected areas)	Assess institutional measures for the protection of spawning season and recruitment resources based on the number of fishery resource protected areas that were designated during the relevant time period
1.3: Improve monitoring and assessing the stock fluctuation at the regional level	Increase the number of target species for restoration and expansion of survey areas	Identify the species that require intensive recovery efforts and assess whether to designate as target fish species for recovery through the monitoring of changes in fishery resources Assess the monitoring performed at the regional level through the expansion of survey areas that are monitored for changes in fishery resources

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 11 7/4/2019 5:39:30 PM

2. Implementation Status and Major Results

Action Plan 1.1. Reduce the number of fishing vessels and maintain a proper mid-/long-term level of fishing efforts in consideration of the fish stock

- The goal of this management action is to maintain fishing efforts at a moderate level in the mid- to long-term in order to protect and secure the stability of the fishery resources of the Yellow Sea.
- The indicators used to assess the implementation of this management action was the number of fishing vessels, which is the most commonly used to measure fishing effort, and number of fishing vessels in RO Korea's coastal waters from 2011 to 2017.
- From 2009 to 2017, the number of fishing vessels in the littoral zone of the Yellow Sea was reduced by an annual average of 4% . The number of fishing vessels was reduced by 25 percent compared to the year of 2009 and 17 percent compared to 2011.
- Although 20% reduction was not achieved by 2011 that was set during Phase I, RO Korea has made substantial progress in reducing the number of fishing vessels to decrease fishing effort, prior to 2011.
  - As of 2017, Korea has reduced the number of fishing vessels by 25 percent compared to 2009. Therefore, the goal has been achieved.
- In addition, the Ministry of Oceans and Fisheries is making efforts to maintain an appropriate level of fishing effort through the establishment of a long-term plan.

Δ **Yes, in consideration of RO Korea's long-term plan for reduction of fishing vessels and a number of reduced fishing vessels so far, the country is maintaining its mid- to long-term fishing effort at a moderate level.**

Current status and plan for reduction of fishing vessels in RO Korea's littoral seas

- In July 2012, RO Korea implemented the "Act on the Restructuring of and Support for inshore and offshore Fisheries and established the "Basic Plan for the Restructuring of inshore and offshore Fisheries" as well as the Five-Year (2014-2018) Plan for Reducing Fishing Vessels in Littoral Seas in December 2014.

  - Under the plan, the number of fishing vessels are to be reduced by 4,413 vessels by 2023 in consideration of the total number of registered fishing vessels that were active in the littoral sea in 2013 (45,598 vessels), of which a reduction of 2,315 vessels was to be achieved during Phase I, from 2014 to 2018.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 12 7/4/2019 5:39:30 PM

Table 3.3 RO Korea's Plan to Reduce the Number of Fishing Vessels in Littoral Seas by Year (2014-2023).

Phase	Year	Number of Fishing Vessels to be Reduced (Plan)			
		Inshore fishery	Offshore fishery	Total	Accumulated Total
Phase 1	2014	450	13	463	463
	2015	450	13	463	926
	2016	450	13	463	1,389
	2017	450	13	463	1,852
	2018	450	13	463	2,315
Phase 2	2019	450	13	463	2,778
	2020	450	13	463	3,241
	2021	450	13	463	3,704
	2022	450	13	463	4,167
	2023	189	57	246	4,413

Source: Basic Plan for the Restructuring of Coastal and Inshore Fisheries (2014-2018), Ministry of Oceans and Fisheries

Results in the Reduction of the number of fishing vessels in the littoral zone of the Yellow Sea

- The number of fishing vessels in the littoral zone of the Yellow Sea was continuously reduced through the Ministry of Oceans and Fisheries' Project of the Restructure of inshore and offshore Fisheries.
  - From 2011 to 2017, the number of fishing vessels of the Yellow Sea (west sea of RO Korea) was reduced from 26,439 in 2011 to 21,929 in 2017, showing 17% reduction.
  - However, Korea has been reducing the number of fishing vessels by 6% to 8% every year prior to 2011. Thus, annual number of reduction has been decreased since 2011.

Table 3.4 Number of Fishing Vessels in the Littoral Zone of the West Sea (2009-2011).

Year	Type	Subtotal	Total	Rate of change YoY
2009	Offshore fishery	1,268	29,169	▼6%
	Inshore fishery	27,901	29,169	▼6%
2010	Offshore fishery	1,197	26,908	▼8%
	Inshore fishery	25,711	26,908	▼8%
2011	Offshore fishery	11,485	26,439	▼2%
	Inshore fishery	25,254	26,439	▼2%
2012	Offshore fisher	1,208	25,784	▼2%
	Inshore fishery	24,576	25,784	▼2%

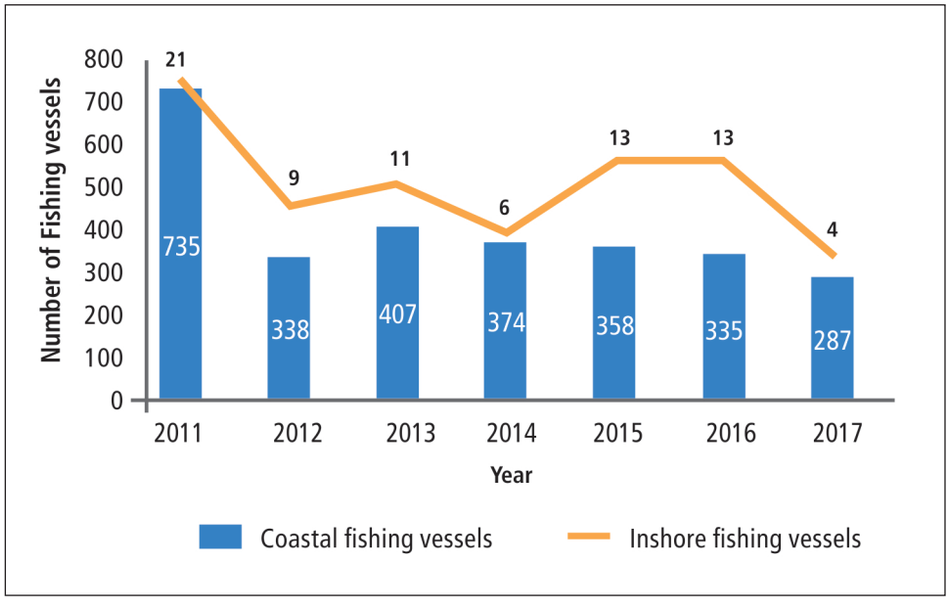
YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 13 7/4/2019 5:39:30 PM

Table 3.4. Number of Fishing Vessels in the Littoral Zone of the West Sea (2009-2011). (cont.)

Year	Type	Subtotal	Total	Rate of change YoY
2013	Offshore fishery	1,167	25,229	▼2%
	Inshore fishery	24,062	25,229	▼2%
2014	Offshore fishery	1,084	24,023	▼5%
	Inshore fishery	22,939	24,023	▼5%
2015	Offshore fishery	1,056	23,851	▼1%
	Inshore fishery	22,795	23,851	▼1%
2016	Offshore fishery	1,073	22,661	▼5%
	Inshore fishery	21,588	22,661	▼5%
2017	Offshore fishery	1,141	21,929	▼3%
	Inshore fishery	20,788	21,929	▼3%

- The number of fishing vessels from 2011 to 2017 in the littoral zone of the Yellow Sea was reduced by 756 vessels in 2011 and 291 vessels in 2017.

Figure 3.1 Reduction of Fishing Vessels in the Littoral Seas.



YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 14 7/4/2019 5:39:30 PM

Action Plan 1.2. Designate the closed areas and seasons for protection of spawning and recruitment stock resources

- The purpose of this management action was to establish no-fishing zones and seasons as a means of protecting spawning stock from overfishing and maintain a moderate level of recruitment resources.
- The indicator used to assess the implementation of this management action was set as the actual status of closed areas (no-fishing zones) and seasons in Ro Korea and the number of designated fishery resource protected areas.
- RO Korea has designated closed areas for each type of fishery by laws to protect the spawning stock and recruitment resources of the Yellow Sea as well as all territorial waters of Korea.
  - In accordance with Article 7(1) of the Enforcement Decree of the Fishery Resources Management Act, RO Korea has designated and been managing closed areas.
- By legally designating closed seasons and water depth for all fishery resources and specific fishery resources, Korea has established an environment that is conducive to the protection of fishery resources in consideration of the number of target fish species and the marine environment of the seas.

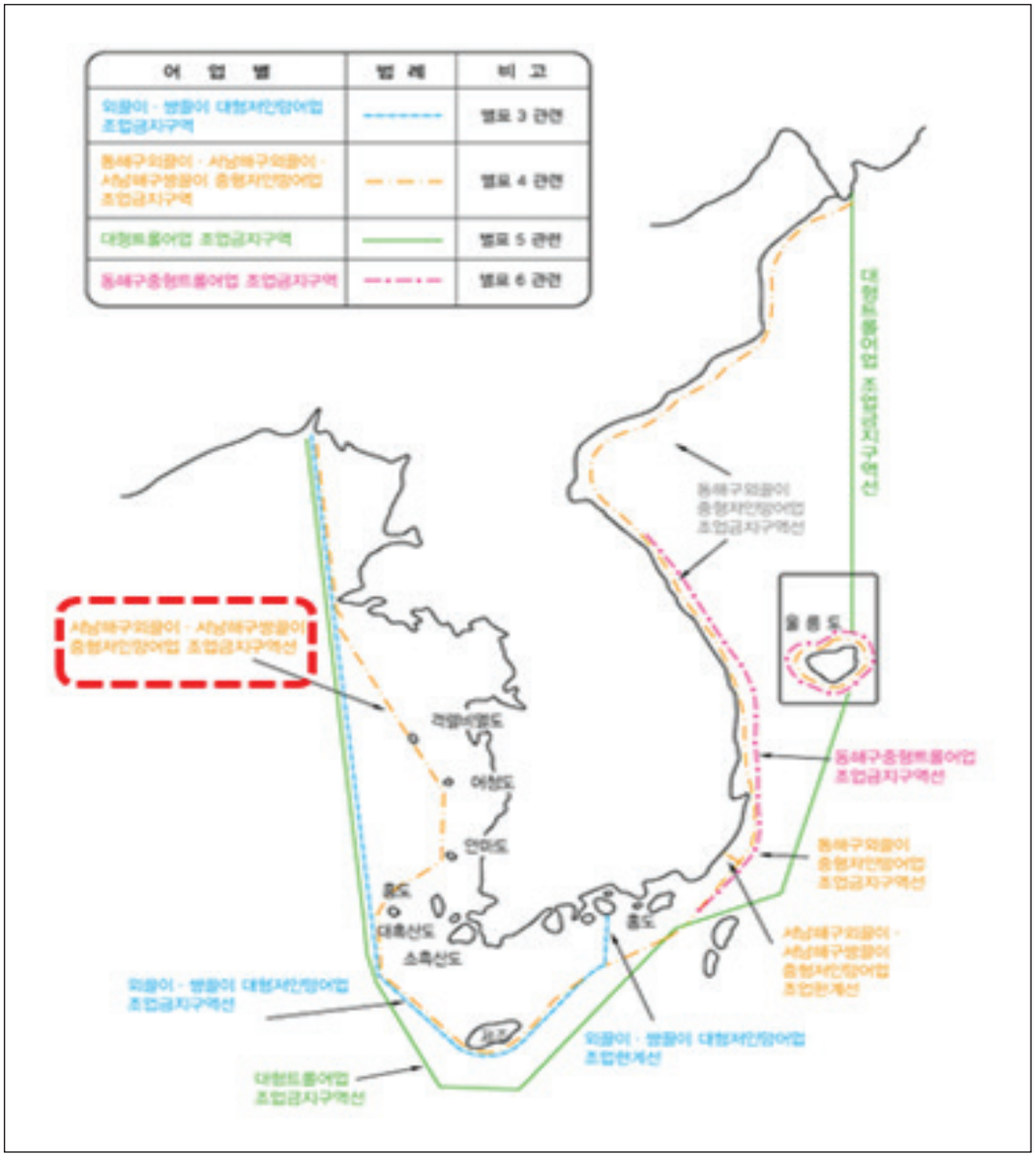
Δ **Yes, implemented. The legally designated closed areas (no-fishing zones) and seasons have been properly revised in consideration of environmental changes, and appropriate measures are being taken to protect spawning stock and recruitment resources.**

Current status of closed areas and seasons in Korea

- Korea designated closed areas for each type of fishery based on the Fisheries Resources Management Act and Article 7(1) of the Enforcement Decree of said Act.
  - According to the Fishery Resources Management Act, when deemed necessary for the propagation and protection of fishery resources, the Minister of Oceans and Fisheries can designate a period of prohibiting of the capture and gathering of fishery resources.
  - The Enforcement Decree of said Act designates and manages the zones where fishing is prohibited by fishing type, such as one-boat and two-boat large bottom trawling, one-boat medium bottom trawling in the East Sea Zone, one-boat medium bottom trawling in the Southwest Sea Zone, two-boat medium bottom trawling in the Southwest Sea Zone, large trawling, and medium trawling in the East Sea Zone (see **Figure 3.2**).

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 15 7/4/2019 5:39:30 PM

Figure 3.2 Closed Areas by Fishing Type in Korea.



- In addition, Article 6(1) of the Enforcement Decree of the Fishery Resources Management Act designates the periods of time, zones, and depths of water subject to the prohibition of the capture and gathering of fishery resources, as shown in the **Table 3.5**.

  - A comprehensive no-fishing season for all fishery resources is put into effect from April 1 to October 31 in certain seas, such as Gunsan and Buan in Jeollabuk-do. Fishery resources are divided into fish species (such as cod and salmon), other crustaceans (such as swimming crab), shellfish, seaweed, and other organisms. For each category, the government defines the period and depth of water in which fishing is prohibited.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 16 7/4/2019 5:39:30 PM

Table 3.5 Period, Zones, and Depths of Water in Which the Capture of Fishery Resources Is Prohibited in Korea.

Fishery resources	Scientific name	Periods, zones, and depths of water in which capture and gathering is prohibited
1. All fishery resources (animals and plants)		
		April 1 to October 31 for waters mentioned in Notes 1 and 2
2. Fish		
a. Robust tonguefish	*Cynoglossus robustus*	July 1 to August 31
b. Pacific cod	*Gadus macrocephalus*	March 1 to 31 (January 1 to 31 for Busan and Gyeongsangnam-do)
c. Marbled flounder	*Pleuronectes yokohamae*	December 1 to January 31 of the following year
d. Chum salmon	*Oncorhynchus keta*	October 1 to November 30
e. Dotted gizzard shad	*Konosirus punctatus*	May 1 to July 15 (excluding Gangwon-do and Gyeongsangbuk-do)
f. Fat greenling	*Hexagrammos otakii*	November 1 to December 31 (November 15 to December 14 for the waters mentioned in Note 3)
g. Mottled skate	*Raja pulchra*	June 1 to July 15
h. Small yellow croaker	*Larimichthys polyactis*	July 1 to 31 (from April 22 to August 10 for fisheries using drift gill nets (among those using gill nets), excluding those who capture or gather less than 10 percent of the catch of small yellow croaker during the relevant period)
i. Largehead hairtail	*Trichiurus lepturus*	July 1 to 31 (limited to waters north of 33° North and excluding inshore jigging and coastal integrated fishing and those who capture or gather less than 10 percent of the catch of largehead hairtail during the relevant period)
j. Chub mackerel	*Scomber japonicus*	Period of one month between April 1 and June 30 announced by the Minister of Oceans and Fisheries (excluding those who capture or gather less than 10 percent of the catch of chub mackerel during the relevant period)
k. Black scraper	*Thamnaconus modestus*	May 1 to July 31 (June 1 to July 31 for fixed-net fisheries, coastal fishing, and sectional fisheries)
l. Red tilefish	*Branchiostegus japonicus*	July 21 to August 20
m. Okhotsk snailfish	*Liparis ochotensis*	August 1 to 31 (Gangwon-do only)
n. Alaska pollock	*Theragra chalcogramma*	January 1 to December 31
3. Crustaceans		
a. Swimming crab	*Portunus trituberculatus*	Period of two months or less between June 1 and September 30 designated by the Minister of Oceans and Fisheries (excluding those who capture or gather less than 5% of the catch of swimming crab during the relevant period using one- or two-boat large bottom trawling, one-boat medium bottom trawling in the East Sea Zone, one-boat medium bottom trawling in the Southwest Sea Zone, two-boat medium bottom trawling in the Southwest Sea Zone, large trawling, and or angling in inshore areas)

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 17 7/4/2019 5:39:30 PM

Table 3.5 Period, Zones, and Depths of Water in Which the Capture of Fishery Resources Is Prohibited in Korea. (cont.)

Fishery resources	Scientific name	Periods, zones, and depths of water in which capture and gathering is prohibited
b. Crabs (not including *Chionecetes japonicus*)	*Chionoecetes spp.*	1. June 1 to November 30 (June 1 to October 31 for moving body of waters at 131°) 22′ East (April 1 to July 20 and October 1 to November 30 for the area within the intersection of the coast of Jigyeong-ri (Hyeonnae-myeon, Goseong-gun, Gangwon-do) and 38° 34′ 9.68″ North; intersection of 38° 34′ 9.69″ North and 128° 30′ 6.89″ East; and intersection of 38° 33′ 9.69″ North and the coast of Jeojin-ri (Hyeonnae-myeon, Goseong-gun, Gangwon-do)) 2. March 1 to April 30 for the waters mentioned in Notes 5 and 6
c. Red snow crab	*Chionoecetes japonicus*	July 10 to August 25 (June 1 to July 10 for coastal gill net fisheries in Gangwon-do)
d. Horsehair crab	*Erimacrus isenbecki*	April 1 to May 31 (for Gangwon-do only)
e. Japanese spiny lobster	*Panulirus japonicus*	July 1 to August 31
f. Chinese white shrimp	*Penaeus orientalis*	May 1 to June 30
g. Japanese spear lobster	*Linuparus trigonus*	June 1 to August 31
4. Shellfish		
b. Egg cockle	*Fulvia mutica*	June 16 to September 30 (June 1 to September 30 for Busan, Ulsan, Gyeongsangnam-do, and Jeollanam-do (excluding Muan-gun and Yeonggwang-gun), and Jeju-do)
c. Spiny top shell	*Batillus cornutus*	June 1 to August 31 for Samsan-myeon (in Yeosu-si, Jeollanam-do) and Jeju-do (excluding Chuja-do (Chuja-myeon, Jeju-do)); July 1 to September 30 for Chuja-do (Chuja-myeon, Jeju-do); and June 1 to September 30 for Ulleung-do and Dok-do (both in Ulleung-gun) and Gyeongsangbuk-do
d. Abalone	*Haliotis spp.*	September 1 to October 31 (October 1 to December 31 for Jeju-do)
e. Geoduck clam	*Panopea japonica*	April 1 to July 31 (for Gangwon-do and Gyeongsangbuk-do only)
f. Comb pen shell	*Atrina pectinata*	July 1 to August 31
g. Japanese scallop	*Patinopecten yessoensis*	March 1 to June 30 for the waters mentioned in Note 7
h. Variously colored abalone	*Sulculus diversicolor*	July 1 to August 31 (for Jeju-do only)
5. Marine plants		
a. Gagome kelp	*Kjellmaniella crassifolia*	November 1 to January 31 of the following year
b. Gamtae Black gamtae	*Ecklonia cava* *Ecklonia kurome*	May 1 to July 31 (January 1 to December 31 for Jeju-do)
c. Gompi	*Ecklonia stolonifera*	May 1 to July 31

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 18 7/4/2019 5:39:30 PM

Table 3.5 Period, Zones, and Depths of Water in Which the Capture of Fishery Resources Is Prohibited in Korea. (cont.)

Fishery resources	Scientific name	Periods, zones, and depths of water in which capture and gathering is prohibited
d. Neolmiyeok	*Undariopsis peterseniana*	September 1 to November 31 (for Jeju-do only)
e. Arame	*Eisenia bicyclis*	May 1 to July 31
f. Green algae (jindobak, meokdobak)	*Grateloupia spp.*	October 1 to April 30 of the following year
g. Rockweed	*Silvetia siliquosa*	August 1 to September 30
h. Umutgasari	*Gelidium amansii*	November 1 to April 30 of the following year
i. Hijiki	*Hizikia fusiformis*	October 1 to January 31 of the following year
6. Other fishery resources		
a. Japanese sea cucumber	*Stichopus japonicus*	July 1 to 31
b. Japanese flying squid	*Todarodes pacificus*	April 1 to May 31 (from April 1 to 30 for offshore angling fisheries and integrated coastal fisheries, excluding catches captured through fixed-net fishing)
c. Whiparm octopus	*Octopus minor*	June 1 to 30 (unless designated otherwise by region by the provincial governor or mayor for a period of one month or longer between April 1 and September 30)
d. Webfoot octopus	*Amphioctopus fangsiao*	May 11 to August 31

- In addition, pursuant to the National Land Planning and Utilization Act and Fishery Resources Management Act, public waters and neighboring lands have been designated as fishery resource protection zones in order to protect and foster fishery resources.[1]
  - As of the end of 2017, a total of 30 areas, including the surface waters of 10 bays and 20 inland bodies of water (approximately 3,172 km^2), have been designated as fishery resource protection zones.

Table 3.6 Status of Designated Fishery Resource Protection Zones in Korea. (Number and Areas) (in km^2).

Year	Number	Designated area (total)	Seawater			Inland water
			Subtotal	Sea	Land	
2011	30 areas	3,230	2,894	2,526	368	336
2015	30 areas	3,161	2,864	2,495	369	297
2017	30 areas	3,172	2,863	2,495	368	309

[1] The Enforcement Decree of the Fisheries Management Act (Articles 7, 8, 10, and 11) notes the items related to the establishment of no-fishing zones and no-fishing seasons.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 19 7/4/2019 5:39:30 PM

Action Plan 1.3. Improve monitoring and assessing the fishery resources stock fluctuation at the regional level

- This management action involved efforts to improve the monitoring of changes in and assessment of basic fishery resources for preservation of fishery resources in the Yellow Sea.
  - In particular, this action focused on the development of survey techniques and a series of activities to secure the scientific data necessary to identify the status of fishery resources.
- The indicator used to assess the implementation of this management action was set as whether to conduct a survey about fishery resources or target species designated for recovery.
- To promote the rational management of fishery resources based on scientific data, RO Korea has been regularly conducting fishery resource surveys. Based on the results, RO Korea has been continuously designating target species that need to be restored as part of the fishery resource recovery project.
  - In particular, areas subject to the fishery resource surveys have been steadily expanded since 2006 and are expected to expand in the future. With that, Korea is monitoring these areas on a broader level.
- In addition, based on the results of the surveys, Korea has been designating fish species that require protection or restoration as target species.

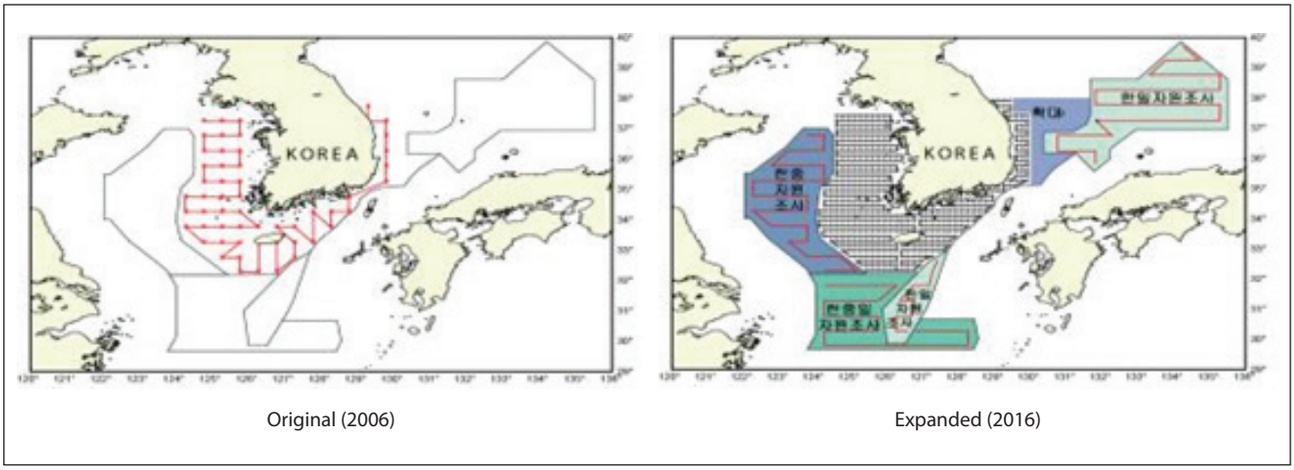
Δ **Yes, the surveys of the changes in fishery resources and monitoring systems are being restructured at the national level, making progress in the assessment and monitoring of the relevant waters.**

Survey of fishery resources and target species that need to be restored

- Since 2006, Korea has strengthened the standards for spatio-temporal surveys of fishery resources and has been conducting accurate resource surveys, thus, the reliability of which has been steadily increasing.
  - As the accurate resource surveys have been conducted continuously, the continuous monitoring of the changes in fishery resources have also been connected and other assessments were improved accordingly.
  - The fishery resource survey areas in 2006 (left figure has been expanded, as the figure on the right shows, revealing that geographic scope of the resource survey has expanded.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 20 7/4/2019 5:39:30 PM

Figure 3.3. Expansion of Fishery Resource Survey Area.



Original (2006) Expanded (2016)

- In addition, based on continuous resource surveys since 2006, the number of target fish species designated for restoration increased to 16 species as of 2017.

Table 3.7 Status of fish stocks to be restored (2006 ~ 2017).

Year	2006	2007	2008	2009	2012	2014
Number of species	4	7	10	12	15	16
Additional species	Sailfin sandfish, swimming crab, whiparm octopus, and variously colored abalone	Mottled skate, small yellow croaker, and Pacific cod	Blackfin flounder, black scraper, and purple Washington clam	Largehead hairtail and daggertooth pike conger	Chub mackerel, North Pacific giant octopus, and red tilefish	Alaska pollock

Management Goal 2	Reasonable resource use and maximization of recruitment stock
Background	Pursuing the sustainable use of resources by overcoming the reduction of resources in the Yellow Sea and maximizing the amount of available catchable resources (recruitment)

1. Implementation Assessment Indicators and Content

- Management Goal 2 involved measures to be taken to maximize catchable resources in the Yellow Sea and improve fishing gear to protect, restore and manage fishery resources.
  - The management actions involved in achieving this goal to restore and manage fishery resources toward maximizing resource recruitment are: (i) use of proper mesh size and develop fishing gear that promotes fishery resource management; (ii) restore fishery resources through stock enhancement; and (iii) establish a rational fishery resource management system.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 21 7/4/2019 5:39:30 PM

- The indicators used to assess the implementation of each management activities were: (i) number and types of eco-friendly biodegradable fishing gear and collection of lost and destroyed fishing gear; (ii) performance of various stock enhancement projects; and (iii) total allowable catch and recovery progress of target species.

Table 3.8 Management actions and indicators for Management Goal 2.

Management action	Indicators	Content
2.1: Set appropriate mesh size and develop fishing gears in resources management type	Number and types of eco-friendly biodegradable fishing gear and collection of lost and destroyed fishing gear	- The development of eco-friendly biodegradable fishing gear is considered as the development of fishing gear that promotes resource management
2.2: Restore fishery resources	Performance of various stock enhancement projects (installation of artificial reef facilities, release of marine species, marine forest, and marine ranching)	- Various fishery stock enhancement projects that can have a direct impact on the restoration of fishery resources
2.3: Establish reasonable fishery resources management system	Development of total allowable catch (TAC) and recovery progress of target fish species	- Setting the total allowable catch within the scope of the allowable biological catch (ABC) to prevent the over utilization and maintain a sustainable amount of fishery resources

2. Implementation Status and Major Results

Action Plan 2.1 Set appropriate mesh size and develop fishing gears in resources management type

- This management action is to improve fishing gear and maximizing the recruitment of fishery resources.
  - In particular, it is focused on the development of fishing gear that reduces the incidental catch of small fish and prevents resource imbalances.
- The indicator used to assess the implementation of these management actions were the use of proper nets (the most basic item of fishing gear) and development of (eco-friendly) fishing gear that promotes resource management.
- In RO Korea, the Enforcement Decree of the Fisheries Act stipulates the size of mesh that is prohibited by fishing type in an effort to protect fishery resources. In addition, Korea has been pursuing the development and distribution of biodegradable fishing gear to prevent the pollution of fishing grounds and reduce damages to fisheries.
  - In particular, the use of properly sized nets for fishing areas takes into consideration of the external factors of change by adjusting the size depending on the amount of resources and environmental changes.

Δ **Yes, The size of net knots has been stipulated by the Enforcement Decree of the Fisheries Act, and the development of fishing gear using eco-friendly materials is still ongoing.**

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 22 7/4/2019 5:39:30 PM

Regulation on proper mesh size per fishing method and type of fishing gear

- In Korea, Article 45(3.3) of the Enforcement Decree of the Fisheries Act stipulates that the Minister of Oceans and Fisheries has the authority to designate and announce the mesh size when deemed necessary for the protection of fishery resources.
  - The current designated fishing method and mesh size are listed in **Table 3.9**.

Table 3.9 Mesh size by Fishing Method (Enforcement Decree of the Fisheries Act).

Fishing Method	Main catch species	Net knots prohibited from use
1. Offshore shore fishery		
a. One-boat large bottom trawling		33 mm or less
b. Two-boat large bottom trawling		54 mm or less
c. One-boat medium bottom trawling in the East Sea Zone, one-boat medium bottom trawling in the Southwest Sea Zone, and two-boat medium bottom trawling in the Southwest Sea Zone		33 mm or less
d. Large trawling		54 mm or less
e. Medium trawling in the East Sea Zone		43 mm or less
f. Large purse seine fishing		30 mm or less
g. Small purse seine fishing		30 mm or less
h. Offshore gill-net fishing	Japanese Spanish mackerel	100 mm or less
	Croaker	50 mm or less
	King crab	240 mm or less
i. Offshore stow-net fishing		35 mm or less
j. Offshore eel pot fishing		35 mm or less
k. Offshore pot fishing	King crab	150 mm or less
	Red snow crab	125 mm or less
	Other species	35 mm or less
2. Inshore fishery		
a. Improved coastal stow-net fishing		25 mm or less
b. Coastal purse seine fishing		15 mm or less
c. Coastal pot fishing	Conger eel, whiparm octopus, shrimp, and freshwater swimming crab	22 mm or less
	King crab	150 mm or less
	Red snow crab	125 mm or less
	Other species	35 mm or less
d. Coastal beam trawling		25 mm or less
e. Coastal drag net fishing		15 mm or less
f. Coastal gill net fishing	Japanese Spanish mackerel	100 mm or less
	Croaker	50 mm or less
	King crab	240 mm or less

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 23 7/4/2019 5:39:30 PM

Table 3.9 Mesh size by Fishing Method (Enforcement Decree of the Fisheries Act). (cont.)

Fishing Method	Main catch species	Net knots prohibited from use
3. Fishery business within a demarcated zone		
a. Gape net fishing (fishing method that involves the use of stow nets on stakes, used in Yeonggwang-gun)		25 mm or less
b. Gape net fishing (fishing method that involves the use of stow nets on stakes, used in Yeonggwang-gun) and other types of fishing in demarcated areas besides shellfish dredge fishing		15 mm or less

Promotion of eco-friendly fishing gear distribution project

- Meanwhile, the Ministry of Oceans and Fisheries has been making efforts to minimize the damage caused by fishing action and the fishing industry by the loss of fishing gear through the promotion of the Eco-friendly Fishing Gear Distribution Project.

Table 3.10 Comparison of Nylon Nets (Existing Fishing Gear) and Biodegradable Nets.

Category	Nylon nets	Biodegradable nets
Material	Polyamide (PA)	Polybutylene succinate (PBS)
Decomposition characteristics	Lasts for several hundred years depending on environmental conditions	Starts to be decomposed by microorganisms after two years

Damage caused by nylon fishing gear	**Effect on the fishing industry and fishery resources**
	• Lost fishing gear does not decompose, thus resulting in constant damage from ghost fishing
	  * 10 percent of gill nets and 20 percent of fish pots are lost in the fishing process
	  * damage from ghost fishing: estimated at KRW 200 billion every year
	• Destroys spawning grounds and hinders the function of artificial reefs
	
	Effect on the environment and safety
	• Marine litter generated due to loss and deposition of fishing gear requiring costly collection efforts
	• Lost fishing gear obstructs fishing activity and increases the risk of vessel related accidents.
	• Nylon fishing gear generates carcinogens when incinerated and causes soil contamination for hundreds of years when buried.	

Source: Ministry of Oceans and Fisheries

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 24 7/4/2019 5:39:30 PM

Action Plan 2.2 Restore fishery resources

- The purpose of this management action is to pursue various stock enhancement project in the Yellow Sea.
- The indicator used to assess the implementation of this management action was the promotion of various fishery resource recovery projects.
- In RO Korea, various fishery resource recovery projects have been carried out, and most of the current projects show sustainable and stable operation.
  - The installation of artificial reefs, release of fry, marine forest, marine ranching, and various other fishery resource creation projects have been carried out.
  - In particular, the size, budget, and target area of related projects have been continuously expanded, showing that management activities have been actively carried out.

Δ **Yes, this management action has been successfully implemented. The fishery resource recovery project began in the 1980s and is still being carried out, and the related budget has been increased.**

Stock enhancement programs (installation of artificial reef facilities, release of fry, marine forest, and marine ranching)

Installation of artificial reef facilities

- Since 2011, artificial reef facilities have been installed across 2.9 ha, using an annual average of more than KRW 40 billion.

Table 3.11 Installation of artificial reef facilities (2011-2016).

Year	Installation area (ha)	Number of facilities installed	Installation costs (KRW 100 million)
2011	3,133	10,015	393.84
2012	3,274	8,315	448.64
2013	2,778	9,741	379.33
2014	2,938	11,661	408.92
2015	2,790	10,743	540.11
2016	1,194	10,836	363.95

Source: Korea Fisheries Resources Agency website

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 25 7/4/2019 5:39:31 PM

Marine forest

- Korea set a goal to create over 54,000 ha of marine forests from 2009 to 2030. As of 2017, 15,252 has of marine forests had been created.
  - The marine forest project and related project costs are as follows:

Table 3.12 Marine forest Project in Korea (2011-2016).

Category	2011	2012	2013	2014	2015	2016	2017	2018
Project costs	KRW 12.9 billion	KRW 15.9 billion	KRW 19.8 billion	KRW 32.7 billion	KRW 35.7 billion	KRW 34.8 billion	KRW 35.2 billion	KRW 35.2 billion
Number	11	10	9	19	21	24	18	20
Area (ha)	715	860	1,388	2,574	3,236	3,064	3,043	3,107

Coastal Marine Ranch

- Korea is aiming to establish 50 coastal marine ranches from 2006 to 2022 as it develops pilot marine ranches in the East, West, and South seas and is currently expanding marine ranches in all coastal areas.
  - The project is being conducted in each phase. In Phase 1 (1998-2010), the government laid the foundation for marine ranching through pilot projects. In Phase 2 (2005-2014), local governments promoted marine ranching through development projects. Phase 3 (2015-2030) is being conducted as a general project, participated in by fishing professionals and private companies.
  - The development of marine ranches from 2011 to 2017 was conducted as follows:

Table 3.13 Marine Ranching Projects in Korea.

Year	Project size (count)				Project cost (KRW 100 million)	Areas with new facilities
	Cumulative total	Implemented	New	Completed		
2009	12	12	3	-	120	Gijang, Sinan, and Seogwipo (Gangjeong)
2010	17	17	5	4	170	Taean, Seocheon, Jindo, Yeongdeok, and Ulju
2011	21	17	4	4	170	Gangjin, Yeosu, Gyeongju, and Geoje (Dadae)
2012	26	18	5	2	190	Ongjin (Baengnyeong, Daecheong), Yangyang, Buan, Pohang, and Tongyeong
2013	30	20	4	2	210	Goseong, Ulleung, Dangjin, and Boryeong
2014	36	24	6	5	240	Gijang, Jung-gu (Incheon), Gunsan, Namhae, Jeju (Bukchon), and Jeju (Geumneung)
2015	36	19	-	4	190	-
2016	40	19	4	5	190	Samcheok, Taean (North), Taean (South), and Boryeong (Sapsi-do)
2017	45	20	5	4	190	Samcheok (Geundeok), Taean (Geunhong), Ongjin (Deokjeok, Jaweol), Sinan (Anjwa), and Boseong
Total					**1,490**	

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 26 7/4/2019 5:39:31 PM

Action Plan 2.3 Establish a reasonable fishery resources management system

- The purpose of this management action is to carry out scientific research on marine resources and use the research results to implement a rational management system of ecosystem-based fisheries.
- The indicators used to assess the implementation of this management actions were the implementation of the Total Allowable Catch (TAC) system (the most representative scientific data-based fishery resource management system), promotion of the TAC, and trend of increasing the number of fish species subject to the TAC.
- RO Korea's TAC system has been implemented since 1998. After 2011, the TAC exhaustion rate has been steadily decreasing.
  - The decrease in the TAC exhaustion rate means that the effects of resource management are beginning to manifest. Therefore, the implementation of the project and the effectiveness of the city administration's activities have been accompanied in the TAC system.
- Only four species of TAC subject in 1999 could reach 18 species in 2017. This means that the overall survey, analysis, and assessment regarding the establishment system have been completed.

Δ **Yes, launched after 1998, the TAC system has become an established fishery resource management system. The fact that the TAC exhaustion rate has been decreasing means that the efforts made to protect fishery resources are now bearing fruit.**

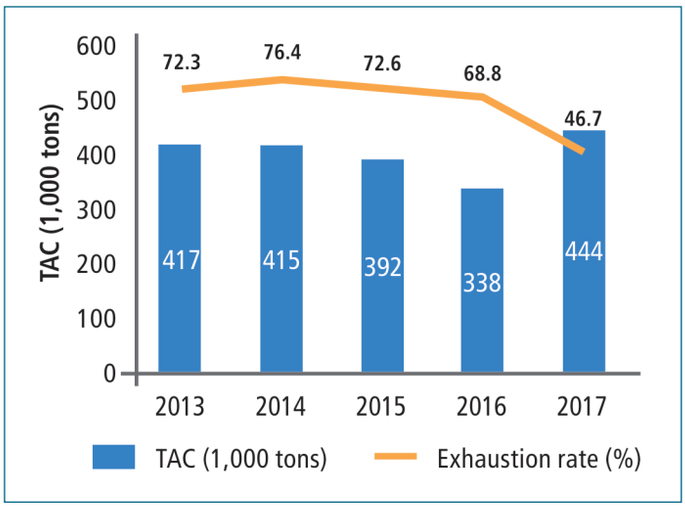
TAC Implementation Status and Annual Average Exhaustion Rate

- To improve the management of fishery resources in its domestic waters, Korea has adopted the TAC system, a real-name system for managing the use of fishing gear, limits to the use of fishing gear, and voluntary management fishing through the revision of the Fisheries Act (1995), revision of the Fishery Resources Protection Decree (1996), and the enactment of the Regulations on the Management of the Total Allowable Catch (TAC) (1998).
  - Korea promoted the TAC system based on scientific surveys and assessments of resources,[2] and as of 2017, the exhaustion rate of the TAC (444,000 tons) is below 50 percent.

[2] The TAC system designates the maximum catch size by species per fishing vessel and prohibits overfishing. The TAC is determined through the deliberation of the TAC Deliberation Committee and Central Fisheries Mediation Committee. Each fishing vessel must report its catch sizes. In order to manage fishing activities, observers are assigned to major landing ports to survey and check compliance.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 27 7/4/2019 5:39:31 PM

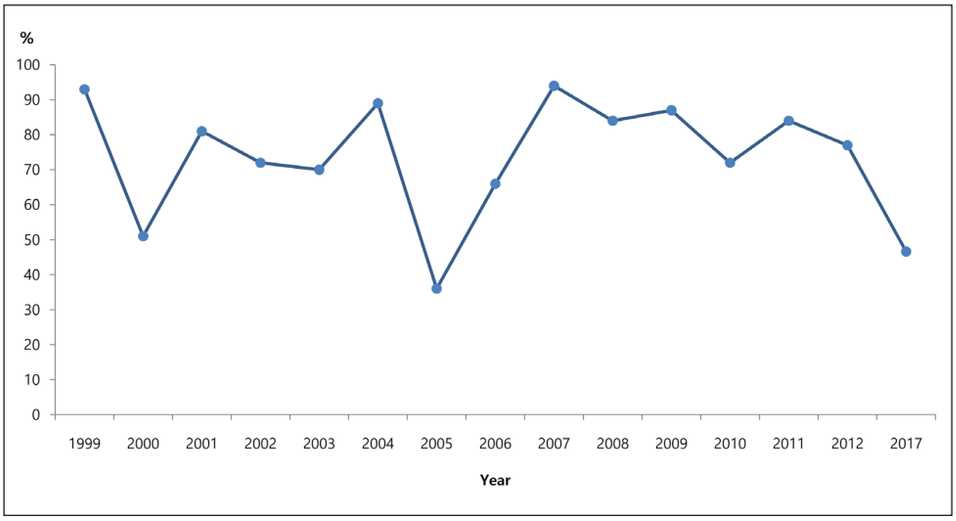
Figure 3.4 TAC and Exhaustion Rate by Year.



** The figure for TAC in 2017 is the sum of TAC until October 2018.*

- The TAC exhaustion rate has been gradually decreasing since 2011, meaning that fishery catches have not been exceeding the allowable catch. This reflects the positive effects of the fishery resource management efforts that have been made so far.
  - In 2011, the exhaustion rate was over 80%, but that figure fell to about 46 percent by 2017. As of 2017, the exhaustion rate of the TAC (444,000 tons) is below 50 percent.

Figure 3.5 TAC System and Changes in Exhaustion Rate by Year (1999-2017).



Status of Species under the TAC System

- After the implementation of the TAC system, the number of species under the system increased to 18 by 2017.
  - Starting with four species in 1999, the number increased to 18, including sailfin sandfish, swimming crab, whiparm octopus, and variously colored abalone.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 28 7/4/2019 5:39:31 PM

Table 3.14 Species under the TAC System (2011-2017).

Details	Species	2011	2012	2013	2014	2015	2016	2017	2018
Established recommendation to restore species subject to fishery resource recovery	Sailfin sandfish								
	Swimming crab								
	Whiparm octopus								
	Variously colored abalone								
	Mottled skate								
	Small yellow croaker								
	Pacific cod								
	Blackfin flounder								
	Purple Washington clam								
	Black scraper								
	Largehead hairtail								
	Daggertooth pike conger								
	Chub mackerel								
	North Pacific giant octopus								
	Red tilefish								
	Japanese flying squid								
	Webfoot octopus								
	Alaska pollock (resource)								
	Alaska pollock (farm)								

Management Goal 3	Continuous improvement of mariculture technology to reduce environment stress
Background	Alleviate environmental stress in the Yellow Sea, including various factors and changes of the cultivation environment, through the development of standard or model aquaculture techniques

1. Implementation Assessment Indicators and Content

- Management Goal 3 is aimed to alleviate the environmental stress caused by the world's most productive and intensive mariculture farms in the Yellow Sea, and thus to promote the environmental preservation and sustainable use of the Sea.
- The Goal 3 consists of three management actions: (i) reduce waterborne pollution; (ii) develop a seawater recirculating aquaculture system and alternative feed sources using fishery by-product; and (iii) conduct early detection and diagnosis of diseases for maricultured organisms.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 29 7/4/2019 5:39:31 PM

- The implementation of the abovementioned three actions will be evaluated with indicators of (i) concentration of organic matter in the sediment under mariculture farms; (ii) development of a model for the seawater recirculating aquaculture system; and (iii) development of alternative feed sources, the number of monitoring activities for notifiable infectious disease and the number of application of fish vaccines in aquaculture farms.

Table 3.15 Management actions and evaluation indicators for Management Goal 3.

Management action	Indicators	Content
3.1: Reduce waterborne pollution and enhance the health of farmed organisms by Integrated Multi-Trophic Aquaculture (IMTA)	Reduction of disease incidence among and improvement of the growth of cultured organisms and reduction of the concentration of organic matter in the sediment	The reduction of incidences of diseases in cultured organisms due to waterborne pollution and changes in the concentration of organic matter in the sediment are measures of improvement of the waterborne pollution.
3.2: Supply industrialized seawater recirculating aquaculture system and develop alternative feed sources using fishery byproducts	The number of developed basic models of seawater recirculation aquaculture system and the number of developed alternative feed sources	The number of developed alternative feed sources and seawater recirculation aquaculture system is directly reflected
3.3: Implement early warning, diagnosis system, effective management for mariculture diseases	The number of monitoring activities for notifiable infectious diseases, progress in research on disease diagnosis, and the number of application of fish vaccines in mariculture farms	Performance of monitoring for notifiable infectious diseases and the use of fish vaccines is directly reflected

2. Implementation Status and Major Results

Action Plan 3.1. Reduce waterborne pollution and enhance the health of culture organisms by IMTA

- The purpose of this management action is to prevent waterborne pollution and disease occurrence by preventing the loss of the self-purification capacity and the balance of the ecosystem, resulting from continuous cultivation of specific organisms in limited areas of water and developing eco-friendly mariculture techniques for sustainable utilization of coastal waters.
- Indicators used to assess the implementation of this management action include reduction of the incidence of diseases in cultured organisms, increase in the growth of cultured organisms through the application of various eco-friendly technologies, and reduction of the concentration of organic matter in the sediment.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 30 7/4/2019 5:39:31 PM

- This management action was carried out mainly through small-scaled projects that were conducted by the National Institute of Fisheries Science (NIFS) from 2011 to 2018.
  - The projects included "Development of Integrated Multi-trophic Aquaculture (IMTA) Techniques for Fishery Tourism Using Fishing Ports" (conducted in fish farms located in Yangyang, Gangwon-do by the East Sea Fisheries Research Institute; Ease Sea-typed IMTA) from 2011 to 2013 and "Development of Offshore-specific IMTA Techniques" (conducted in fish farms in Tongyeong by the Southeast Sea Fisheries Research Institute; South Sea-typed IMTA from 2014 to 2018.
- In particular, the development of IMTA facilities and techniques was promoted only through national research and development projects, and therefore practical application and commercialization of the technique is not yet achieved
  - The implementation of this management action was thus evaluated as "not yet achieved".

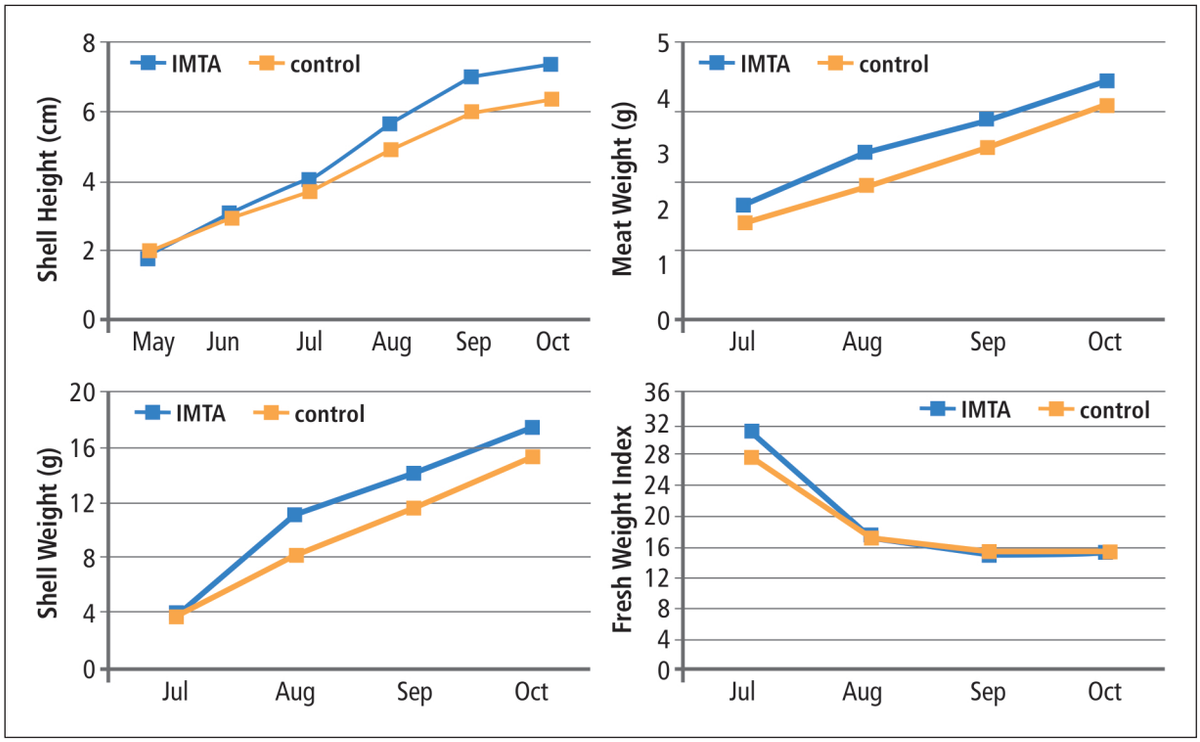
Δ **Yes or No, this management action has not been successfully implemented. Besides the West Sea, where research projects were conducted, projects to verity models were only conducted in other seas, where additional efforts should be made to develop IMTA .**

Reduction of the incidence of disease and enhancement of growth rate

- The National Institute of Fisheries Science (NIFS) promoted the development of IMTA as well as coastal-specified IMTA from 2011 to 2018. The application of the aquaculture techniques developed through these projects successfully reduced the incidence of diseases.
  - In particular, the South Sea-type IMTA technique showed 35.2% lower incidence of disease in farmed red sea breams than the traditional mono-culture technique.
- In terms of growth rate, IMTA-farmed Pacific oysters exhibited 15.5% faster growth in shell height, and 10.1% faster growth in flesh weight than monocultured Pacific oysters and IMTA-farmed sea cucumbers achieved 41.7% faster growth in weight than their monocultured counterparts.
  - These results indicate that IMTA-farmed organisms have lower incidence of disease and better health. It is thus proved that IMTA is effective for reducing diseases caused by waterborne pollution.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 31 7/4/2019 5:39:31 PM

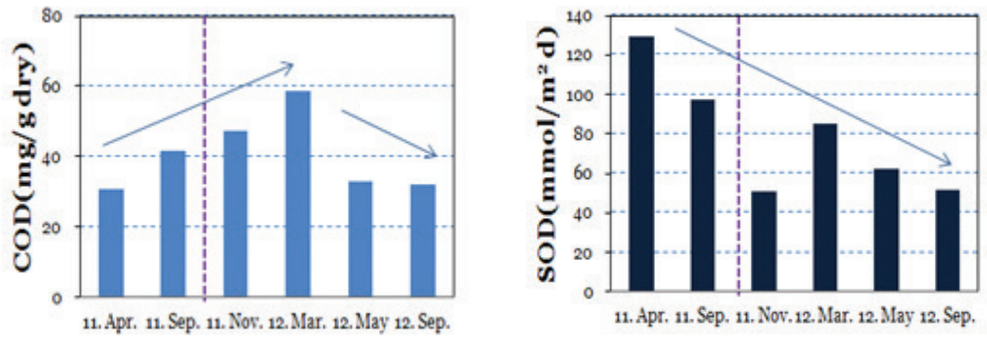
Figure 3.6 Comparison of growth performance between IMTA and monoculture-farmed Pacific oysters.



Reduction of the concentration of organic matter in the sediment (South Sea-typed IMTA)

- It was also shown that an application of IMTA reduced the concentration of organic matter in the sediment under fish farms.
  - The results of the application of the technique and model showed that the decomposition rate of anaerobic organic matter in the sediment was 34% in the IMTA farm while 82% in the control, this revealed that the habitat environment of IMTA farms is much more favorable.
  - The primary production in an IMTA farm was 1.5 to 2.6 times higher than in the control group, again indicating a better habitat environment. In addition, the reduction of the concentration of organic matter in the farm sediment oxygen consumption after the installation of IMTA facilities clearly showed the positive effects of IMTA farming.

Figure 3.7 Changes in the concentration of organic matter in the farm sediment and sediment oxygen consumption after the installation of IMTA facilities.



YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 32 7/4/2019 5:39:32 PM

Action Plan 3.2 Supply industrialized seawater recirculating aquaculture system and develop alternative feed sources using fishery byproducts

- This management action is aimed to develop and commercialize an eco-friendly recirculation aquaculture system to minimize the adverse ecological effects of waterborne pollution in fish farms.
- It is also aimed to develop alternative feed sources using fishery by-products as a means of improving, distributing, and expanding eco-friendly formulated feeds.
- The evaluation indicator of this management action is the number of supplied seawater recirculation aquaculture system units and the number of alternative feed sources developed using fishery by-products.
- This action was mainly carried out through research projects carried out by NIFS from 2012 to 2017 on development of basic model of seawater recirculation aquaculture system and development of alternative feed sources.
- The above research projects by NIFS focused on the development of prototype model of seawater recirculation aquaculture system and have thus not yet resulted in the actual distribution and commercialization of such a system.
  - As for the recirculation aquaculture system, implementation of the management action was limited to research activities at the R&D project level and thus it should be evaluated that the task was not effectively achieved.
- On the other hand, the project for the development of alternative feed sources using fishery by-products conducted by NIFS has produced new feed sources since 2011 and can therefore be considered as an achievement of the management action.

Δ **Yes, this management action can be evaluated as somewhat insufficient. Although the action for development of seawater recirculation aquaculture system was partly achieved through development of a model as a national R&D project, new alternative feed sources using fishery byproducts were developed and distributed.**

Development of alternative feed sources using fishery byproducts

- From 2011 to 2017, NIFS developed seven types of alternative feed sources using fishery byproducts (one new feed source every year).

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 33 7/4/2019 5:39:32 PM

Table 3.16 Status of the development of alternative feed sources using fishery byproducts (2011-2017).

Year	Developed feed	Characteristics
2011	Alternative feed source using flatfish fermented fishery byproducts	Potentially to replace 18% of fish meal content (currently 60% in fish feed)
2012	Alternative feed source for fish meal using flatfish	Potentially to replace 30% of fish meal (152 won/kg to be saved)
2013	Alternative feed source mixed vegetable and red sea-bream	Potentially to replace 20% of fish meal
2014	Alternative feed source using flatfish hydrolyzed chicken	Potentially to replace 40% of fish meal
2015	Alternative feed source mixed rockfish and animal/ vegetable	Potentially to replace 70% of fish meal
2016	Alternative ingredient using Korean rockfish tuna by-products	Potentially to replace 75% of fish meal
2017	Flatfish carbohydrate alternative feed source	Potentially to replace flour

Action Plan 3.3 Implement early warning, diagnosis system, effective management for mariculture diseases

- This management action was designed to implement the effective management of diseases in mariculture farms through the early detection and diagnosis of diseases that have serious adverse impacts on seawater aquaculture production.
  - As a measure to promote effective management, including the early detection and diagnosis of diseases for seawater aquaculture, it is important to develop and apply new techniques and management measures for controlling diseases.
- The evaluation indicator of this management action is whether a new management and management measure was actually developed and applied for animals reared in seawater farms.
- This management action was carried out through the project for the "development and operation of an epidemic prevention system for fishery organisms" conducted by NIFST, this project led to the development and operation of an epidemic prevention program as well as the development of disease diagnosis methods for cultured species and improvement of the disease forecasting rate and other aspects of the seawater aquaculture disease management system.

Δ **Therefore, this management action has been successfully implemented. For this action, a broad range of activities were conducted through the project for the development and operation of an epidemic prevention system for fishery organisms, which also led to significant results.**

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 34 7/4/2019 5:39:32 PM

Promotion and effects of the project for the "development and operation of an epidemic prevention program for fishery organisms"

- NIFS promoted the project for the "development and operation of an epidemic prevention program for fishery organisms" and made various achievements in relation to the epidemic prevention program for fishery organisms and related techniques, establishment of the system, and distribution of vaccines.
  - This project allowed for the development and operation of an epidemic prevention system that complies with the international standards for the management of diseases affecting fishery organisms and strengthened the management of fishery diseases.
- The project also made it possible to increase the disease forecasting rate (number of actively forecasted diseases/number of notifiable infectious diseases) from 76% in 2015 to 90% in 2017. In addition, the number of notifiable infectious diseases subject to monitoring was increased from 16 in 2013 to 18 in 2015 and 19 in 2017.
- In addition, from 2011 to 2017, measures for diagnosing diseases affecting cultured species were researched and developed, and the sales of vaccines for fisheries have been steadily increasing since 2011.

Table 3.17 Status of research and development of disease diagnosis methods for cultured organisms.

Year	2011-2013	2014-2016	2017-2019
Targeted diseases	Koi herpes virus disease, white spot disease virus, Marteilia in shellfish, and Oyster herpes virus	Streptococcus in olive flounder, Edwardsiellosis, and Vibrio vulnificus	Spring Viremia in carp, viral pustulosis in abalone, vibrio vulnificus in cultured fish, and Streptococcus

Table 3.18 Sales of fish vaccines.

Year	2011	2012	2013	2014	2015	2016
Sales	KRW 1.3 billion	KRW 1.8 billion	KRW 2.3 billion	KRW 1.9 billion	KRW 2.5 billion	KRW 3.2 billion

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 35 7/4/2019 5:39:32 PM

Management Goal 4	Establish and improve continuous integrated pollution monitoring system and pollutant countermeasure system
Background	Establish a monitoring and managing system for source-management of various pollutants flowing into the Yellow Sea

1. Implementation Assessment Indicators and Content

- The purpose of Management Goal 4 was to manage the various sources of marine pollutants causing damage to the YSLME's regulating services and meet international emissions standards through intensive monitoring of the inflow pollutants and indicator establishing of management system.
- This goal consists of three management actions: (i) conduct intensive monitoring and evaluation of pollution; (ii) manage organic pollutants and comply with international standards; and (iii) implement international treaties on oil and the Hazardous and Noxious Substances (HNS) regulations.
  - The indicators for assessing the implementation of the management actions are: (i) regular surveys for monitoring the marine environment; (ii) promotion of the banning of waste dumping and industrial wastewater dumping into the sea in order to comply with international standards; and (iii) implementation of international treaties on oil and the HNS regulations.

Table 3.19 Management actions and Indicators for Management Goal 4.

Management action	Indicators	Content
4.1: Intensive pollution monitoring and assessment	Regular surveys to monitor the marine environment	Carry out regular surveys necessary for intensive pollution monitoring and assessment
4.2: Comply with the international standards for regulating the toxic organic pollutants	Compliance with the international standards for persistent organic pollutants (POPs) and management of pollutants based on the Stockholm Convention	Enact and enforce of domestic laws necessary for the management of POPs in accordance with international standards
4.3: Implement the international agreements regarding the regulations on oil and HNS	Acceptance and implementation of international treaties related to oil and the HNS regulations in national laws	Ratification of the IMO Convention on the HNS and the OPRC (International Convention on Oil Pollution Preparedness Response and Cooperation), results of domestic efforts of implementation and improvements, etc.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 36 7/4/2019 5:39:32 PM

2. Implementation Status and Major Results

Action Plan 4.1 Intensive pollution monitoring and assessment

- This management action aimed to expand the foundation for the prevention of and responses to changes and pollution in the marine environment caused by various factors and implement the intensive monitoring and assessment of pollution necessary to enable effective responses.
  - A continuous monitoring system is needed to enable adaptive management by identifying the trend of the status and changes of the marine environment and implement a management plan.
- The indicator used to assess the implementation of this management action was whether environmental surveys were regularly conducted for the intensive monitoring of the marine environment.
- Korea has been operating astable and continuous marine environment surveys since the 1980s. The surveys have been operated in a practical manner through the adjustment of the survey items, regions, and subjects of intensive surveys under the circumstances and demands.
  - Korea is also considering to build an open-access database system in order to facilitate and maximize data use and transparency.
- Thus, it could be said that the management action of the intensive monitoring and assessment of pollution has been faithfully implemented.

Δ **Yes, the management, monitoring, and assessment of pollution sources and marine environments are being conducted in a systematic manner through the stable marine environmental survey system.**

Stable operation of the Marine Environment Monitoring Network

- Korea has been operating the Marine Environment Monitoring Network since the 1980s.
  - The Marine Environment Monitoring Network has been continuously adding and expanding survey stations (or areas), items, and objects and thus supporting actual environmental assessments based on analysis and monitoring of previous survey results.
- Since 2010, the National Institute of Fisheries Science has been conducted the environmental monitoring of fishing grounds for six times per year (February, April, June, August, and October), as a result of which 12 sets of data (water temperature, salinity, dissolved oxygen, pH, transparency, suspended matter, chlorophyll a, and five types of dissolved nutrients) have been disclosed.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 37 7/4/2019 5:39:32 PM

- These data have been used not only for numerous marine environmental management policies[3]* but also for National Reports on Marine Environment submitted to international organizations, such as the UNEP and OECD, meaning that they are being well used as fundamental data for assessing Korea's marine environment.

- Since 2017, the Korea Marine Environment Management Corporation (KOEM) has taken over this project, and the results of the surveys are open-accessed through Korea's Marine Environment Information System.[4]

Table 3.20 Changes in Korea's Marine Environment Monitoring Network.

Year	Developed feed
2011	103 shores, 377 stations, 52 items, 4 times, surface and bottom layers, commissioned to KOEM
2012	103 shores, 401 stations, added survey stations for intensive survey of waters under special management (27 stations)
2013	103 shores, 417 stations, strengthened survey of waters and estuaries under environmental management
2014	98 shores, 417 stations, intensive monitoring of 23 stations on Sihwa Lake, 8 stations on Suyeong River, and 13 stations at Masan Bay
2015	99 shores, 417 stations, strengthened the survey of the Estuary Environment Monitoring Network, and established additional automatic water quality measurement stations
2016	99 shores, 417 stations, strengthened surveys of environmental management sea areas, etc.
2017	57 shores, 425 stations, demarcated and surveyed waters via the Marine Environment Monitoring Network according to revised marine environment standards (Ministry of Oceans and Fisheries Notice No. 2016-207), in accordance with Article 8 of the Marine Environment Management Act

- The survey items, period, and stations for each survey medium as of 2017 are listed in the **Table 3.21.**

[3] Designation of marine environmental management areas, determination of target water quality for the coastal pollution control load, selection of priority survey areas for the development of purification and restoration technologies for polluted sediment, establishment of a comprehensive marine environmental preservation plan, establishment of basic national strategies for marine environmental preservation, establishment of a basic plan for the management of fishing grounds, confirmation of survey stations for the basic marine ecosystem survey, etc.

[4] Marine Environment Information System (http://www.meis.go.kr/).

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 38 7/4/2019 5:39:32 PM

Table 3.21 Survey Items, Period, and Stations for Each Survey Medium of the Marine Environment Monitoring Network, as of 2017.

Category	Survey items	Survey period	Survey stations
Seawater			
General	Water temperature, salinity, pH, DO, COD, TN, DIN (NO_2-N, NH_4-N, and NO_3-N), TP, DIP (PO_4-P), SiO_2-Si, oil content, SS, and transparency	February, May, August, and November	374 stations
Trace minerals	Cu, Pb, Zn, Cd, Cr6+, total mercury, As, and CN	February and August	81 stations
Marine organisms			
General	Chlorophyll-a	February, May, August, and November	374 stations
	Total coliform	February, May, August, and November	81 stations
Trace minerals	Cu, Pb, Zn, Cd, Cr, total mercury, and As	February	25 stations
Persistent organic pollutants	PCBs, TBT, organic chlorinated pesticides, PAHs, and dioxin/furan	February	25 stations
Marine sediment			
General	Grain size, volatile solids, sulfides, and COD	February	81 stations
Trace minerals	Cu, Pb, Zn, Cd, Cr, total mercury, and As	February	81 stations
Persistent organic pollutants	PCBs, TBT, organic chlorinated pesticides, PAHs, and dioxin/furan	February	25 stations

- In addition, various monitoring networks classified by type and purpose are being operated, and surveys of special management areas and environmental conservation areas are also conducted on a regular basis.

Figure 3.8 Map of Survey Areas for the Marine Environment Monitoring Network and Screenshot of the Marine Environment Information System (MEIS).

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 39 7/4/2019 5:39:32 PM

The Marine Environment Monitoring Network consists of Port Environment Monitoring Networks (50), Littoral Sea Environment Monitoring Networks (212), Environment Monitoring Networks for Environmental Management Sea Areas (135), Estuary Environment Monitoring Networks (20), Automatic Seawater Quality Monitoring Networks (15), and Regular Service Vessel Automatic Seawater Quality Monitoring Network (1).

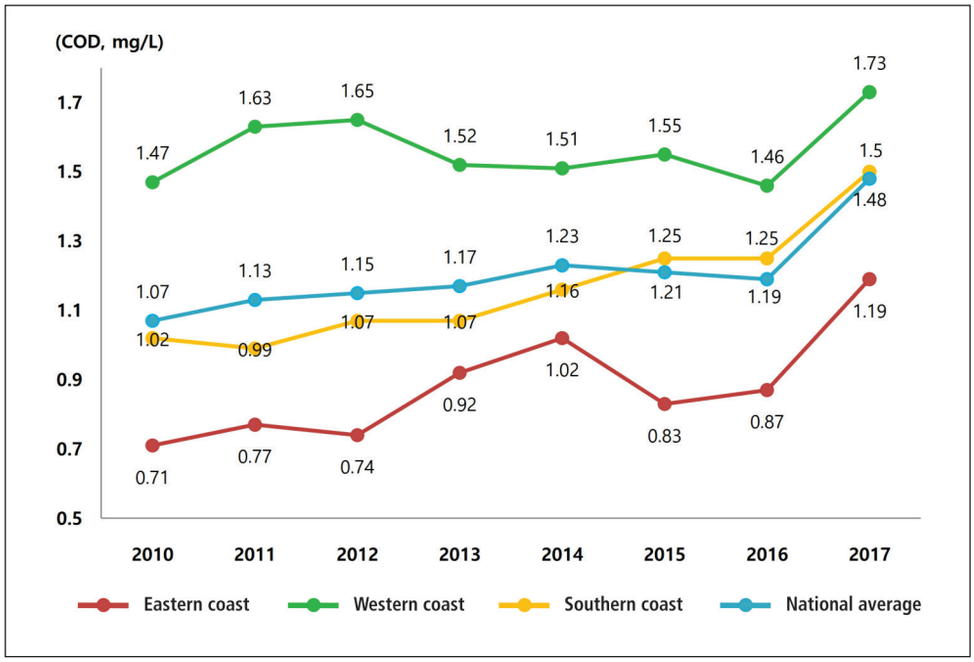
- The recent trend and status (2010-2017) of the chemical oxygen demand (COD) of Korea's coastal areas measured through the Marine Environment Monitoring Network Project is outlined in **Table 3.22** and **Figure 3.9**

Table 3.22 Status of COD of Korea's Coastal Areas by Year.

Region	2010	2011	2012	2013	2014	2015	2016	2017
Eastern coast	0.71	0.77	0.74	0.92	1.02	0.83	0.87	1.19
Southern coast	1.02	0.99	1.07	1.07	1.16	1.25	1.25	1.50
Western coast	1.47	1.63	1.65	1.52	1.51	1.55	1.46	1.73
National average	1.07	1.13	1.15	1.17	1.23	1.21	1.19	1.48

(Unit: mg/L (ppm))

Figure 3.9 Recent Trends of the COD in Korea's Coastal Areas.



YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 40 7/4/2019 5:39:32 PM

Action Plan 4.2. Comply with the international standards for regulating the toxic organic pollutants

- This management action aimed to promote the management of persistent, bio accumulative and toxic pollutants that enter the marine environment from industrial facilities and cities in compliance with international standards.
- The indicator used to assess this management action was the application of international standards to the management of persistent organic pollutants (POPs), particularly the acceptance, application, and management of the criteria proposed in the Stockholm Convention, which was established to promote the sound management of POPs.
- The Stockholm Convention was ratified and entered into force in Korea in 2007. Korea has implemented the same POP management criteria set out in the Convention. Any new changes or discussion on the management criteria of the Convention are promptly reflected in the national criteria.
  - The criteria proposed in the Stockholm Convention have been incorporated into the POPs Control Act and Marine Environment Management Act to provide the basis for POPs management efforts.
- In addition, POPs monitoring networks have been established and operated to monitor the status and trend of pollution of the marine environment by POPs.
  - This shows that Korea has been complying with international conventions in terms of the management of toxic pollutants.

Δ **Yes, this management action has been successfully implemented. The Stockholm Convention on POPs has been applied, incorporated into domestic laws, and implemented in actual management in Korea, indicating that this management action has been faithfully implemented.**

Establish and implement domestic criteria and management according to the Stockholm Convention

- Korea joined the Stockholm Convention in 2007, identified the status of its POPs emissions, and implemented related laws.
  - To promote the domestic implementation of the Stockholm Convention (ratified in January 2007), Korea has been systematically managing POPs at the national level through the POPs Control Act and Marine Environment Management Act.
- For the risk management of POPs, including dioxins and furans, Korea has been promoting consistent management at the global level in accordance with the Stockholm Convention.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 41 7/4/2019 5:39:32 PM

- With the aim of improving its management of POPs, Korea created the Basic Plan for the Management of POPs and established basic goals, a direction, promotion plan, and cooperative plans with international organizations and domestic and overseas institutions.

- Korea has reformed its domestic laws regarding POPs in order to comply with international criteria and strengthened international regulations, such as the addition of new POPs subject to the Stockholm Convention.
  - Reflecting international criteria in domestic laws, Korea added new POPs through the Enforcement Decree of the POPs Control Act, bringing it into compliance with international management criteria.

Table 3.23 Status of Designated POPs in Korea (Enforcement Decree of the POPs Control Act).

Year	Persistent organic pollutants	Remarks
2008	12 POPs: aldrin, endrin, dieldrin, toxaphene, chlordane, heptachlor, mirex, hexachlorobenzene, polychlorinated biphenyls (PCBs), DDT, dioxins, and furans	Incorporated POPs that were included at the time the Stockholm Convention was ratified (January 2007)
2011	21 POPs: existing 12 POPs plus chlordecone, lindane, alpha hexachlorocyclohexane (HCH), beta HCH, tetrabromodiphenyl ether (tetraBDE) and pentaBDE, hexaBDE and heptaBDE, hexabromobiphenyl, pentachlorobenzene, and PFOS	Incorporated 9 POPs that were newly listed at the 4th Meeting of the Conference of the Parties (COP4) (May 2009) to the Stockholm Convention
2015	23 POPs: existing 21 POPs plus endosulfan and hexabromocyclododecane	Incorporated 2 POPs that were newly listed at COP5 (April 2011) and COP6 (May 2013) to the Stockholm Convention
2017	27 POPs: existing 23 POPs plus pentachlorophenol, hexachlorobutadiene, chlorinated naphthalene, and mercury	Incorporated 3 POPs that were newly listed at the COP7 (May 2015) to the Stockholm Convention, as well as mercury, in accordance with the adoption of the Minamata Convention on Mercury

Establishment of policies and monitoring of POPs pollution through the operation of POPs monitoring networks

- In addition, Korea has comprehensively identified the status and trends of POPs pollution in the environment (atmosphere, soil, water, and sediment) through the establishment and operation of POPs monitoring networks and secured the data necessary for establishing POPs policies.
  - Korea has been carrying out POPs monitoring through the POPs monitoring networks for each environmental medium across Korea in accordance with the Plan for the Establishment and Operation of POP Monitoring Networks.
  - Korea monitors POPs, including endosulfan, and other new POPs listed in the Stockholm Convention.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 42 7/4/2019 5:39:32 PM

Table 3.24 Status of POP Survey and Analysis by Year.

Year	Survey items
2011/2012 (13 POPs each)	• Process by-products (3 POPs): dioxins, furans, and PCBs • Pesticides (9 POPs): aldrin, endrin, dieldrin, heptachlor, toxaphene, mirex, chlordane, DDT, and hexachlorobenzene • Industrial chemicals (1 POP): perfluorooctane sulfonic acid (PFOS)
2013 (22 POPs)	• Process by-products (3 POPs): dioxins, furans, and PCBs • Pesticides (15 POPs): aldrin, endrin, dieldrin, heptachlor, toxaphene, mirex, chlordane, DDT, hexachlorobenzene, pentachlorobenzene, chlordecone, lindane, alpha HCH, beta HCH, and endosulfan • Industrial chemicals (4 POPs): tetraBDE, pentaBDE, hexaBDE and heptaBDE, hexabromobiphenyl, and PFOS
2014 (23 POPs)	• Process by-products (5 POPs): dioxins, furans, coplanar PCBs, indicator PCBs, pentachlorobenzene, and hexachlorobenzene • Pesticides (14 POPs): aldrin, endrin, dieldrin, heptachlor, toxaphene, mirex, chlordane, DDT, hexachlorobenzene, pentachlorobenzene, lindane, alpha HCH, beta HCH, and endosulfan • Industrial materials (4 POPs): tetraBDE, pentaBDE, hexaBDE and heptaBDE, hexabromobiphenyl, and PFOS
2015/2016 (24 POPs)	• Process by-products (5 POPs): dioxins, furans, coplanar PCBs, indicator PCBs, pentachlorobenzene, and hexachlorobenzene • Pesticides (14 POPs): aldrin, endrin, dieldrin, heptachlor, toxaphene, mirex, chlordane, DDT, hexachlorobenzene, pentachlorobenzene, lindane, alpha HCH, beta HCH, and endosulfan • Industrial chemicals (5 POPs): tetraBDE, pentaBDE, hexaBDE and heptaBDE, hexabromobiphenyl, PFOS, and perfluorooctanoic acid (PFOA)

- In addition, the Korean government is working to reduce emissions by designating a national dioxin emission rate, based on studies of POPs emission sources and amounts, and strengthening the management of POPs-emitting facilities.
  - The emission coefficient and amount have been calculated by conducting actual monitoring of emission concentrations of POPs-emitting facilities, including incineration and non-incineration facilities.
  - Emission reduction has been promoted by strengthening inspection and guidance, such as confirming POPs-emitting facilities' compliance with the maximum permissible emission standard for dioxins.

Table 3.25 National Dioxin Emissions by Year.

Year	2011	2012	2013	2014	2015	2016	2017
Emissions	120.9	111.6	111.4	ND	ND	ND	ND

(Unit: g I-TEQ/yr.)
Source: Environment Statistics Portal, Ministry of Environment

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 43 7/4/2019 5:39:32 PM

Action Plan 4.3 Implement the international agreements regarding the regulations on oil and HNS

- This management action was designed to prevent offshore leakages of oil and hazardous and noxious substances (HNS) in the Yellow Sea, which is central to maritime transport, and ensure that international conventions on oil and HNS are faithfully implemented.
- It is necessary to minimize damage by establishing a countermeasure system that allows prompt response and cleanup activities.
- The index used to assess the implementation of this management action was the incorporation of international conventions on oil and HNS regulations into domestic laws and management of the regulations.
- In particular, the acceptance of the OPRC and OPRC-HNS2000, which are IMO conventions on oil and HNS regulations (in Korean laws), as well as the establishment of a system to manage them and their implementation, were reviewed.
- Since the OPRC went into effect in the 2000s, Korea has regulated and managed the management standards and system under the Marine Environment Management Act in order to ensure compliance with this convention. In addition, Korea has been participating in international conferences and international cooperative activities to implement the agreement.
- In addition, Korea has established a response and management system to oversee related activities.

Δ **Yes, Korea has accepted the OPRC and OPRC-HNS 2000 standards as domestic standards, incorporated changes and discussion of these agreements, and created a management system to implement them.**

Acceptance of the OPRC and OPRC-HNS 2000 in Korea

- In 2000, Korea enacted the OPRC, provided contingency plans regarding oil pollution for vessels and marine facilities, issued reports and notifications regarding oil spills, and established national and regional systems to respond to and address oil spills as part of its efforts to implement the Convention.
- In particular, the Korean government included the mandatory clauses for countries directly concerned that are stipulated in the OPRC-HNS 2000 in the Marine Environment Management Act, which focuses on managing the overall marine environment. Meanwhile, the Korea Coast Guard and KOEM are carrying out related tasks.
- The Marine Environment Management Act stipulates that the Commissioner of the Korea Coast Guard is required to oversee and direct preventive activities and establish

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 44 7/4/2019 5:39:32 PM

prevention and response headquarters in the event of disastrous marine pollution accidents. In addition, the Korea Coast Guard is required to provide equipment and technology to support local governments in responding to oil spills along shorelines, and the Commissioner of the Korea Coast Guard has the authority to oversee and direct the response and cleanup activities of KOEM.

- In addition, the law includes clauses on maintaining contingency plans for responding to pollution accidents on vessels, reporting pollution, establishing national cleanup plans and pollution response-related international cooperation, conducting research and development, engaging in technical cooperation, promoting bilateral and multilateral cooperation regarding preparation and response, and providing training, education, technical services, and technical support.

Establishment of various management systems and promotion of related activities

- Meanwhile, Korea has managed to consistently recover the target amount of oil at sea and secure the response equipment and resources necessary to prepare for and respond to marine oil spill accidents, as shown in **Table 3.26, Table 3.27** and **Table 3.28**.

Table 3.26 Recovered Amount of Oil at Sea.

Target amount (kℓ)	Amount recovered (kℓ)			
	2011	2013	2015	2017
22,500	25,100	30,990	28,731	30,040

Table 3.27 Secured Response Equipment and Resources Necessary to Prepare for and Respond to Marine Oil Spill Accidents.

Category	2011	2013	2015	2017
Response equipments				
Response vessels	-	1	1	2
Oil skimmers	4	15	10	5
Washers	5	11	6	6
Response resources				
Oil fence (km)	1.1	6.5	6.5	1.1
Oil adsorbent (tons)	54.5	0.7	15.7	11.3
Oil dispersant (kℓ)	8	3.1	5.4	1.2

Table 3.28 Secured Equipment Necessary to Prepare for and Respond to Chemical Accidents at Sea.

	2011	2013	2015	2017
Chemical protective suits	-	10	26	36
Comprehensive gas detectors	-	2	-	-
Thermal imaging cameras	-	-	4	4

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 45 7/4/2019 5:39:32 PM

- In addition, various systems have been put in place to prevent and respond to accidents causing oil spills at sea.

Prepared a standard manual for crisis management in cases of "maritime ship accidents"

- This manual, prepared by the Ministry of Oceans and Fisheries in 2014, specifies the government's risk management goals, directions, decisionmaking system, crisis alert system, and duties and the roles of government ministries and agencies related to maritime ship accidents.

Maritime pollution control project (Busan branch of KOEM)

- The purpose of this project is to minimize the economic losses of the nation and its people by building capacity to respond to marine pollution and promptly recover oil and other waste in a rational and scientific manner.

Table 3.29 Major Achievements of the Marine Pollution Response Project.

Category	Major achievements
Improved pollution response system	• Implemented follow-up measures to the decision to publicly disclose the consigned placement of pollution response vessels • Improved and strengthened standards for the placement of pollution response vessels
Enhanced quality of pollution response service	• Expanded the training of HNS experts
Strengthened capability to combat HNS accidents	• Process by-products (5 POPs): dioxins, furans, coplanar PCBs, indicator PCBs, pentachlorobenzene, and hexachlorobenzene • Pesticides (14 POPs): aldrin, endrin, dieldrin, heptachlor, toxaphene, mirex, chlordane, DDT, hexachlorobenzene, pentachlorobenzene, lindane, alpha HCH, beta HCH, and endosulfan • Industrial materials (4 POPs): tetraBDE, pentaBDE, hexaBDE and heptaBDE, hexabromobiphenyl, and PFOS
Strengthened and improved onsite preventive measures	• Introduced and operated marine pollution prevention patrols using drones
Strengthened cooperation with related organizations	• Jointly manufactured and promoted plastic packs for containing spilled oils with the Korea Coast Guard • Expanded and operated a consultative body to prevent fishing vessel accidents caused by negligence
Promoted management of sunken ships	• Improved the information management system for sunken ships • Secured the sustainability of the sunken ship management project
Strengthened pollution prevention capacity and infrastructure	• Promoted the construction of two substitute pollution response vessels • Promoted the construction of one substitute working vessel
Expanded culture of maritime safety	• Improved vessel management indicators that focused on practicality and take into account onsite opinions and environmental changes • Held workshops on the supervision of public officials to strengthen work capacity and prevent accidents • Participated in the 4th Korea Maritime Safety Expo and operated a promotion booth

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 46 7/4/2019 5:39:32 PM

Preparation of a standard manual for crisis management in the case of "maritime ship accidents"

- Regarding large-scale human casualties, fires, explosions, and marine pollution caused by HNS accidents, the manual stipulates the Korea Coast Guard's response procedures and measures for prompt and efficient prevention and response to minimize loss of life and property.

Operation of a POPs monitoring network (Ministry of Environment, from 2008)

- The Ministry of Environment, which manages land-based pollutants, has been operating a monitoring network for POPs since 2008 to promote the management of POPs.
- This monitoring network comprehensively monitors and manages information on 28 POPs listed in the Stockholm Convention and provides necessary information, such as physical and chemical properties, hazards and toxicity, characteristics of environmental behaviors, and main usage.
- In addition, the Korean government enacted and promulgated the POPs Control Act in January 2007 to strengthen the management of POPs and has been monitoring POPs levels in the atmosphere, soil, water, and sediment every year.

Establishment of a nationwide pollution response information system by shore

- This system contains information on the topographical, physical, and ecological characteristics of the shores and seabed morphology of Korea and their economic usage as well as pollution response measures suitable for particular geographical characteristics, status of human and material resources for cleanup, and recommended pollution response techniques.

Establishment of a Korea-Japan HNS response system

- Education and training program on HNS, exchange of information on the compensation and sharing of expenses for HNS accidents, international compensation system for HNS accidents and related workshops, training programs, etc.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 47 7/4/2019 5:39:32 PM

Management Goal 5	Reduction of total loading of nutrients through the management of pollution sources
Background	Control the sources of pollution loads in the Yellow Sea, a semi-enclosed body of water, through the management of land-based point and nonpoint source pollutants and adoption of nutrients treatment techniques

1. Implementation Assessment Indicators and Content

- Management Goal 5 aimed to reduce the damage caused by the buildup of contaminants in the Yellow Sea, a semi-enclosed body of water, through the management of the sources of various pollutants flowing into it.
  - The management actions involved in achieving this goal included: (i) manage land-based sources of pollution load to completely cut off land-based point and nonpoint pollution sources and atmosphere-based pollution sources; (ii) manage land-based nonpoint pollution sources and pollution load of atmosphere-based pollution sources; and (iii) adopt new technologies and facilities for removing major nutrients, such as nitrogen and phosphorous, to minimize their inflow.
- The indicates use to assess the implementation of the management actions were: (i) expansion of wastewater treatment facilities; (ii) implementation of a management system for nonpoint pollution sources; and (iii) increasing of the treatment rate of advanced wastewater treatment facilities.

Table 3.30 Management actions and Indicators for Management Goal 5.

Management action	Indicators	Content
5.1: Manage land-based point pollution source loads	Expansion of wastewater treatment facilities and maintenance of sewage pipes	Expand wastewater treatment facilities to increase the treatment rate of point pollution sources and improve the maintenance of sewage pipes
5.2: Manage land-based nonpoint pollution source and atmospheric pollutants	Implementation of nonpoint pollution source management (system) activities and investment in facilities and establishment of a monitoring network for the management of atmosphere-based pollution load	Manage nonpoint pollution sources in all directions through various management systems, activities, and facilities Establishment of a monitoring network for the management of atmosphere-based pollution sources
5.3: Introduce new technology to reduce nutrients (nitrogen and phosphorus)	Increasing of the treatment rate of advanced wastewater treatment facilities	Advance wastewater treatment facilities through the application of new technologies for removing nutrients in order to increase the treatment rate and meet the water quality standards for outfalls

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 48 7/4/2019 5:39:32 PM

2. Implementation Status and Major Results

Action Plan 5.1 Manage land-based point pollution source loads

- This management action was designed to reduce the pollution load of point source pollution and thus alleviate the environmental stress on the Yellow Sea, which can be achieved through the expansion of wastewater treatment facilities, such as sewage and wastewater treatment facilities, which form the basic foundation for reducing land-based point source pollution sources, and the maintenance of sewage pipes.
- The indicator used to assess the implementation of this management action was the expansion of wastewater treatment facilities in the river basins that were created to block contaminants from entering streams, which are channels through which land-based pollutants enter the Yellow Sea.
  - The status of the implementation of the management action was examined, with the expansion of wastewater treatment facilities and maintenance of sewage pipes used as indicators.
- Korea has been pursuing a project to expand wastewater treatment facilities as a means of reducing point pollution load in cooperation with the Ministry of Environment, which is in charge of managing land-based pollution sources. As a result, the number of treatment facilities has been increased every year.
  - The sewage pipe maintenance project has also been steadily expanded, and activities for managing land-based point pollution load have been faithfully carried out.

Δ **Yes, this management action has been successfully implemented through the maintenance of sewage pipes, which is central to managing land-based point pollution sources, and development of related technologies.**

Continuous expansion of wastewater treatment facilities

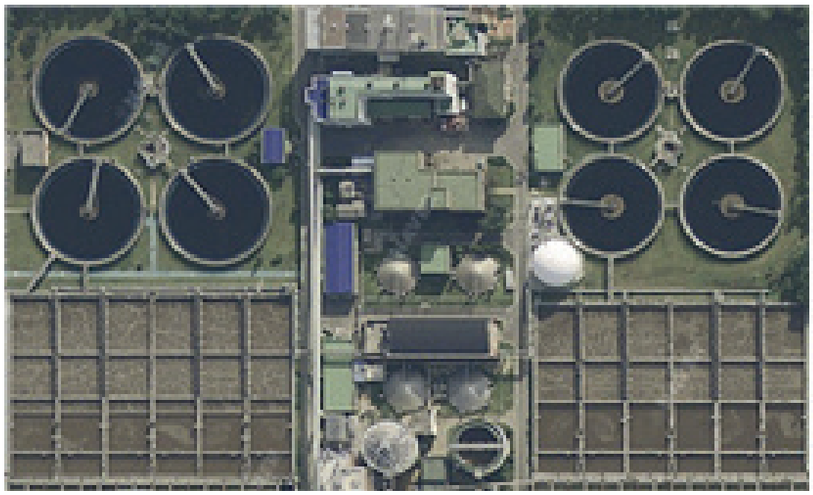
- The Ministry of Environment, which is in charge of managing land-based point source pollution in Korea, has been expanding wastewater treatment facilities, such as sewage and wastewater treatment facilities, in order to reduce land-based point source pollution load.
- The number of wastewater treatment facilities in the Han River, Geum River, and Yeongsan River basins increased continuously from 2,162 in 2012 to 2,335 in 2016, showing that an additional 173 facilities were established.
  - This is an 8% increase compared to 2012 and reflects Korea's efforts to reduce land-based point source pollution load.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 49 7/4/2019 5:39:32 PM

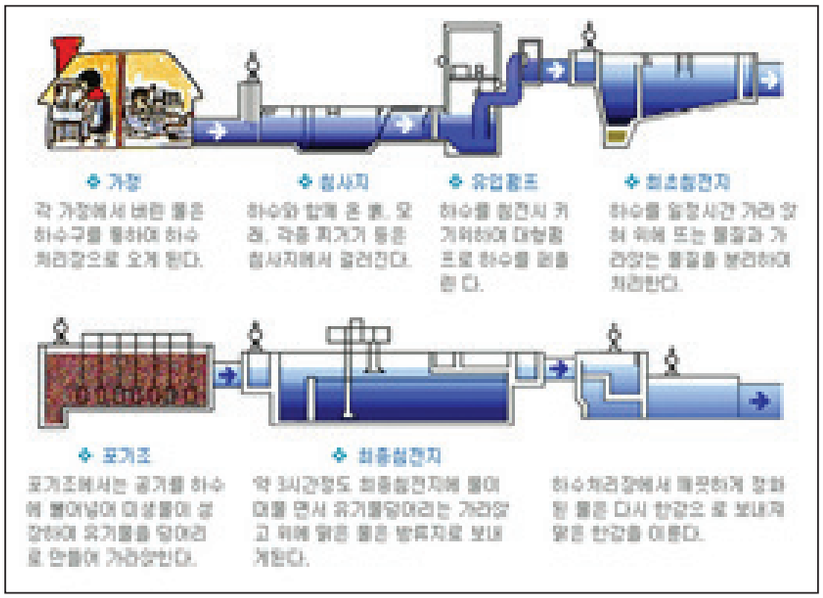
Table 3.31 Status of the Operation of Wastewater Treatment Facilities in Korea by Year.

Facilities	2012	2013	2014	2015	2016
Public sewage	360	394	408	405	415
Industrial wastewater	51	56	59	65	71
Agricultural wastewater	48	47	47	46	47
Livestock wastewater	22	17	19	17	16
Excrement disposal	31	28	27	26	27
Simplified septic tanks	12	12	12	12	12
Town sewage	1,638	1,669	1,726	1,761	1,747
Total	**2,162**	**2,223**	**2,298**	**2,332**	**2,335**

Figure 3.10 Image of a Public Sewage Treatment Plant and Mimetic Diagram of the Sewage Treatment Process.



(a) Aerial View of Public Sewage Treatment Plant in Cheongju *(Daum, 2018)*



(b) Mimetic Diagram of Sewage Treatment Process *(Korea Water Resources Corporation, 2018)*

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 50 7/4/2019 5:39:33 PM

- In addition, the supply rate of sewerage has increased by 2.3%, from 90.9% in 2011 to 93.2% in 2016.

Table 3.32 Supply Rate of Sewerage in Korea by Year.

Category	2011	2012	2013	2014	2015	2016
Total population (1,000 people)	51,717	51,881	52,127	52,419	52,672	52,858
Treatment population (1,000 people)	47,034	47,538	48,016	48,506	48,925	49,275
Sewerage supply rate (%)	90.9	91.6	92.1	92.5	92.9	93.2

Source: Ministry of Environment, 2018a.

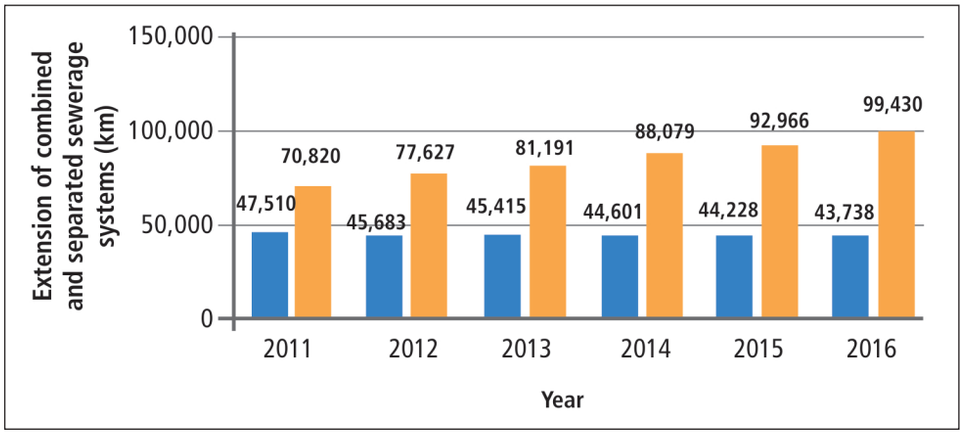
Continuous maintenance of sewage pipes

- Korea has consistently promoted the maintenance of existing sewage pipes. In particular, to compensate for the blind spots in the combined sewerage system, which is one of the causes of water pollution, the Ministry of Environment carried out a project through which it installed the separated sewerage system, which separates wastewater from storm water.
  - The project to extend the existing combined sewerage system and by replacing it with separated sewerage system increased the total length of sewage pipes from 70,820 km in 2011 to 99,430 km in 2016.

Table 3.33 Supply Rate and Extension of Sewage Pipes in Korea by Year.

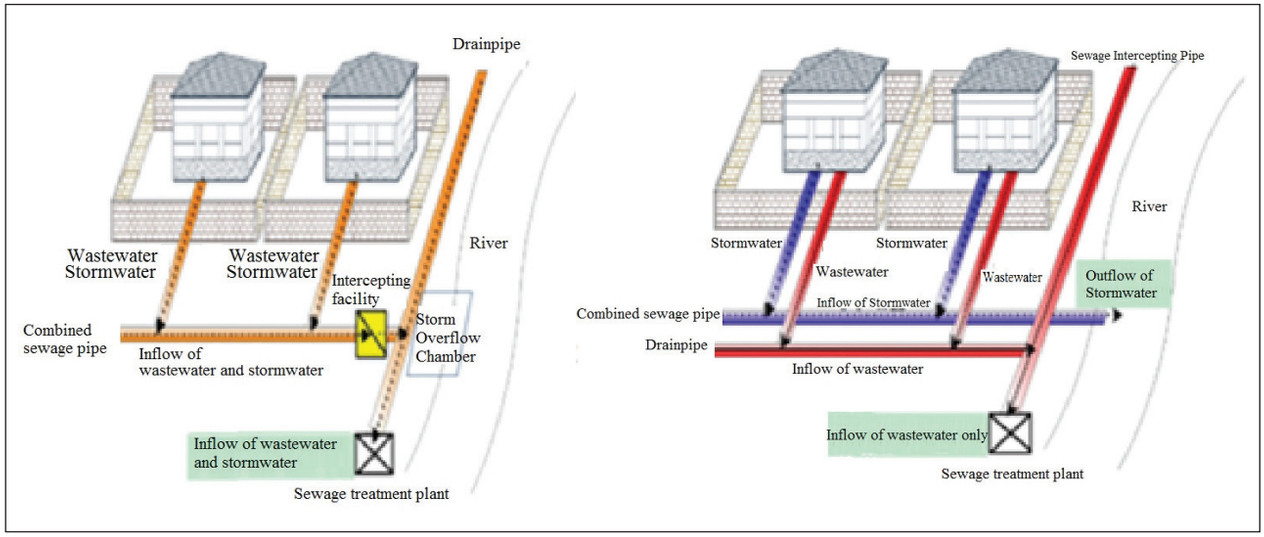
Category		2011	2012	2013	2014	2015	2016
Planned extension (km)		161,321	162,633	165,479	170,472	171,803	178,951
Pipe extension	Combined	47,510	45,683	45,415	44,601	44,228	43,738
	Separated	70,820	77,627	81,191	88,079	92,966	99,430
	Total	118,329	123,309	126,606	132.68	137,193	143,168
Sewage pipe supply rate (%)		73.4	75.8	76.5	77.8	79.9	80.0

Figure 3.11 Changes in the Extension of Combined and Separated Sewerage Systems (2011-2016).



YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 51 7/4/2019 5:39:33 PM

Figure 3.12 Concept Map of Combined and Separated Sewage Treatment (Board of Audit and Inspection, 2018).



Action Plan 5.2 Manage land-based nonpoint pollution source and atmospheric pollutants

- This management action was designed to improve the water quality to a certain level by managing atmosphere-based pollution load and reducing the amount of pollutants flowing into the Yellow Sea from nonpoint pollution sources, which are relatively poorly managed compared to point pollution sources.
  - The indicators used to assess the implementation of this management action were the implementation of various systems, investment, and policies for the management of nonpoint pollution and atmosphere-based pollution loads.
- Korea has implemented various systems for the management of nonpoint pollution sources. In particular, the Ministry of Environment and the Ministry of Oceans and Fisheries have been carrying out intensive management of the four major river basins and coastal areas under special management, respectively.
  - In addition, a monitoring network has been established to help manage atmosphere-based pollution, showing that the management of pollution from all sources is being faithfully carried out.
- This management action, which consists of institutions, systems, and management actions, was carried out comprehensively and considerable efforts were made to carry it out.

Δ **Therefore, this management action has been successfully implemented. The Ministry of Environment, Ministry of Oceans and Fisheries, and local governments have established their own systems for managing land-based nonpoint pollution sources and atmosphere-based pollution sources.**

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 52 7/4/2019 5:39:33 PM

Nonpoint pollution source management of Ministry of Environment

- The Ministry of Environment established the Second Comprehensive Plan for the Management of Nonpoint Pollution Sources (2012-2020), a long-term measure for managing nonpoint source pollutants, and has been monitoring and installing management facilities on land and along roads with high nonpoint pollution loads.
  - The Ministry of Environment has established comprehensive measures for the management of nonpoint source pollutants in the four major rivers and has been carrying out Stage 3 (2012-2020) of Phase 2 of the plan since 2012.5

Implementation of the Total Water Pollution Load Management System (Ministry of Environment, since 2011-)

- Rather than a simple method of regulating the concentration of pollutants, this system strengthens the responsibilities of each economic agent to achieve the target water quality (administrative goals) in a timely manner.
  - As the Stage 2 (2011-2015) of the comprehensive pollution management plan having been completed, the Nakdong River, Geum River, Yeongsan River, and Seomjin River basins are currently in Stage 3 (2016-2020). The Han River basin is in Stage 1 (2013-2020).
- The Total Water Pollution Load Management System does not regulate the concentration of pollutants but the total load of pollutants in wastewater. It is a highly effective system that manages pollutants by allocating pollution load quotas.

Implementation of designation of nonpoint pollution source management areas

- Areas where there may be significant negative impacts on utilization, residents' health, property, or the natural ecosystems of rivers and lakes due to the leakage of rainwater from nonpoint pollution sources are designated and managed as nonpoint source pollution management areas.

[5] In Phase 1 of the plan, Korea implemented a project to promote the optimal management of the four major river basins and other pilot projects, divided into Stage 1 (2004-2005) and Stage 2 (2006-2011).

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 53 7/4/2019 5:39:33 PM

Table 3.34 Designated Nonpoint Source Pollution Management Areas.

Areas	Location (area)	Date of Designation
Gwangju Metropolitan City	Gwangju Metropolitan City (501.31 km^2)	August 23, 2007
Doam Lake	Pyeongchang-gun (148.73 km^2)	August 23, 2007
Suwon, Gyeonggi-do	Suwon (121.0 km^2)	December 28, 2010
Golji Stream watershed	Jeongseon-gun, Gangneung, Samcheok (398.34 km^2)	December 24, 2013
Saemanggeum watershed	Jeonju, Gunsan, Iksan, Jeongeup, Gimje, Wanju-gun, and Buan-gun (815.8 km^2)	December 24, 2013
Inbuk Stream watershed, Mandae district	Yanggu-gun, Inje-gun (64.14 km^2)	October 15, 2015
Inbuk Stream watershed, Gaa district	Inje-gun (47.3 km^2)	October 15, 2015
Naerin Stream watershed, Jaun district	Hongcheon-gun (133.18 km^2)	October 15, 2015
Yangsan Stream watershed, Yangsan	Yangsan (245.9 km^2)	March 31, 2017

Nonpoint pollution source management activities of the Ministry of Oceans and Fisheries

Implementation of total pollution load management system in major special management areas

- Separate from the Ministry of Environment's total water pollution load system, the Ministry of Oceans and Fisheries has implemented a total pollution load management system for major special management areas.
  - This is a system that manages the discharge of pollutants into target waters within the total allowable pollution load and target areas that are highly contaminated or at high risk of becoming contaminated (among the special management areas and including areas on land that directly affect marine pollution.
  - So far, the system has been implemented in Masan Bay (2008) and Sihwa Lake (2013) and the Busan coastal area (2015) and is expected to be implemented in the Ulsan coastal area in 2018 and in Gwangyang Bay in 2019.
- The management period for and pollutants in special management areas are shown in **Table 3.35**.

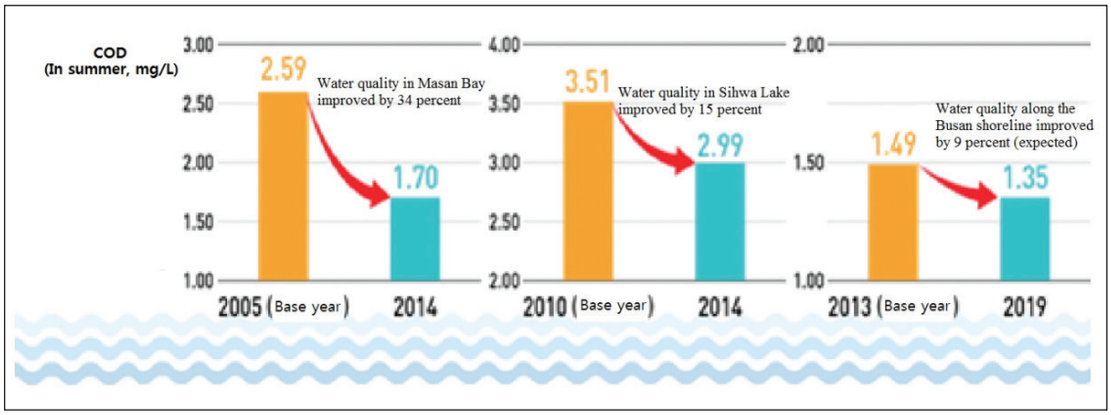
YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 54 7/4/2019 5:39:33 PM

Table 3.35 Management Period for and Pollutants in Special Management Areas in Korea.

Special management areas	Period of total pollution load management	Pollutants
Masan Bay	Second Total Pollution Load Management Period (2012-2016)	COD and TP
Sihwa Lake	First Total Pollution Load Management Period (2013-2017)	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

- After the implementation of this management system, the water quality (COD level) in the areas under management improved, showing decrease of 34% in Masan Bay, 15% in Sihwa Lake, and 9% in Busan coastal area in terms of COD.

Figure 3.13 Improvement in Water Quality in Three Areas (Target Expected to Be Achieved in Busan coastal area), Ministry of Oceans and Fisheries (2015).



Installation of facilities to reduce nonpoint pollution sources

- In addition, nonpoint pollution sources reduction facilities were installed and operated on a trial basis to address nonpoint source pollutants that are discharged with rainwater in a wide range of areas, such as urban areas, roads, and farmlands.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 55 7/4/2019 5:39:33 PM

Table 3.36 Installation of Facilities for Reducing Nonpoint Source Pollution.

Category		Total	Nonpoint source pollution reduction facilities	
			Nature-type facilities	Equipment-type facilities
Han River system	Four Major Rivers pilot project	25	Vegetated swale (2), vegetative filter strip (2), artificial wetlands (2), infiltration trench (3), infiltration retention basin (2), and screen + detention facility (2)	Vegetated swale (2), vegetative filter strip (2), artificial wetlands (2), infiltration trench (3), infiltration retention basin (2), and screen + detention facility (2)
	Urban-based pilot project	1	Artificial wetlands (1)	
	LID pilot project	2	LID(2)	
Geum River system	Four Major Rivers pilot project	7	Artificial wetlands (5)	Filter-type facility (1) and vortex-type facility (1)
Yeongsan River system	Four Major Rivers pilot project	5	Artificial wetlands (1) and infiltration parking lot (1)	Filter-type facility (3)
	Ecological pond pilot project	2	Ecological pond (2)	
Nakdong River system	Four Major Rivers pilot project	5	Artificial wetlands (1) and vegetated swale (1)	Vortex-type facility (1), vortex + filter-type facility (1), and coagulation and sediment treatment facilities (1)
Total		**47**		

LID: low-impact development

Status of government expenses related to the management of nonpoint pollution sources

- Since 2008, the Korean government has spent over KRW 170 billion on the installation of facilities to reduce nonpoint pollution sources.
  - In particular, the expenses for this project have nearly doubled from KRW 54.4 billion in 2011 to KRW 103.7 billion in 2016, which reflects the efforts of the government to manage nonpoint pollution sources.

Table 3.37 Investment in Nonpoint Pollution Source Management.

Category	2011	2012	2013	2014	2015
Investment in nonpoint pollution source management (KRW 100 million)	544	749	825	1,209	1,037

Unit: KRW 100 million
Source: Data from the Ministry of Environment, 2018a

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 56 7/4/2019 5:39:33 PM

Installation of a monitoring network to manage atmosphere-based pollution load

- The Korea Environment Corporation of the Ministry of Environment has been installing and operating an air pollution monitoring network to monitor and manage air pollution across Korea.
  - The Ministry of Environment has entrusted the operation of 154 monitoring stations to the Korea Environment Corporation, and local governments are operating additional 356 stations through city or provincial governments or health and environment research centers.

Table 3.38 Installation and Operation of Air Pollution Monitoring Networks in Korea.

Category	2011	2012	2013	2014	2015	2016	2017
Ministry of Environment	119	128	148	148	154	154	159
Local governments	345	349	358	358	350	356	374
Total	463	477	506	506	504	510	533

- Meanwhile, the number of air pollution monitoring stations has steadily increased since 2011, growing from 463 in 2011 to 533 in 2017.

Table 3.39 Detailed Operation of Air Pollution Monitoring Networks in Korea.

Category	Purpose	Number of stations		
		Subtotal	Ministry of Environment	Local governments
Urban air monitoring network	Use the average concentration of air pollutants in urban areas to determine whether environmental standards are being met	282 (96 cities and counties (*gun*))	-	282 (96 cities and counties (gun))
Roadside air monitoring network	Identify the air quality along roads with high traffic volumes and areas with large floating populations	37 (17 cities)	-	37 (17 cities)
National background concentration monitoring network	Identify the national background concentration and inflow and outflow of pollutants to and from foreign countries	3 (3 cities and counties (*gun*))	3 (3 cities and counties (*gun*))	
Suburban air monitoring network	Identify the background concentrations of pollutants in suburban areas surrounding cities	22 (22 cities and counties (*gun*))	22 (22 cities and counties (*gun*))	

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 57 7/4/2019 5:39:33 PM

Table 3.39 Detailed Operation of Air Pollution Monitoring Networks in Korea. (cont.)

Category	Purpose	Number of stations		
		Subtotal	Ministry of Environment	Local governments
Acid deposition monitoring network	Determine the dry deposition of air pollutants and wet deposition of air pollutants	41 (36 cities and counties (*gun*))	41 (36 cities and counties (*gun*))	-
Atmospheric heavy metal monitoring network	Identify status of pollution by heavy metals in urban areas and in areas near industrial complexes	55 (22 cities and counties (*gun*))	-	55 (22 cities and counties (*gun*))
Hazardous air pollutants monitoring network	Identify status of pollution by VOCs and PAHs	32 (22 cities and counties (*gun*))	32 (22 cities and counties (*gun*))	-
Photochemical air pollutant monitoring network	Monitor VOCs, which contribute to ozone formation, and accumulate basic data for effective management and response	18 (12 cities and counties (*gun*))	18 (12 cities and counties (*gun*))	-
Atmosphere monitoring network	Determine the atmospheric concentration of global warming substances	1 (1 county (*gun*))	1 (1 county (*gun*))	-
PM2.5 content monitoring network	Determine the concentration of particulate matter (PM2.5) that poses a high risk to human health and identify emission sources	36 (28 cities and counties (*gun*))	36 (28 cities and counties (*gun*))	-
Intensive air pollution monitoring network	Identify the status of air quality in national background areas and major regions, identify the inflow and outflow of pollutants, analyze long-range transported air pollutants such as yellow sand, and identify the causes of severe pollution	6 (6 cities and counties (*gun*))	6 (6 cities and counties (*gun*))	-
Total		**533** (111 cities and counties (gun))	**159** (52 cities and counties (gun))	**374** (96 cities and counties (gun))

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 58 7/4/2019 5:39:33 PM

Action Plan 5.3 Introduce new technology to reduce nutrients (nitrogen and phosphorus)

- This management action was designed to introduce the latest technology and methods for removing nutrients from pollution sources in order to eliminate the inflow of nutrients, which can adversely affect the marine ecosystem by causing red tides and hypoxia.
- This management action was implemented in connection with the overall management of land-based point pollution sources and nonpoint pollution sources in Management actions 5.1 and 5.2.
- The indicators used to assess the implementation of this management action were the advanced treatment techniques applied to sewage, wastewater, and nonpoint pollution sources, which were promoted to strengthen the management of nutrients inflow, and the advanced treatment of sewage and wastewater treatment facilities.
- The Ministry of Environment has continuously promoted the development of related technology and equipment for removing nutrients that flow in from point pollution sources.
  - As a result, the rate of advanced treatment of treatment facilities in Korea has gradually increased since 2012, and the BOD of the four major rivers, which are the major channels of inflow of point pollution sources, has been gradually decreasing.

Δ **Yes, under the leadership of the Ministry of Environment, Korea has been developing related techniques to remove the nutrients that flow into the Yellow Sea, and the BOD concentration of the four major rivers has been gradually decreasing.**

Improvement of the rate of advanced treatment of wastewater treatment facilities

- The Ministry of Environment is continuing to develop technologies and equipment for removing nutrients that flow into the Yellow Sea from point pollution sources using secondary treatment and tertiary advanced treatment methods, which are biological and chemical treatment methods.
- General advanced treatment methods include: coagulating sedimentation, activated sludge process with coagulants, PhoStrip method, contact phosphorus removal, nitrification-denitrification using the endogenous respiration process, ammonia stripping, breakpoint chlorination injection method, reverse osmosis, and selective ion exchange resin method.
- Although various advanced treatment methods are being adopted, treatment costs remain relatively high.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 59 7/4/2019 5:39:33 PM

- Nevertheless, the treatment rate of advanced wastewater treatment facilities in Korea has been increasing gradually since 2012. As of 2016, the average rate of advanced treatment is 74%.
- The increasing trend of the rate of advance treatment by wastewater treatment facilities from 2012 to 2016 is shown in **Table 3.40**.

Table 3.40 Rate of Advanced Wastewater Treatment at Basic Environmental Facilities. (in percentage)

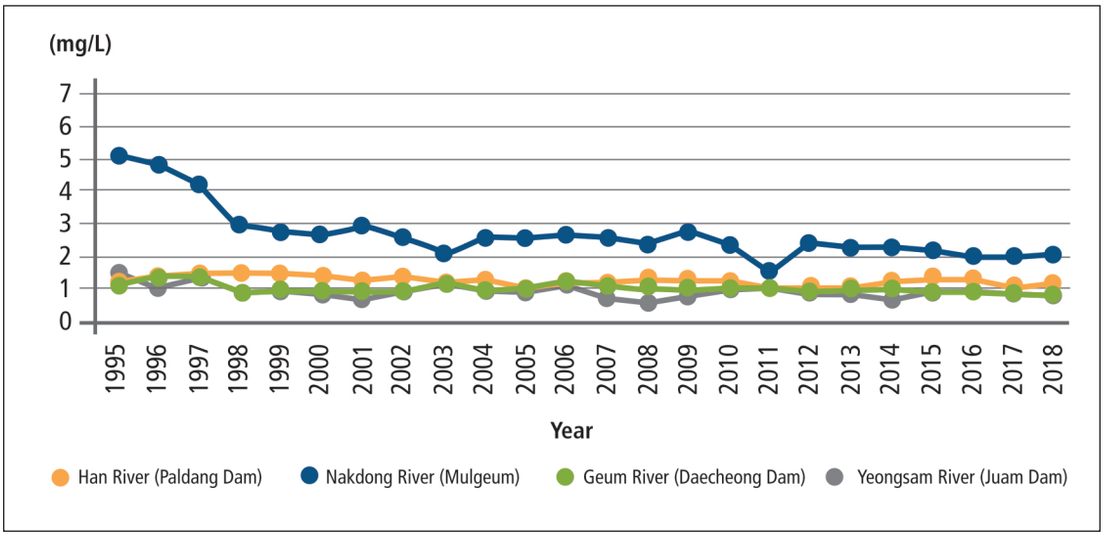
Facilities	2012	2013	2014	2015	2016
Public sewage	80.6	83.8	84.6	90.1	91.3
Industrial wastewater	47.1	57.1	66.1	58.5	60.6
Agricultural wastewater	14.6	29.8	34.0	43.5	46.8
Livestock wastewater	36.4	41.2	42.1	58.8	56.3
Excrement disposal	45.2	46.4	40.7	46.2	51.9
Simplified septic tanks	58.3	58.3	58.3	66.7	66.7
Town sewage	52.6	54.8	55.9	64.2	71.7
Total	**56.0**	**59.3**	**60.5**	**67.9**	**74.0**

Source: Ministry of Environment, 2018a.

Improvement of biological oxygen demand (BOD) of the four major river basins

- The BOD concentration of the four major river basins has been improving since 2011, as shown in **Figure 3.14**.

Figure 3.14 Changes of BOD in the Basins of the Four Major Rivers.



Source: Water Environment Information System, Ministry of Environment (Measurement of Water Quality Nationwide)

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 60 7/4/2019 5:39:33 PM

Management Goal 6	Reduce the currently existing marine litters to the level of 2007
Background	Efforts to reduce social and economic damage and damage to the marine ecosystem caused by the inflow of marine litter into the Yellow Sea

1. Implementation Assessment Indicators and Content

- Management Goal 6 involved efforts and activities that aimed to recognize and reduce the social, economic, and aesthetic damages caused by the increase in marine litter.
  - Marine litter is comprised of – not only land-based litter – but also ocean-based litter resulting from marine activities (fisheries, aquaculture, etc.)
- The management actions carried out to achieve this goal were: (i) to manage the sources of marine litter and solid waste; (ii) to strengthen the capacity for collecting and treating marine litter; (iii) to establish a basis for marine litter management; and (iv) to increase citizen participation in and strengthen international cooperation on reducing and managing marine litter.
- The indices used to assess the implementation of the management actions were: (i) trend of supply of eco-friendly buoys and compactors; (ii) collection of marine litter; (iii) establishment of a marine litter management system; and (iv) output of education on and promotion of participation in reducing marine litter.

Table 3.41 Management actions and Indicators for Management Goal 6.

Management action	Indicators	Content
6.1: Minimize generation of marine litter through the management of original sources of marine litter and solid waste materials	Policy measures to stop solid waste generation	Replace used Styrofoam buoys, which is a major source of marine litter, and provide collection and disposal facilities
6.2: Strengthen capability of marine litter collection and treatment	Adoption of marine litter collection and treatment equipment and trend of the amount of collected marine litter	Trend of the amount of marine litter collected due to the improvement of equipment used to collect and treat marine litter
6.3: Establish management system of marine litter	Establishment of marine litter management system	Tangible and intangible systems, such as the institutions, organizations, and structures necessary to manage marine litter
6.4: Promote public participation and international cooperation	Output of citizen participation in marine litter collection, related training and promotional activities, and international cooperation activities	Output of training of citizens and promotion of measures to reduce marine litter Number of international cooperation activities implemented to reduce marine litter between countries

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 61 7/4/2019 5:39:33 PM

2. Implementation Status and Major Results

Action Plan 6.1 Minimize generation of marine litter through the management of original sources of marine litter and solid waste materials

- This management action was designed to manage the sources of marine litter in order to prevent the inflow of marine litter and solid waste into the sea and minimize the generation of solid waste.
  - The indicator used to assess the implementation of this management action was the distribution trend of Styrofoam compactors and eco-friendly buoys provided to replace used Styrofoam buoys, which is a major source of marine litter.
- Through the Marine Environment Management Act, enacted in 2007, Korea established a basis for the creation of "Plan for waste collection and disposal at sea" for the effective management of marine litter. Since 2008, the country has been establishing and implementing a basic plan for marine litter management every five years.
  - The First Basic Plan for Marine Litter Management (2009-2013) was implemented in 2008, and the Second Basic Plan for Marine Litter Management (2014-2018) was launched in 2014.
- In addition, Korea has been replacing Styrofoam buoys, cited as a main source of marine litter, with eco-friendly buoys and collecting used Styrofoam buoys.
  - Korea has also been actively implementing policy measures and carrying out activities for the management of marine litter and solid waste at sources, including supplying biodegradable fishing gear and compactors for used Styrofoam.
  - As a result of such efforts, Korea has been collecting 200,000 to 400,000 tons of marine litter every year.
- However, the marine litter generated in Korea can also cross national boundaries. Due to this transboundary property as well as weather conditions and other factors, it is difficult to effectively address this problem, despite the many related management actions and policies that are being carried out.
  - Nevertheless, the government has been relatively active in its efforts and related policies and activities to minimize the occurrence of marine litter.

Δ **Yes, Korean government has implemented a series of measures to minimize the occurrence of marine litter, such as the establishment of long-term plans for marine litter management and supply of compactors to minimize generation of solid waste.**

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 62 7/4/2019 5:39:34 PM

Intensive management of used Styrofoam

- Korea's Ministry of Oceans and Fisheries has been supplying eco-friendly buoys to replace Styrofoam buoys, which are cited as a major source of marine litter, and working to collect used Styrofoam buoys.
  - The Ministry of Oceans and Fisheries began supplying eco-friendly buoys to replace high-density Styrofoam buoys in 2015. As of 2017, 386 eco-friendly buoy products have been developed and released by 38 companies.

Figure 3.15 Supplied Eco-friendly Buoys.

Ejection-type buoy | Coated buoy | EPP buoy | Multi-cell buoy

- For this effort, the Ministry of Oceans and Fisheries carried out projects to establish a comprehensive system to manage and reinforce the collection of used Styrofoam buoys, supply used Styrofoam buoy compactors, and hold consultations for fishers.

Supply of biodegradable fishing gear

- In addition, the Ministry of Oceans and Fisheries distributed to fishers biodegradable fishing gear that decomposes underwater via microbe action as a means of reducing the source of derelict fishing gear.
  - This distribution of biodegradable fishing gear has reduced the occurrence of non-degradable derelict fishing gear.

Table 3.42 Supply of Biodegradable Fishing Gear.

Year	2014	2015	2016	2017	**Total**
Number of vessels	370	380	480	374	**1,604**

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 63 7/4/2019 5:39:34 PM

Distribution of used Styrofoam buoy compactor[6] and promotion of education and consultations for fishers

- In addition, to reinforce the collection of used Styrofoam buoys, used Styrofoam buoy compactors were distributed. At the same time, consultations were held for fishers in order to minimize the use of Styrofoam buoys.

Table 3.43 Distribution of used Styrofoam buoy compactors by Ministry of Oceans and Fisheries.

Installation year	Installation location			End of life or suspended locations		
	No.	Fixed	Movable	No.	Fixed	Movable
2003	5	Namhae-gun 1 Tongyeong 1 Geoje 1 Goseong-gun Yeosu 1	-	3	Tongyeong 1 Goseong-gun 1 Yeosu 1	-
2004	6	Changwon (Jinhae, Masan) 2 Wando-gun 1 Sinan-gun 1 Busan 1 Seogwipo 1	-	3	Sinan-gun 1 Busan 1 Seogwipo 1	-
2005	7	Ganghwa-gun 1 Sinan-gun 2 Jeju 1 Seogwipo 1 Seoul 1	-	3	Ganghwa-gun 1 Seogwipo 1 Taean-gun 1 Seoul 1	-
2006	5	Hwaseong 1 Boryeong 1 Hongseong-gun 1 Buan-gun 1	Jindo-gun 1	2	Hwaseong 1 Hongseong-gun 1	-
2007	3	Guri 1 Namhaegun 1	Tongyeong 1	1	Guri 1	-
2008	3	-	Sinan-gun 2 Jeju 1	2	-	Sinan-gun 2
2009	1	-	Gyeongsangnam-do 1	0	-	-
2010	2	Yeosu 1 Jeju 1	-	0	-	-
2011	1	Geoje 1	-	0	-	-
2012	1	-	Jangheung 1	0	-	-
2013	1	Tongyeong 1	-	0	-	-
2014	1	Goseong-gun 1	-	0	-	-
2015	2	Jeju 1	Haenam-gun 1	0	-	-
2016	1	Sinan-gun	-	0	-	-
2017	1	Goheung-gun	-	1	-	-
Total	**40**	**32**	**8**	**15**	**13**	**2**

[6] A machine that compresses Styrofoam to reduce its volume.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 64 7/4/2019 5:39:34 PM

Table 3.44 Designated Nonpoint Source Pollution Management Areas.

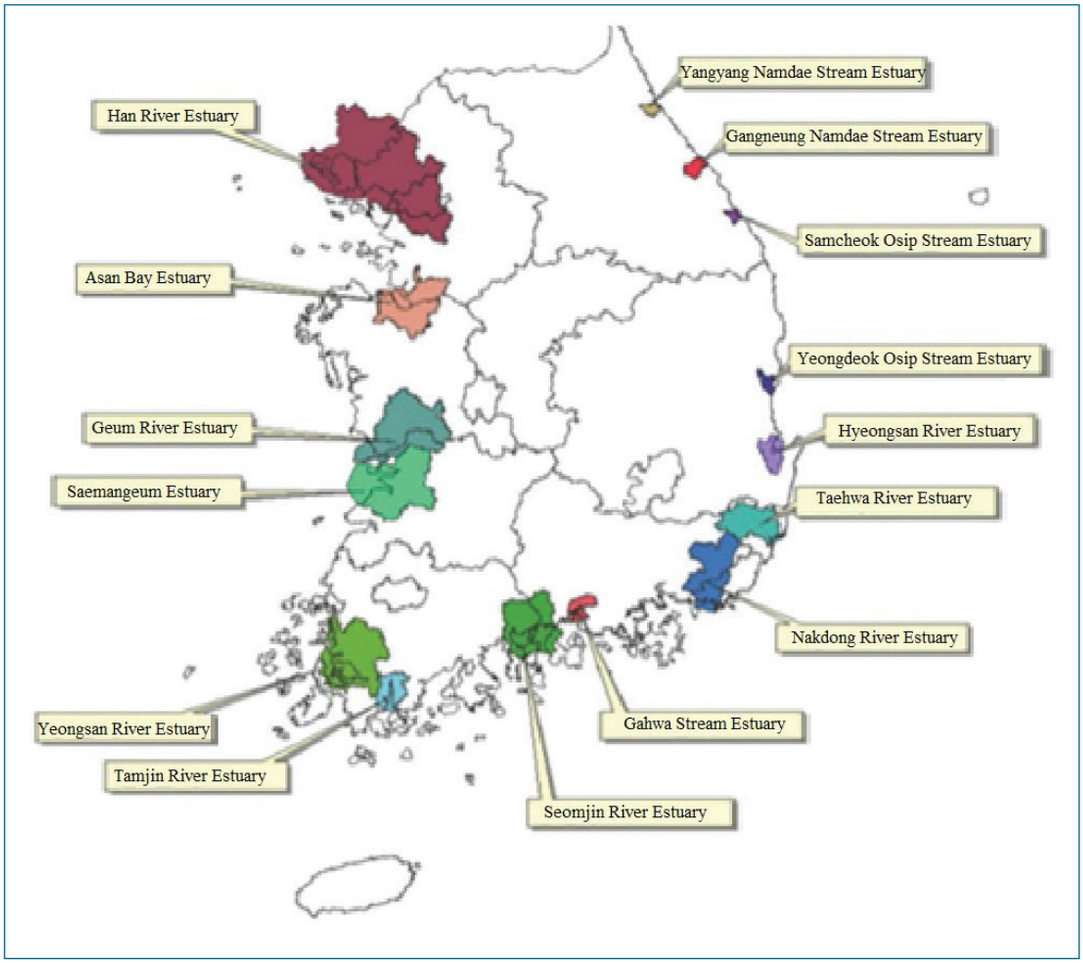
Category	Target	Performance
Fishing industry professionals	Laver farmers	July 14, 2017: 50 people (lecture at a conference for the development of customized eco-friendly buoys for laver farming) July 27, 2017: 30 people (visiting education session at fishing villages of Naejang, Haenam) October 14, 2017: 15 people (visiting education session at Balpo, Goheung)
	Oyster farmers	March 14, 2018: 600 people (general assembly of the Oyster Cooperative Federation, distributed and posted materials)
Leaders	People with degrees in fishery education	December 15, 2017: 13 people (master's and doctoral program students in fishery education at Pukyong National University, lecture)
	Leaders of fishing village development and tourism	February 22, 2018: 56 people (leadership program at the Korean Oceans and Fisheries HDR Institute, lecture)
	Managers of fishing experience villages	February 26, 2018: 74 people (leadership program at the Korean Oceans and Fisheries HDR Institute, lecture)
	Executives of the Oyster Cooperative Federation	March 9, 2018: 2 people (training for executives of the Oyster Cooperative Federation)
Total	**Total of 8 sessions, 838 people (fishing industry professionals: 4 sessions for 695 people; leaders: 4 sessions for 145 people)**	

Preventive management of the inflow of land-based litter from rivers and estuaries

- In addition, the Ministry of Environment carried out projects to minimize land-based marine litter through the Second Basic Plan for the Management of Litter from Rivers and Estuaries (2014-2018), aiming to cut off the inflow of land-based litter into the sea.
  - These projects include minimization of the occurrence of marine litter through the prevention of the inflow of general vegetation and riverside waste and management of hotspots, collection of marine litter in accordance with regional characteristics, and enhancement of the efficiency of litter collection conducted in rivers and estuaries in response to heavy rainfalls.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 65 7/4/2019 5:39:34 PM

Figure 3.16 Estuaries of the Second Basic Plan for the Disposal of River and Estuary Litter.



Source: Ministry of Environment (2014) The Second Basic Plan on the Disposal of Litter in Rivers and Estuaries of the Five Major Rivers (2014-2018)

- The amount of litter that was collected in rivers and estuaries from 2012 to 2016 as part of this initiative recorded 200,000 to 400,000 tons a year.

Table 3.45 Collection of Litter in Rivers and Estuaries through the River and Estuary Litter Cleanup Initiative.

Initiative implemented by	Collection of litter in rivers and estuaries					
	2012	2013	2014	2015	2016	Total
Busan	5,139	3,453	2,938	3,864	4,060	**19,454**
Incheon	6,118	6,118	7,399	6,442	5,734	**30,333**
Gwangju	19	-	-	-	-	**19**
Ulsan	1,757	407	408	363	276	**3,211**
Sejong	155	360	441	567	351	**1,874**
Gyeonggi-do	14	132	151	19	17	**333**
Gangwon-do	4,830	2,460	2,669	2,355	2,299	**14,613**

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 66 7/4/2019 5:39:34 PM

Table 3.45 Collection of Litter in Rivers and Estuaries through the River and Estuary Litter Cleanup Initiative. (cont.)

Initiative implemented by	Collection of litter in rivers and estuaries					
	2012	2013	2014	2015	2016	Total
Chungcheongbuk-do	688	862	851	721	639	**3,761**
Chungcheongnam-do	3,882	3,653	4,066	2,704	4,200	**18,505**
Jeollabuk-do	7,833	4,573	5,186	5,146	5,081	**27,819**
Jeollanam-do	6,841	7,384	6,723	5,801	6,985	**33,734**
Gyeongsangbuk-do	1,868	1,486	1,561	1,803	2,062	**8,780**
Gyeongsangnam-do	2,969	4,556	4,471	4,258	5,163	**21,417**
Jeju-do	-	-	-	800	39	**839**
Weirs and dams of the four major rivers	3,976	11,841	15,754	5,795	22,290	**59,656**
Total	**46,089**	**48,566**	**51,661**	**39,930**	**58,102**	**244,348**

Note: The amount of litter collected in 2017 was recorded in September.
Source: Internal documents from the Ministry of Environment (July 2018)

Action Plan 6.2 Strengthen capability of marine litter collection and treatment

- The purpose of this management action was to reinforce the marine litter collection and disposal capability by focusing on the collection equipment, methods, and procedures needed to increase the efficiency of marine litter collection and disposal work.
- The indicators used to assess the implementation of this management action were: machines and equipment developed to strengthen the marine litter collection and treatment capability, facilities, various projects, and activities as well as the marine litter collection rate.
- Korea has been actively operating various marine litter collection and management facilities in an effort to increase the efficiency of marine litter collection and disposal, showing that this management action has been actively carried out.
  - Through the Ministry of Oceans and Fisheries, Korea has been promoting various projects to manage marine litter generated in the ocean, fishery harbors, fishing grounds, and recreational fishing sites, and the amount of marine litter collected through these projects has been increasing.

Δ **Yes,by operating a series of systems and facilities for the collection and disposal of marine litter, Korea has been reinforcing its marine litter collection and disposal capability.**

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 67 7/4/2019 5:39:34 PM

Installation of floating marine litter collection platforms

- The Ministry of Oceans and Fisheries provided support for the installation of floating marine litter collection platforms, on which marine litter generated during marine activities can be temporarily stored. To improve implementation, the platform locations, manufacturing, installation, and other details have been stipulated in the Guidelines for the Installation, Manufacturing, and Operation of Floating Marine Litter Collection Platforms.[7]
  - Local governments are responsible for the management of floating marine litter collection platforms and training of fishing industry professionals in terms of marine environment issues. Sorting, processing, and recycling are prioritized for the litter stored on the platforms.

Table 3.46 Installation of floating marine litter collection platforms.

Category	2010	2011	2012	2013	2014	2015	2016	2017
Busan	-	2	-	-	-	-	-	-
Incheon	-	1	-	-	-	-	-	-
Chungcheongnam-do	5	1	2	2	3	3	3	3
Jeollabuk-do	-	2	2	2	2	2	2	2
Jeollanam-do	24	29	35	39	43	41	34	35
Gyeongsangnam-do	11	7	7	9	14	11	8	13
Total	**40**	**42**	**46**	**52**	**62**	**57**	**47**	**53**

Source: Internal documents, Ministry of Oceans and Fisheries (June 2018)

Figure 3.17 Floating Marine Litter Collection Platforms Currently Installed and in Operation.

Source : KMI (2018) Trend of Fisheries Product Imports from FTA-Contracting Parties, Third Quarter

[7] Floating marine litter collection platforms are to be installed near harbors or ports in consideration of the entry and exit of vessels, convenience of fishing industry professionals, odor prevention, and progress. They should be built with wood, wood plastic composite (synthetic wood), PE, and other materials, prioritizing the use of eco-friendly materials. The size of the platforms should be adjusted in consideration of the marine litter generation and conditions of the relevant fishery ports.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 68 7/4/2019 5:39:34 PM

Cleanup of marine litter

- The Ministry of Oceans and Fisheries has been continuously promoting the cleanup of marine litter, KOEM's collection of floating litter, deposited litter, and obstacles to navigation in the blind spots of management efforts as well as in fishery harbors and areas subject to environmental conservation.
- The details of the marine litter cleanup project are provided in the table below:

Table 3.47 Status of the Marine Litter Cleanup Project.

Category		Number	Target areas
Management districts			
Designated ports		60	31 trade ports (managed by central government: 14, managed by regional governments: 17) 29 coastal ports (managed by central government: 11, managed by regional governments: 18)
Areas designated for the purpose of environmental conservation		37	9 environmental management sea areas 14 marine protected areas 14 (coastal) wetland protected areas
National fishery ports not managed by government management agencies	Prior to 2016	12	Hwaseong 1 (Gunpyeong), Taean 1 (Anheung Harbor), Gochang 1 (Gusipo), Jeju-do 5 (Moseulpo, Dodu, Kimnyeong, Wimi, Hahyo), Ongjin 1 (Seonjinpo), Sacheon 1 (Sinsu), and Ulleung 3 (Hyeonpo, Namyang, and Jeodong)
Ulsan coastal area	After 2017	5	Ongjin 1 (Seonjinpo), Sacheon 1 (Sinsu), and Ulleung 3 (Hyeonpo, Namyang, and Jeodong)
Total	**Prior to 2016**	**109**	
	After 2017	**102**	

- In addition, the amount of marine litter from fishery harbors collected through this project annually is shown in the table below:

Table 3.48 Collection of Litter in Rivers and Estuaries through the River and Estuary Litter Cleanup Initiative.

Year	Number of operating days of cleanup vessel at sea	Amount collected (tons)			
		Floating litter	Deposited litter	Obstacles to navigation	Total
2014	1,230	174	1,231	3,827	5,232
2015	1,253	39	1,590	4,649	6,278
2016	1,244	4	1,710	6,374	8,088
2017	1,279	1	341	12,428	12,770

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 69 7/4/2019 5:39:34 PM

Fishing ground litter collection

- The Ministry of Oceans and Fisheries has entrusted the Korea Fisheries Infrastructure Public Agency with the collection and disposal of lost or deposited fishing nets and fishing gear in major fishing grounds in nearshore and offshore.
  - This project also involves training and promotion related to these activities for fishing industry experts and citizens in order to induce their direct participation in resource management and spread awareness of the importance of protecting fishery resources.

Table 3.49 Achievements of the Fishing Ground Litter Collection Project and Training and Promotion Project.

Year	Projects performed
2014	• Litter collection project in 23 coastal fishing grounds • Training for fishing industry experts and various promotional projects • Workshop for local government personnel in charge of litter collection
2015	• Litter collection project in 23 coastal fishing grounds • Training for fishing industry experts and various promotional projects • Workshop for local government personnel in charge of litter collection
2016	• Litter collection project in 26 coastal fishing grounds • Training for students in fishery related fields and various promotional projects • Workshop for local government personnel in charge of litter collection
2017	• Litter collection project in 28 coastal fishing grounds • UCC contest and various promotional projects • Workshop for local government personnel in charge of litter collection

Fishing ground litter collection (buyback of litter recovered during fishing activities)

- The Ministry of Oceans and Fisheries and local governments have been providing buyback (economic incentive) for the marine litter collected by fishing industry professionals during fishing activities.
  - The project was designed to motivate fishing industry professionals to voluntarily collect and recycle marine litter. The amount of marine litter collected through this project increased from 6,597 tons in 2014 to 6,667 tons in 2017.

Table 3.50 Amount of Marine Litter Collected during Fishing Activities Purchased and Disposed of.

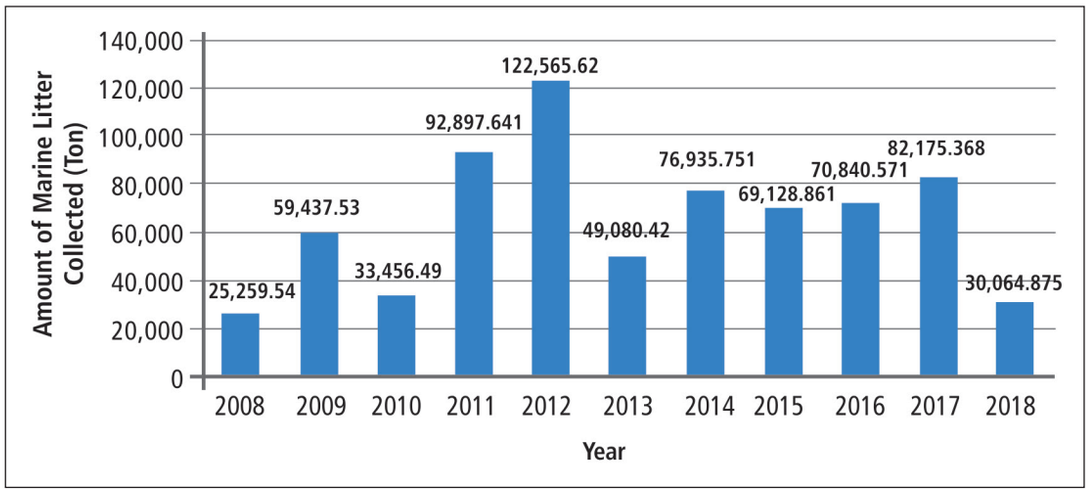
Year	2014	2015	2016	2017
Amount purchased and disposed of (tons)	6,597	6,158	6,296	6,667

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 70 7/4/2019 5:39:34 PM

Other environmental improvement projects for recreational fishing areas and collection and disposal of disaster waste

- In addition, the Ministry of Oceans and Fisheries has been working with local governments to collect lead sinkers on the bottom of recreational fishing areas, litter, and other pollutants in areas surrounding recreational fishing areas and install garbage cans to help prevent the improper disposal of waste.
- Moreover, disaster debris is collected within one month following disasters in areas designated by the Central Disaster Safety Measures Headquarters as "disaster-affected areas" and areas where large amounts of litter have been generated due to disasters.
- The amount of marine litter collected in Korea every year through these projects is shown in the table below:
  - In 2012, nearly 120,000 tons of litter was collected, but that figure has since fallen to about 82,000 tons.

Figure 3.18 Trend in the Amount of Marine Litter Collected through Various Projects.



Action Plan 6.3 Establish management system of marine litters

- The purpose of this management action was to establish the basis necessary for the systematic management of marine litter, including the systemization of the overall marine litter management process, calculation of related data, and monitoring activities.
- The indicator used to assess the implementation of this management action was the establishment of tangible and intangible systems (institutions, organizations, or system restructuring) that include overall activities and processes necessary for marine litter management.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 71 7/4/2019 5:39:34 PM

- To ensure the systematic management of marine litter, Korea created the Marine Litter Information System, through which various data, including the amount of marine litter generated and collected, survey data, and training materials, are managed.
- In addition, Korea established the basis necessary for the management of marine litter, including marine litter monitoring projects, marine litter policies, and cooperative governance, showing that this management action has been well implemented.

Δ **Yes, the Marine Litter Information System and Marine Litter Management Center (MALI Center) have become central to the series of activities related to marine litter management that are being conducted, and various tasks have been actively carried out.**

Operation of the Marine Litter Information System and Marine Litter Management Center (MALI Center)

- Through the establishment of the Marine Litter Information System,[8] Korea has been collecting and analyzing information on overall marine litter management.
  - The amount of marine litter generated and collected every year, information on marine litter, educational materials, related laws, and other various data and information are available on the system, and the government has been establishing long-term plans and annual projects based on such data.

Figure 3.19
Korea's Marine Litter Information System.

[8] https://www.malic.or.kr

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 72 7/4/2019 5:39:34 PM

- Korea established the Marine Litter Management Center (MALI Center) in 2011 to serve as an integrated organization capable of proposing research and policy measures to address the issue of marine litter in a comprehensive and scientific manner.
  - The center conducts research on marine litter and surveys and monitoring of marine litter generated in Korea and abroad for the purpose of creating a related database. It also operates an advisory committee related to marine litter that works to provide education, promote awareness, hold related workshops, and participate in international exchange.
  - For the operation of the MALI Center and provision of support for related activities, the government spends over KRW 300 million of its budget every year.

Table 3.51 Budget Execution for the Operation of the MALI Center (Unit: KRW 1 million).

Category	2014	2015	2016	2017	2018	Total
Budget execution	307	269	271	381	407	**1,634**

Expansion of the national marine litter monitoring project

- In 2014, Korea designated a total of 20 additional locations for monitoring marine litter through the "Selection of New Marine Litter Monitoring Locations and National Marine Litter Monitoring Project," after analyzing the long-term changes of existing locations and the feasibility report on new monitoring locations.
- The results of marine litter monitoring have been entered into the Marine Litter Information System and are being used as basic data for policy development.

Strengthening of marine litter policy capacity and cooperative governance

- The Ministry of Oceans and Fisheries adopted an incentive system to induce public participation in the marine litter project. It also currently operates the Marine Litter Policy Council.
  - The council consists of relevant personnel from the central and local governments, related organizations, schools, research institutes, and public organizations and is convened more than once every year.

Table 3.52 Budget Execution for the Project to Strengthen Marine Litter Policy Capacity and Cooperative Governance (Unit: KRW 1 million).

Category	2014	2015	2016	2017	2018	Total
Budget execution	22	-	4	6	6	**38**

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 73 7/4/2019 5:39:34 PM

Action Plan 6.4 Promote public participation and international cooperation

- The purpose of this management action was to promote synergy through public and international cooperation in the cooperative system of the public, government, and research institutes, which needed to be established before progress could be made on increasing the efficiency of marine litter management.
- The indicators used to assess the implementation of this management action were the training and promotional activities carried out for citizens, among the overall activities related to marine litter management, and the international cooperation activities related to marine litter in which Korea participated.
- The Ministry of Oceans and Fisheries has been involving various educational and promotional activities in an effort to increase people's awareness of marine litter. Through regular marine litter cleanup activities, the government has been eliciting Korean citizens' direct participation.
- In addition, international cooperation activities have been promoted at the regional sea level in order to address the marine litter issue.

Δ **Yes, the Korean government is performing various activities to elicit public participation in marine liter collection and management as well as engaging in international cooperation activities with NOWPAP.**

Promotion of marine litter policy to Korean citizens

- The Ministry of Oceans and Fisheries has been airing various public campaign advertisements and commercials to promote voluntary citizen participation in marine litter reduction and increase people's awareness of the problem of marine litter.
  - Public campaign advertising is focused on the summer season and fishing industry professionals, spreading different messages depending on the time and target audience.
- In addition, the Ministry of Oceans and Fisheries holds an annual photo contest about marine environment protection and marine litter.

Table 3.53 Budget Execution for the Project to Promote Marine Litter Policy to Korean Citizen (Unit: KRW 1 million).

Category	2014	2015	2016	2017	2018	Total
Public campaign and advertising	3,500	3,500	3,500	3,500	3,500	**17,500**
Contest for promotional materials (photo)	70	44	40	44	136	**334**

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 74 7/4/2019 5:39:34 PM

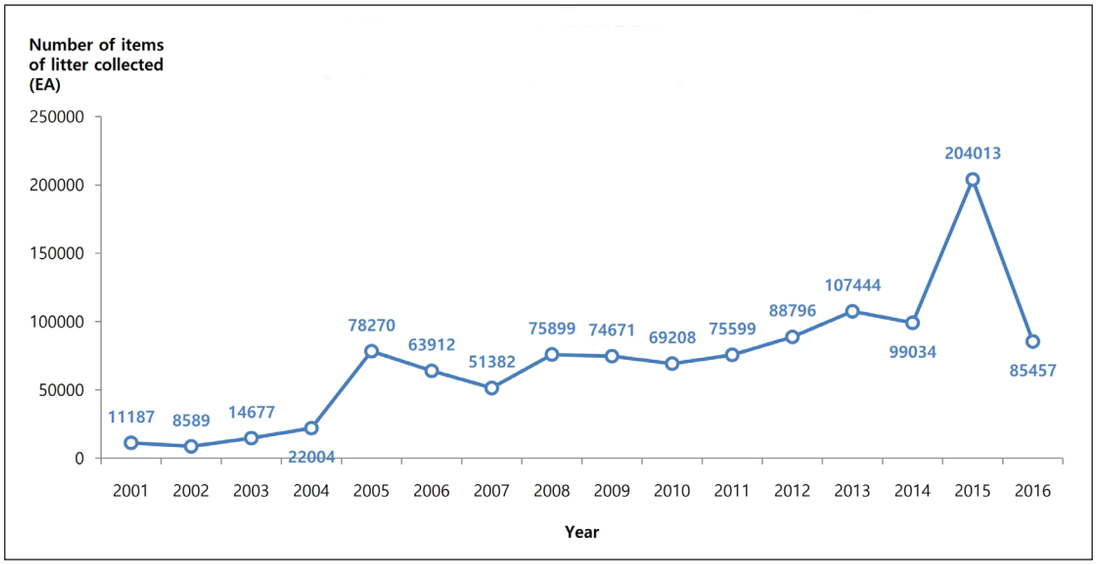
Vitalization of citizen participation in coastal cleanup activities

- Every year, the Ministry of Oceans and Fisheries holds a ceremony for the international coastal cleanup event and supports local events and training for the expansion and development of International Coastal Cleanup Day. In addition, it has promoted the development of hands-on volunteer programs for cleaning up marine litter and the development of a marine litter-related smartphone application with citizen participation.
  - The third Saturday of every September has been designated as International Coastal Cleanup Day, and local governments organize and hold their own activities.

Figure 3.20 Activities Performed on International Coastal Cleanup Day.

- A significant amount of marine litter is collected through the events that are held on International Coastal Cleanup Day every year.

Figure 3.21 Amounts of Marine Litter Collected in International Coastal Cleanup events (by year).



YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 75 7/4/2019 5:39:35 PM

Participation in international cooperation activities in regional seas

- In addition, Korea is actively participating in the activities of related international organizations in order to cooperate with other countries in resolving the issue of marine litter in regional seas.
  - The Korean government has promoted support for international cooperation activities between governments and local governments and participated in NOWPAP RAP/MALI and ICC campaign workshops.

Table 3.54 International Cooperation to Address the Marine Litter Problem in Regional Seas.

Year	2014	2015	2016	2017	2018
NOWPAP workshops and ICC campaign	Boryeong, Korea	Yantai, China	Slavianka, Russia	Toyama, Japan	Busan, Korea
Budget input	30	5	11	12	50

Figure 3.22 International Workshops and Related Activities Held with NOWPAP.

Management Goal 7	Reduce contaminants, particularly in bathing beaches and other marine recreational waters
Background	Promote the management of the quality of the marine tourism environment in line with the diversification of tourism needs and the increasing demand for marine ecotourism

1. Implementation Assessment Indicators and Content

- Management Goal 7 aims to promote the monitoring and management of the marine environment in order to prevent and manage the decline in the quality of ecotourism attractions due to human contact and use, in recognition of the growing interest in and demand for marine tourism and ecotourism.
  - The management actions involved in achieving this goal include: (i) regular monitoring and assessment of hazards and pollution in the waters of bathing beaches and marine tourism attractions; and (ii) control of the inflow of pollutants into the waters of bathing beaches and marine tourist attractions.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 76 7/4/2019 5:39:35 PM

- The indicators used to assess the implementation of the management actions were: (i) monitoring and disclosure of water quality at bathing beaches, and (ii) management of facilities in surrounding areas that discharge pollutants to control the inflow of pollutants into the waters of bathing beaches.

Table 3.55 Management actions and Indicators for Management Goal 7.

Management action	Indicators	Content
7.1: Conduct regular monitoring, assessment and information dissemination particularly in bathing beaches and other recreational waters	Monitoring of water quality at bathing beaches (regular) and disclosure and dissemination of information	Monitor hazards and pollution in the waters of marine tourism areas by conducting regular water quality tests at bathing beaches and marine tourist attractions Disclose and disseminate information, such as survey and monitoring results
7.2: Control pollution in bathing beaches and other marine recreational waters	Management of facilities in surrounding areas that discharge pollutants to control the inflow of pollutants into the waters of bathing beaches	Install and manage discharge facilities to control the inflow of pollutants into the waters of bathing beaches and recreational areas

Action Plan 7.1 Conduct regular monitoring, assessment and information dissemination particularly in bathing beaches and other recreational waters

- This management action was designed to regularly monitor and assess pollution and hazards in the waters of bathing beaches and disseminate the information gained in order to ensure that beachgoers are able to enjoy safe and pleasant experiences.
  - The indicator used to assess the implementation of this management action was the dissemination of the information gained through the regular surveys and monitoring of the waters of bathing beaches.
- According to the Ministry of Oceans and Fisheries' management-related standards and guidelines for bathing beaches, a system has been put in place to regularly monitor hazards and pollution in the waters of beaches operated by local governments and related organizations.
  - This is a system for monitoring and sharing information on pollution and hazardous materials, water quality, soil surveys and related data, occurrences of rip currents, and occurrence of poisonous jellyfish.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 77 7/4/2019 5:39:35 PM

- However, local governments are actually in charge of managing bathing beaches, and most related surveys and information gathering are concentrated in summer. As a result, management efficiency and continuous management through all four seasons have been insufficient.

Δ **Yes, Korea conducts regular monitoring of bathing beaches and discloses survey results via web portals and mobile application. However, such related activities are performed only in the summer.**

Regular water quality monitoring of bathing beaches and disclosure of results

- Since the implementation of the Act on the Use and Management of Bathing Beaches in 2014, Korea has been making efforts to install bathing beach facilities and manage the environment by planning to establish Master Plans for Bathing Beaches every ten years, in accordance with the law.
  - There are a total of 254 bathing beaches in Korea, concentrated in Gangwon-do, Jeollanam-do, Busan, and Chungcheongnam-do.

Table 3.56 Distribution of Bathing Beaches in Korea (2014) (Designated by Law).

Beach	Distribution
Gangwon-do	92 (36%)
Gyeongsangbuk-do	25 (10%)
Ulsan	2 (1%)
Busan	7 (3%)
Gyeongsangnam-do	25 (10%)
Jeollanam-do	55 (22%)
Jeollabuk-do	3 (1%)
Chungcheongnam-do	34 (13%)
Gyeonggi-do	0 (0.0%)
Incheon	0 (0.0%)
Jeju-do	11 (4%)
TOTAL	**254 (100%)**

- The Ministry of Oceans and Fisheries has stipulated in a directive that local governments must conduct water and soil quality tests for beaches to ensure the proper management of bathing beaches.
  - It stipulates that tests must be conducted at least once every two weeks before, after, and during the open season of bathing beaches.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 78 7/4/2019 5:39:35 PM

- In accordance with the Ministry of Oceans and Fisheries' Bathing Beach Facility Installation and Management Standards and Guidelines for the Management of Bathing Beach Water Quality, the local governments with jurisdiction over beaches conduct water quality tests at the beaches and report the results to the Ministry of Oceans and Fisheries.
  - Each local government conducts tests for enterococci and E. coli at the beaches under its jurisdiction.[9] The tests are conducted once before and after the opening of the beaches and every two weeks during the open season.
- However, water and soil quality tests are required to be conducted only before, after, and during the open season of bathing beaches. As a result, the management of the water and soil quality of beaches is insufficient during the off-season.
- Results of water quality test are reported by the Public Health and Environment Research Institutes to their respective cities and provinces and comprehensively managed by the Marine Environment Policy Division of the Ministry of Oceans and Fisheries.

Figure 3.23 Marine environment information for bathing beaches provided by the Public Data Portal.

Source: Public Data Portal (https://www.data.go.kr/dataset/15026698/openapi.do)

Establishment of a cooperation system for the provision of information on hazards at bathing beaches

- To promote safety through advance warning of hazards at bathing beaches, cooperation systems with experts and related organizations have been established to provide information to the public.
  - An advance warning system has been established to provide information and alerts regarding the recent appearance of jellyfish at bathing beaches.[10]

---

9 Standards: 100 CFU/100mL or 100 MPN/100mL or less for enterococci and 500 CFU/100mL or 500 MPN/100mL or less for E. coli.

10 Rip current: powerful and narrow channels of fast-moving water that flows from the beach directly out into the ocean sporadically for several minutes. Also known as "rip tide."

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 79 7/4/2019 5:39:35 PM

- The National Institute of Fisheries Science provides information on poisonous jellyfish and the appearance of jellyfish through the hazard assessment system. Moreover, a service is provided that issues notifications of the results of the rip current monitoring system via the internet and mobile text messages in cooperation with the Korea Hydrographic and Oceanographic Agency.

Figure 3.24 Information on Appearance of Jellyfish and Rip Current Alert Service for public including people at bathing beaches.

Action Plan 7.2 Control pollution in bathing beaches and other marine recreational waters

- The purpose of this management action was to prevent pollution sources at beaches and marine tourist attractions through the management of point and nonpoint pollution sources that may occur in the vicinity of bathing beaches and marine tourist attractions.
- The indicator used to assess the implementation of this management action were the installation and operation of facilities, and establishment of systems to prevent the inflow of various pollutants into the waters of bathing beaches.
- According to the Sewerage Act, local governments are requested to construct sewage treatment facilities at major bathing beaches. However, only a few such facilities have been constructed and are in operation.
- In addition, the Bathing Beach Management and Operation Regulations contains clauses related to controlling the inflow of pollutants, but there are difficulties in actual operation and management of the facilities in bathing beaches.

Δ **Yes, the legal basis necessary to control the inflow of pollutants into the waters of bathing beaches has been laid, but actual operation and management of treatment facilities remains insufficient.**

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 80 7/4/2019 5:39:35 PM

Enactment of relevant regulations for controlling pollutants inflow into the waters of bathing beaches

- In Korea, the installation of sewage treatment facilities at major bathing beaches has been scheduled on an annual basis, in accordance with the Sewerage Act. However, not many facilities have been constructed and put into operation.
  - Support facilities for bathing beaches are required to install sewage treatment facilities on an individual basis after obtaining permission from local governments. Temporary facilities, including bathrooms and shower stalls, are allowed to bury waste nearby, also with the permission of local governments. However, due to insufficient budget and personnel, systematic management of such facilities has been difficult.
- In consideration of the characteristics of the activities in which people engage in the waters of bathing beaches and marine tourist attractions, where skin contact and oral absorption is possible, it is necessary to establish measures to oversee and manage facilities that fail to maintain sufficient control, excluding the existing sewage treatment systems.
- In addition, the Installation and Management Standards for Bathing Beach Facilities stipulate the installation and management standards for waste treatment facilities.
  - The standards stipulate that sewage from shower stalls and bathrooms should not be allowed to enter the sea directly and require appropriate waste collection and disposal facilities to be installed in consideration of the people using the bathing beaches.
- However, the management regulations are vague, and the management and operation of such facilities are often insufficient due to a lack of manpower at the local governments that are responsible for the actual operation and management of such facilities.

Table 3.57 Installation and Management Standards for Bathing Beach Facilities in Korea.

Category	Installation standards	Management standards
Sewage and wastewater treatment facilities and water pollution prevention facilities	Prevent untreated sewage and wastewater from shower stalls, bathrooms, and rental and sales facilities from entering the sea.	Inspect pollution sources that may deteriorate the water quality at beaches and implement necessary measures to prevent sewage and wastewater from entering the beach.
Garbage collection and processing facilities	Install one or more garbage collection and processing facilities in consideration of the period of the open season and annual number of visitors.	(1) Clean up the beach before and after the opening hours of the bathing beach at regular intervals in consideration of the number of visitors and amount of garbage generated during the open season. (2) Ensure the sanitary management of garbage collection and processing facilities installed at or in the vicinity of bathing beaches and take measures to prevent secondary pollution generated by the facilities' garbage collection and processing processes.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 81 7/4/2019 5:39:35 PM

Management Goal 8	Better understanding and prediction of ecosystem changes for adaptive management
Background	Establish a basis for adaptive management of the Yellow Sea through the understanding and assessment of various factors that affect the rapid changes of the ecosystem

1. Implementation Assessment Indicators and Content

- Management Goal 8 aimed at examining the overall impact of climate change on marine ecosystems as well as the potential impact of measures that have not yet been implemented to address climate change and their potential effects on marine ecosystems.
  - This goal promotes the predictions and understanding needed to implement the adaptive management[11] of marine ecosystems based on the monitoring and predicting of the impacts on and changes of marine ecosystems caused by climate change.
- The management actions involved in achieving this goal were: (i) monitor and evaluate the effects of changes in the ratio of nitrogen, phosphorus, and silicon; (ii) monitor and evaluate the lower trophic level effects due to climate change; and (iii) predict long-term changes of the Yellow Sea's ecosystem due to climate change.
- The indicators used to assess the implementation of these management actions were: (i) monitoring and evaluation of the effects of changes in the ratio of nitrogen, phosphoric acid, and silicon; (ii) implementation of long-term monitoring and assessment of changes in the lower trophic level and climate change factors; (iii) collection of data on the Yellow Sea ecosystem; and (iv) monitoring and assessment of harmful algal blooms (HABs).

Table 3.58 Management actions and Indicators for Management Goal 8.

Management action	Indicators	Content
8.1: Monitor and evaluate the effects of the ratio of nitrogen, phosphoric acid, and silicon	Monitoring and evaluation of the effects of the changes in the ratio of nitrogen, phosphorus, and silicon	Perform basic monitoring and evaluation to examine the changes in the ratio of nitrogen, phosphorus, and silicon
8.2: Monitor and evaluate the lower trophic level effects due to climate change	Implementation of long-term monitoring and assessment of changes in the lower trophic level and climate change factors	Perform long-term monitoring of changes in lower trophic level organisms due to climate change
8.3: Predict long-term changes of the Yellow Sea's ecosystem due to climate change	Collection of data on the Yellow Sea ecosystem and verification of the selected ecosystem model using such data	Establish and validate a model to forecast the impact of climate change on Yellow Sea ecosystem using data from long-term monitoring in Yellow Sea

[11] A method of resource management in preparation for future uncertainty and a management method that ultimately reduces uncertainty over time by continuously adapting to changes through systematic monitoring.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 82 7/4/2019 5:39:35 PM

Table 3.58 Management actions and Indicators for Management Goal 8. (cont.)

Management action	Indicators	Content
8.4: Monitor and evaluate the transboundary impact of jellyfish blooms	Various activities to monitor and evaluate the transboundary impact and of jellyfish blooms	Conduct regional surveys necessary to monitor the transboundary impact of jellyfish blooms
8.5: Monitor the appearance of harmful algal blooms (HABs) and evaluate their effects	Various activities to monitor and evaluate harmful algal blooms	Review of red tide forecasting, which is an important prerequisite to monitor HABs and evaluate the impact of HABs

2. Implementation Status and Major Results

Action Plan 8.1 Monitor and evaluate the effects of the ratio of nitrogen, phosphoric acid, and silicon

- This management action was designed to improve the quality of support services for ecosystems through continuous monitoring and assessment of changes in the ratio of nutrients, which can cause changes in the structure and function of marine ecosystems.
  - Changes in the ratio of nutrients have impacts on the marine ecosystem by triggering changes in the species composition and biomass of phytoplankton, zooplankton, and fish.
- The indicators used to assess the implementation of this management action were whether the ratio of nitrogen, phosphorus, and silicon was monitored through regular surveys and analyses and whether impact assessment was conducted.
- Through the marine environment monitoring network project, Korea has maintained a system for monitoring nutrients, but monitoring of the ratio of nitrogen, phosphorus, and silicon and assessment and management of changes in this ratio remain insufficient.
  - It is thus necessary to recognize the potential factors driving changes in the marine ecosystem due to changes in the ratio of nutrients salts and conduct systematic monitoring, analysis, and assessment accordingly.
- However, Korea has the necessary basis for calculating the ratio of nutrients and assessing its impact based on research on individual nutrients conducted through various previous projects. Therefore, it seems that Korea would need to carry out an in-depth analysis and impact analysis on the ratio of nutrients in the future.

Δ **Yes or No, this management action has been partially implemented. Although Korea is monitoring nutrients, regular monitoring and assessment of the ratio of nutrients is lacking.**

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 83 7/4/2019 5:39:35 PM

Monitoring of nutrients through various projects

Monitoring through the marine environment monitoring network project

- In accordance with the guidelines on the establishment and operation of marine environment monitoring networks stipulated in the Marine Environment Management Act, KOEM operates marine environment monitoring networks including nutrient monitoring.
  - The survey has been conducted at 425 stations along the coasts of Korea four times (February, May, August, and November) per year since 1997. Water samples for nutrients are collected from two different layers (surface and bottom) at each station.
- In particular, the number of survey stations has been increased from 374 in 2011 to 425 in 2017.

Table 3.59 Number of survey stations by year (2011-2017).

Category	2011	2012	2013	2014	2015	2016	2017
Number of survey locations	374	374	417	417	417	417	425

Monitoring through comprehensive marine environment surveys

- Two regions of the sea around Korea peninsula has been monitored with one or two surveys in every year, alternatively (Odd-numbered years: West Sea and South Sea (Western Region)/Even-numbered years: South Sea (Eastern Region), East Sea, and Jeju Area).
  - Additionally, intensive surveys have been conducted every year for the areas of Korea's marine ecosystem designated as important.
- Monitoring through Basic Survey of Marine Ecosystems (2006-2013) and the Comprehensive Survey of Marine Ecosystems (2015-2020)
- This survey has been carried out since 2006 to measure the concentration and ratio of nutrients. Until 2013, it had been conducted in 318 stations. The number of survey stations has been doubled to 732 through the follow-up monitoring project named 'Comprehensive Survey of Marine Ecosystems (2015-2020)'.

Table 3.60 Related survey and station number.

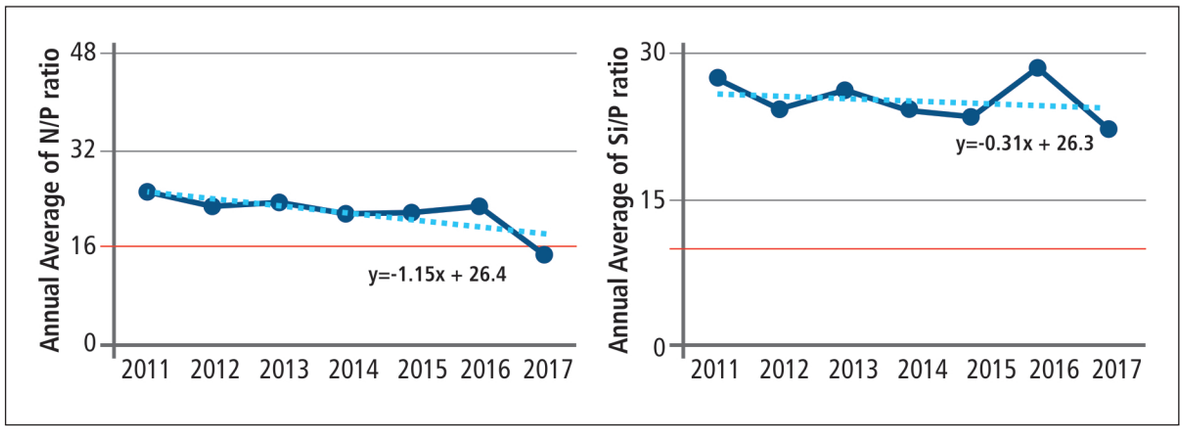
Surveys	Period conducted	Number of survey stations
Comprehensive Survey of Marine Ecosystems (Stage 1)	2015-2020	732 stations (194 coastal stations, 435 mudflat stations, 90 inshore stations, and 13 key stations)
Basic Survey of Marine Ecosystems	2006-2013	318 stations (246 stations for floating matter and deposits, 32 stations for nekton, and 40 stations for hard bedrock)

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 84 7/4/2019 5:39:36 PM

Example of annual ratio calculation using data on nutrients

- Using the nutrient data on nutrient salts gained through the marine environment monitoring network project from 2011 to 2017, the inter-annual changes in the ratio of nutrients (N:P:Si)[12] were detected as follows:
  - In the West Sea, the mean ratio of silicon to phosphorus (Si: P) was almost twice higher than that of the Brzezinski-Redfield ratio (15:1), due to the significant effects of river discharge.
  - In 2017, Si:P ratio fell to 22:1, similar to the ratio of nitrogen to phosphorus. It could be related with the drastic changes of nutrient input in 2017. However, it is required to determine whether this was a temporary fluctuation or involved other oceanographic processes.

Figure 3.25 Inter-annual variation of N:P Ratio (left) and Si:P Ratio (right) in Korea's West Sea. Ratios were obtained from the data collected through the National Marine Environment Monitoring Network.



Action Plan 8.2 Monitor and evaluate the lower trophic level effects due to climate change

- This aimed to monitor and examine the impact of climate change, which is currently taking place around the globe, on the marine ecosystem of the Yellow Sea, especially on the lower trophic levels, where such organisms as primary (i.e., phytoplankton) and secondary (i.e. zooplankton) producers are found.
  - The indicators used to assess the implementation of these were the assessment and monitoring of the changing trends among lower trophic-level organisms and climate change factors.
- Assessments of the impact of climate change on marine ecosystems and the lower trophic levels have generally been lacking because small-scale researches with limited time periods were only carried out.

[12] Normally, the ratio of nitrogen to phosphorus is 16:1, and the Brzezinski-Redfield ratio (Brzezinski, 1985) is usually applied when including silicon to denote the molar ratio of N:P:Si, which is 16:1:15.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 85 7/4/2019 5:39:36 PM

- In particular, any monitoring programs or projects to assess the impact of climate change on marine ecosystems were not carried out in the West Sea (Yellow Sea).

• In 1998, Korea formed the Committee on Climate Change Convention and has been establishing and promoting comprehensive measures. The fourth comprehensive measure, implemented in 2008, includes five sections—negotiation countermeasures, greenhouse gas statistics, reduction, impact assessment and adaptation, and research and development. Although activities related to addressing climate change have been carried out, very limited activities were targeted on marine ecosystems.

Δ **Yes or No, this management action has not been successfully implemented. Although monitoring and assessment for the impact of climate change on the lower trophic levels have been conducted at the national level, no projects have targeted the Yellow Sea.**

The Ministry of Oceans and Fisheries' projects related to the impact of climate change on the marine environment/ecosystem

• The Ministry of Oceans and Fisheries selected the assessment of the impact of climate change on marine ecosystems, which is one of the key areas of climate change study, and carried out the related research.
  - Monitoring of the impact of climate change on the lower trophic levels of the Yellow Sea was partially conducted through the National Institute of Fisheries Science's "Research on the Response to the Impact of Climate Change on Marine Ecosystems and Fishery Resources" and KIOST's "Assessment of the Impact of Climate Change on Marine Ecosystems in the South Sea of Korea."

Introduction of research results derived from related projects

Evidence of the impact of climate change on marine environment and ecosystems

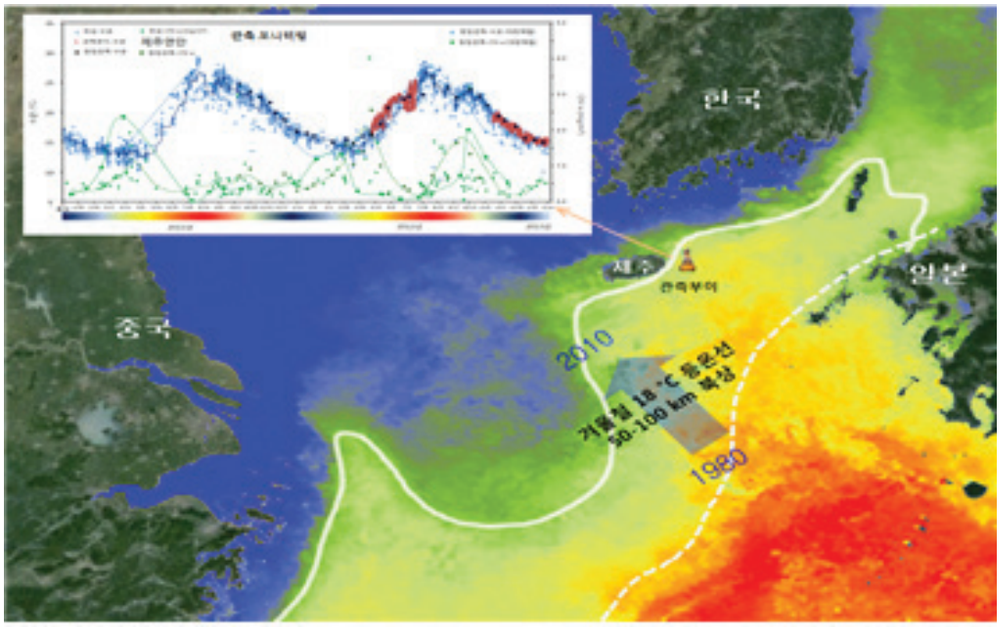
• One of the key findings is that 18°C isotherm of sea surface temperature (which is the temperature that allows for the reproduction of sub-tropical coral species) of the South Sea and coastal waters of Jeju-do has moved 50 to 100 km north over the past 25 years. From this, it would be possible to say that the impacts of climate change have being progressed on the seas around Korea, too.
• The followings are some evidences of the impact of climate change on the marine ecosystem:
  - In 2010, a tropical black pearl oyster (same kind as the black pearl oysters found in Micronesia, according to genetic testing) was discovered to be inhabiting the coastal waters of Seogwipo,

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 86 7/4/2019 5:39:36 PM

Jeju-do, and found to be about four years old (settled down in the summer of 2007, result of isotope analysis of shell).

- After 2000, subtropical Alveopora coral in the coastal waters of Jeju-do began reproducing rapidly (resulting in the rapid reduction of habitat for existing periphytons).
- Over the past 10 years, primary productivity has decreased. In addition, changes were noted in the community composition of microalgae, which are primary producers (from large microalgae to ultra-small microalgae), and the number of harmful zooplankton (jellyfish) has increased rapidly since 2000.

Figure 3.26 A Satellite Image of Sea Surface Temperature in winter with 18°C isothermal temperature lines in 1980 (dotted line) and 2010 (solid line). In a box, an example of real-time continuous monitoring of environmental data (Temp., Salinity, Chl-a, etc.) from the Mooring Buoys in the South Sea was presented.

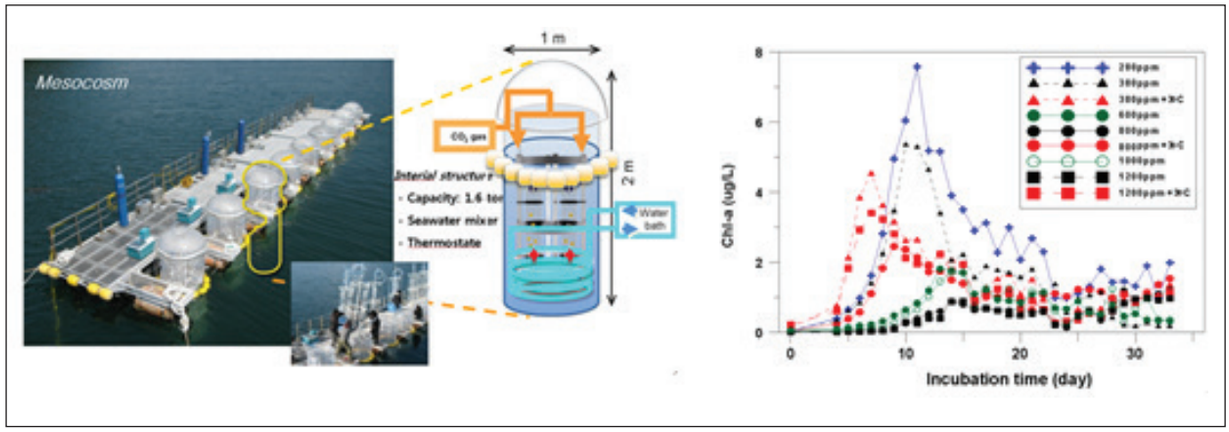


Establishment of a monitoring system in sea areas vulnerable to climate change (2009-2013)

- In addition, from 2009 to 2013, Korea established a monitoring system in sea areas vulnerable to climate change and collected data on the assessment of the progress of climate change and its effect on and changes in the ecosystem.
  - Under this monitoring system, the pilot operation and management of a real-time observation and monitoring system for assessing the impact of climate change on the marine environment and ecosystem were conducted. Moreover, the methodology and prediction of the response of the lower trophic levels to climate change (high CO_2 condition: rising of water temperature and ocean acidification) were established.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 87 7/4/2019 5:39:36 PM

Figure 3.27 A Photo and specification of KIOST self-produced Mesocosm System, which mimics the natural condition except CO_2 conditions, to assess the impact of Climate Change on marine ecosystem. An example of the results (algal growth rates under different CO_2 condition) obtained from a mesocosm experiment was presented.



Action Plan 8.3 Predict long-term changes of the Yellow Sea's ecosystem due to climate change

- The purpose of this management action was to predict long-term changes in the Yellow Sea's ecosystem considering with climate change, alongside other anthropogenic factors, such as eutrophication, overfishing, and habitat destruction.
- The indicators used to assess the implementation of this management action were the collection of ecological data necessary to predict long-term changes in the Yellow Sea due to climate change and the verification of the ecological model using the collected data.
- As described in Management action 8.3, the prediction of long-term changes in the Yellow Sea's ecosystem considering climate change has so far been done only through small-scale, one-off projects, and has thus been very limited.
  Although this management action was carried out via one-off research projects, it was possible to derive results regarding the structure, function, and monitoring of long-term changes of the Yellow Sea's ecosystem.

Δ **Yes, this management action has been successfully implemented. The project for predicting long-term changes in the Yellow Sea was carried out through institutional research projects. However, as the projects were one-off, a continuous research program is now recommended to pursue the effects of climate changes.**

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 88 7/4/2019 5:39:36 PM

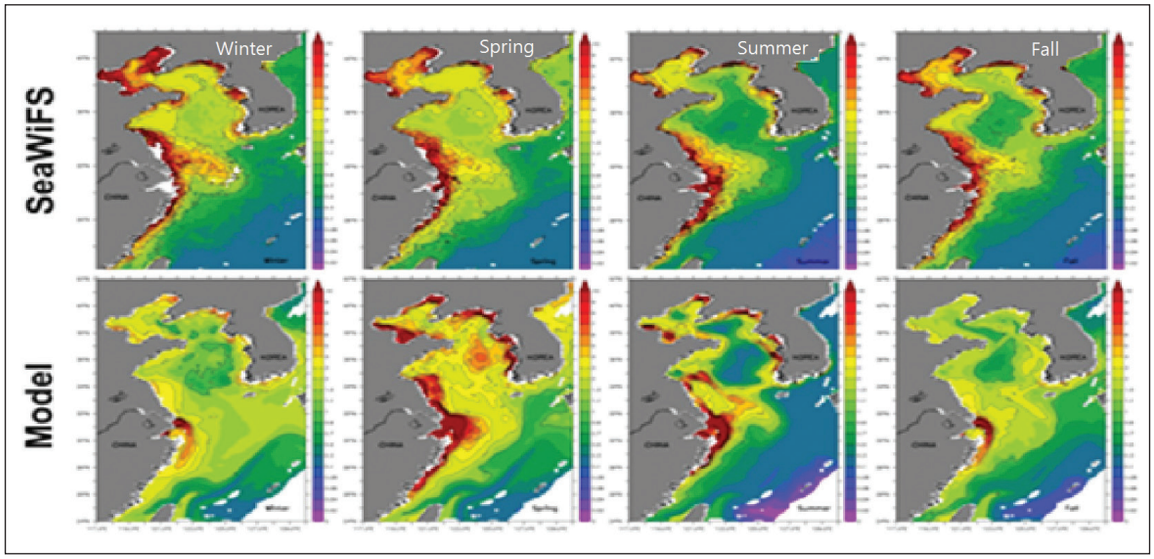
Understanding of the structure and function of the Yellow Sea's ecosystem

- Although research institutes affiliated with the Ministry of Oceans and Fisheries and universities have been working on projects to predict long-term changes in the Yellow Sea's ecosystem considering with climate change, these projects remain in the early stages yet.
  - KIOST and other institutes have been identifying seasonal changes in the physical characteristics of the Yellow Sea and gaining a better understanding of its inter-annual variation through the project named "Cold-water Masses in the Yellow Sea".
  - In addition, they were able to identify the seasonal characteristics (structure and function) of the ecosystem in the southeastern area of the Yellow Sea (area with cold water masses), as well as the trophic levels of major biota and their functions in the food web.

Prediction of long-term variability of the Yellow Sea ecosystem

- In addition, research institutes have conducted projects to gain a better understanding of the inter-annual variation of nutrients and chlorophyll in the Yellow Sea, using the ecosystem model. A key result is provided in **Figure 3.28**.

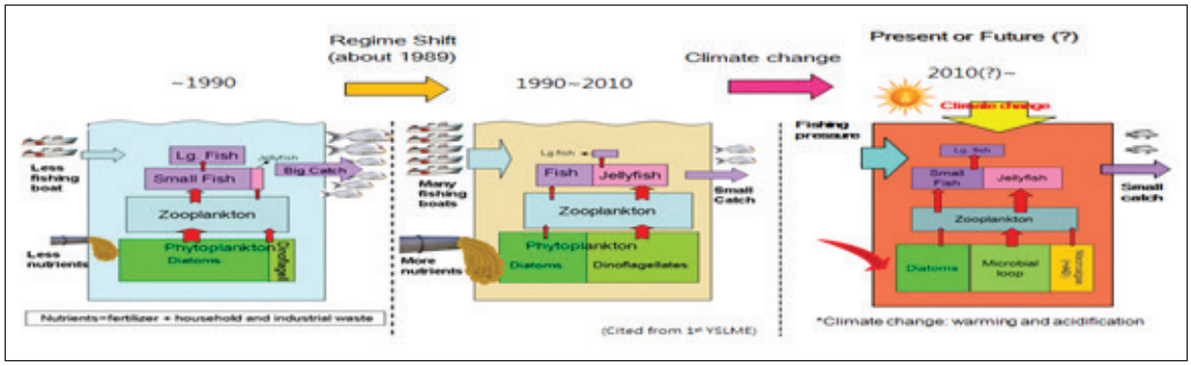
Figure 3.28 Comparison of Observed (on the top) and Predicted Values (on the bottom) of the Seasonal Distribution of Chlorophyll Concentration in the Yellow Sea.



- Through this project, key factors and coefficients of the physical-ecosystem coupled model were identified to help predict long-term changes in the Yellow Sea ecosystem according to the climate change scenario.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 89 7/4/2019 5:39:36 PM

Figure 3.29 Past, Current and Future Changes in the Yellow Sea Ecosystem.



Action Plan 8.4 Monitor and assess the transboundary impact of jellyfish blooms

- This management action was designed to secure the basic analytical data necessary to minimize the appearance of rapidly increasing masses of jellyfish and the damages they cause.
  - This task, in particular, focuses on the comprehensive monitoring of jellyfish, which have strong transboundary attributes, at both regional and national levels within the waters of the Yellow Sea.
- The indicators used to assess the implementation of this management action were the various activities conducted to monitor the transboundary effects of jellyfish blooms.
- Diverse activities have been conducted for this management action, including research projects, establishment of a national monitoring system, and engagement in international cooperation within the region, making it the task for which the most activities have been performed.
  - The various activities conducted include: monitoring of and ecological research on the appearance of jellyfish, provision of the information gathered from jellyfish monitoring, and monitoring of the movement of jellyfish in public waters using ships of opportunity.

Δ **Yes, as a result, monitoring, assessment, and ecological research on and against the transboundary effects of jellyfish blooms have been continuously carried out.**

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 90 7/4/2019 5:39:36 PM

Table 3.61 Monitoring frequency of Nomura's Jellyfish (2011-2017) (Unit: frequency)

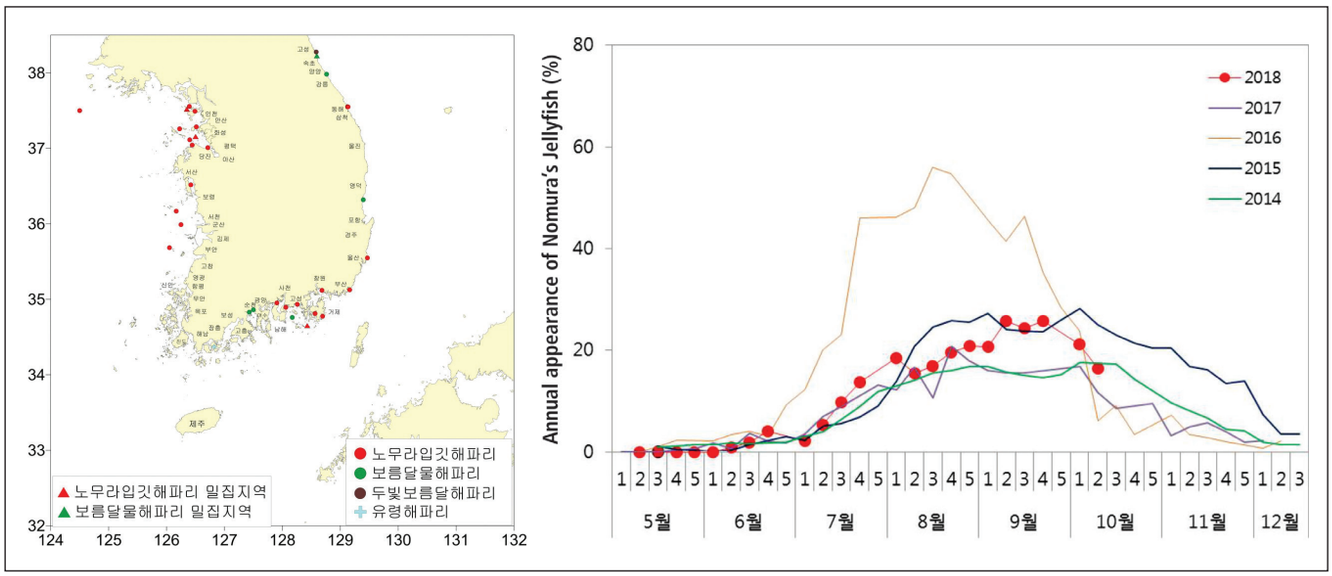
Year	2011	2012	2013	2014	2015	2016	2017
Inshore	3	5	5	5	5	5	5
Coastal	24,420	22,275	23,680	37,760	37,760	18,290	17,515

Table 3.62 Abundance and appearance rate of Nomura's Jellyfish (2011-2017).

Year	2011	2012	2013	2014	2015	2016	2017
Inshore	0.2	3.1	0.2	-			
Coastal	4.81	25.12	25.21	15.64	19.31	24.15	16.59

- The areas of jellyfish appearance and annual variation identified by the monitoring system are shown in **Figure 3.30**.

Figure 3.30 Weekly appearance of Nomura's Jellyfish (red dot), Moon jelly (green dot) and other (left) and annual variation of appearance rate of Nomura's Jellyfish in 2014-2018 (right)



Jellyfish monitoring and provision of information

- NIFS collates and analyzes the data provided by jellyfish monitoring agents and disseminates information via its website (since 2006).
  - Every year, from May to December, when jellyfish begin to occur, NIFS posts jellyfish information on its website on a weekly basis and collects the information for publication and distributes an annual report on the appearance of jellyfish in Korea's coastal waters.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 91 7/4/2019 5:39:36 PM

Figure 3.31 Weekly (left) and annual report (center) on jellyfish appearance in Korea's coastal waters (left) with major jellyfish species (right).

- NIFS has monitored jellyfish blooms over 1,120 times, and the information it provides has been useful to establish policies and related measures for identifying the characteristics of jellyfish, predicting their movement, and preventing damages to fisheries.

Monitoring appearance of jellyfish in the Yellow Sea using ships of opportunity

- NIFS and the Ministry of Oceans and Fisheries (MOF)/KOEM are carrying out a project to monitor the appearance of jellyfish in the Yellow Sea using ships of opportunity as a regional YSLME project.
  - This project has been carried out under the YSLME framework in an effort to reduce the transboundary damage caused by jellyfish in the Yellow Sea.
- MOF and NIFS began their projects in 2017, while MOF/KOEM began in 2018. Through these projects, the institutes are monitoring the appearance of jellyfish using sighting method on ships of opportunities that regularly travel in the Yellow Sea, Bohai Sea, Jeju Strait and Korea Strait—that is, between Incheon and Qingdao, Incheon and Yantai, Yantai and Dalian, Ingkou and Incheon, Pyeongtack-Lianyungang, Mokpo/Yeosu/Goheung-Jeju, Busan-Fukuoka.
  - To date, over KRW 200 million have been invested in this management action, and the number of sessions for monitoring Nomura's jellyfish through these projects is shown in **Table 3.63**.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 92 7/4/2019 5:39:37 PM

Table 3.63 Jellyfish monitoring in the Yellow and adjacent seas using ships of opportunity (2017-2018).

Project/Year	2017	2018
National Institute of Fisheries Science	• 1 ship in the central Yellow Sea, 6 times • 3 ships in the Jeju Strait, 6 times • 1 ship in the Korea Strait, 1 time	(same as in 2017)
Ministry of Oceans and Fisheries	• 3 ships in the northern Yellow Sea and Bohai Sea, 5 times	None
Ministry of Oceans and Fisheries/ Korea Marine Environment Management Corporation	None	• 4 ships in the Yellow and Bohai Seas, 5 times • (1 ship in the central Yellow Sea, 5 times) • (3 ships in the northern Yellow and eastern Bohai Seas and Bohai Strait, 5 times)

- Through this project, the research institutes were able to identify the temporal and spatial distribution of Nomura's jellyfish in the central and northern Yellow Sea, Jeju Strait, Korea Strait, and eastern Bohai Sea and Bohai Strait). Monitoring information from MOF/KOEM was provided to the NMEMC, which is in charge of jellyfish projects in the YSLME in China (2018).

Action Plan 8.5 Monitor the occurrence of harmful algal blooms (HABs) and evaluate their effects

- This management action was designed to strengthen the monitoring and impact assessment of the occurrence of harmful algal blooms (HABs), which have been occurring in large-scale since the 1995, in coastal waters of the Yellow Sea.
- The indicators used to assess the implementation of this management action were the activities that came to form the basis for HABs monitoring and impact assessment, including HABs predictions, eco-physiological study of HABs species, and monitoring of their effects.
- Korea has been consistently promoting the monitoring and impact assessment of HABs through the National Institute of Fisheries Science since the 2000s.
  - Since 2016, HABs have not occurred in the coastal waters of the West Sea, but eco-physiological studies of HABs species in the Yellow Sea have been consistently conducted.

Δ **Yes, NIFS is conducting various activities such as regular monitoring, assessment and information service.**

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 93 7/4/2019 5:39:37 PM

Expansion of the research scope and HABs monitoring area using survey vessels and ships of opportunity

- In Korea, National Institute of Fisheries Science has regularly conducted HABs monitoring using survey vessels and ships of opportunity
  - As of 2017, there are 82 stations of HABs monitoring in the Yellow Sea and nine surveys have been carried out.
- HABs monitoring is being conducted 7 times at 30 stations from May to November when HABs mainly appeared. NIFS Serial Oceanographic Observation (NSO) of the West Sea is carried out three times at 52 stations in June, August, and October.
- Continuous eco-physiological research on harmful algae in the Yellow Sea
- Since 1997, the National Institute of Fisheries Science has been regularly monitoring HABs in the West Sea as a study item of the project called "Study on HABs Monitoring and Outbreak Mechanism."
  - The results of this project were analyzed in correlation with the water quality data collected through fishing ground environment monitoring to identify the conditions that cause red tides and long-term changes.
- Through this project, the National Institute of Fisheries Science has been calculating an ecosystem-based water quality indicator and providing the results as well as identifying the environment conditions of HABs and long-term variations in the fishing ground environment.

Figure 3.32 Example of Transmission of Real-time Fishing Ground Environment Information by Linking the HABs Monitoring Results in West Sea.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 94 7/4/2019 5:39:37 PM

Relevant activities for monitoring and assessment of the impact of HABs on the YSLME

- The National Institute of Fisheries Science has been pursuing international cooperation between Korea and China, including information exchange and workshops on red tides, in order to promote the monitoring of HABs and their impacts. The details of the activities are as follows:

EASTHAB (EAST Asian Harmful Algal Bloom Research Group: launched in 2004, held biennially since 2009)

- 2011 (Philippines), 2013 (Hanyang University, Korea), 2015 (China), and 2017 (Japan)
- Promotes research on the HABs occurrence mechanism and countermeasure in East Asia by sharing information and research results on HABs in RO Korea, PR China, Japan, and the Philippines.

Annual Meeting of PICES (North Pacific Marine Science Organization) "HABs-S," presentation of National Reports

- Shares information on HABs among North Pacific nations (RO Korea, China, Japan, Russia, United States, and Canada) and seeks direction for joint response to HABs
- Presented the results of the special session at the International Conference on Harmful Algae (ICHA) and published PICES report

HAB expert meeting (HABs-S)

Publication of joint report

Joint presentation at ICHA

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 95 7/4/2019 5:39:37 PM

Promotion of a cooperative project between fisheries research institutes in RO Korea, China, and Japan titled "Information Exchange on Harmful Red Tide Algae"): since 2007, annual, NIFS-CAFS/ ECSF

- Contributes to the development of fisheries science by strengthening personnel exchange and research cooperation between national fisheries research institutes of Korea, China, and Japan.

Operation of China-Korea Joint Research Center (Korea's NIFS West Sea Fisheries Institute and China's Yellow Sea Fisheries Research Institute, since 2013)

- Held workshops and annual meetings of the China-Korea Joint Ocean Research Center in Incheon (2014), Guangzhou (China, 2015), Jeju (2016), and Xining (China, 2017).

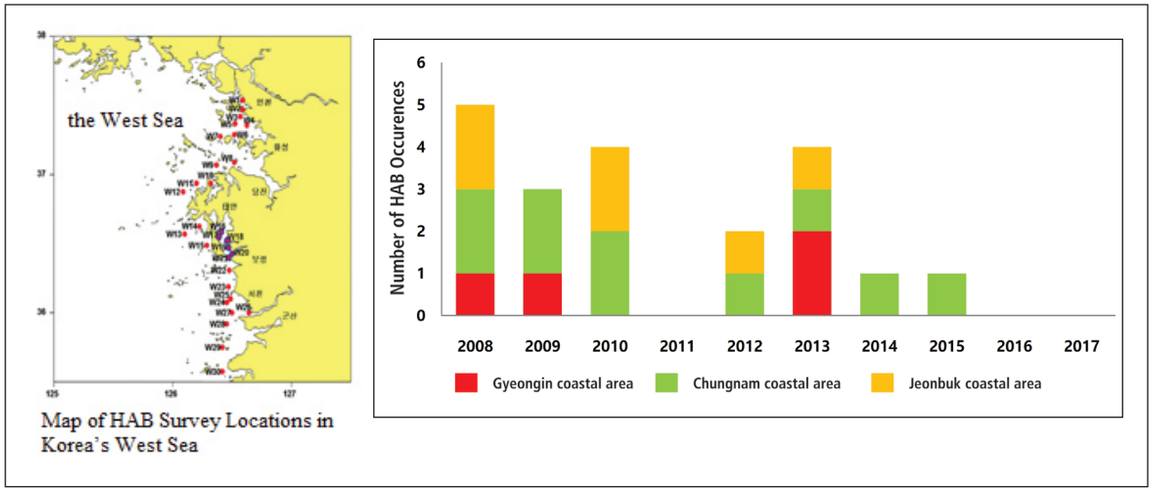
Center's Opening Ceremony in Qingdao, China, 2013.

Center's Opening Ceremony in Incheon, Korea, 2013.

Occurrence of HABs in the vicinity of the coastal waters of the West Sea (Yellow Sea)

- The number of HABs occurrence in the coastal waters of the West Sea (Yellow Sea) since 2008 is shown in the graph below. The number of occurrences began declining after 2014, and no red tides occurred in 2016 and 2017.

Figure 3.33 Map of HAB Survey stations in Korea's West Sea and Number of HAB Occurrences in the West Sea (2008-2017).



YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 96 7/4/2019 5:39:37 PM

Management Goal 9	Maintenance and improvement of current populations/distributions and genetic diversity of the living organisms including endangered and endemic species
Background	Maintenance of genetic diversity in the West Sea (Yellow Sea) through the management of endemic species and protected organisms

1. Implementation Assessment Indicators and Content

- Management Goal 9 aimed to manage the inflow of introduced species that threaten the ecology of endemic species and disturb the ecosystem and maintain the current numbers, distributions, and genetic diversity of marine organisms.
- The management actions implemented to achieve this goal include: (i) development of related guidelines on preserving the genetic diversity of endemic species and marine organisms under protection, specifying such matters as the establishment of domestic guidelines and acceptance of laws.
  - Therefore, the indicator used to assess the implementation of this management action was the establishment of domestic guidelines and acceptance of laws for the management of endemic species and marine organisms under protection.

Table 3.64 Management actions and Indicator for Management Goal 9.

Management action	Indicators	Content
9.1: Conserve the genetic diversity and population of endemic species and marine organisms under protection and develop regional guidelines	Establishment of guidelines and acceptance of laws for the management of endemic species and marine organisms under protection	Recognize the importance of managing endemic species and marine organisms under protection and establish a legal basis that outlines the actions necessary to carry out such management

2. Implementation Status and Major Results

Action Plan 9.1 Conserve the genetic diversity and populations of endemic species and marine organisms under protection and develop regional management manuals

- This management action aimed to develop regional management guidelines for the conservation of endemic species and endangered marine organisms in order to maintain the number, distribution, and genetic diversity of existing marine organisms.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 97 7/4/2019 5:39:37 PM

- The indicators used to assess the implementation of this management action were activities to preserve the number and genetic diversity of endangered marine organisms and domestic laws or regional guidelines established to manage said activities.

- In 2006, Korea established the Marine Ecology Division within the Ministry of Land, Transport and Maritime Affairs (currently the Ministry of Oceans and Fisheries) and actively began focusing on preserving the diversity of marine life and managing related protected species. To this end, various laws and long-term plans were established, and related activities were conducted based on such laws and plans.
  - With the creation of a new division dedicated to such matters, national interest was running high and related activities were actively conducted, resulting in various achievements.
- However, this management action focused on the biological populations with high mobility that needed to be addressed as a transboundary issue, and therefore required the development of guidelines for managing regional cooperation. Efforts toward that end, however, were insufficient.
  - Although the activities carried out to develop domestic guidelines have been evaluated positively, there is a lack of regional cooperation.

Δ **Yes, these Management actions were actively promoted at the national level, but regional cooperation projects aiming to address transboundary issues were insufficient.**

Restructuring of protected marine life system and designation of protected marine life

- Restructuring of protected marine life system and designation of protected marine life
- Based on the Conservation and Management of Marine Ecosystems Act (enacted in 2006), Korea has been establishing basic plans for the conservation and management of marine ecosystems every 10 years, and conducting various projects in accordance with these plans.
  - Based on the First Basic Plan for the Conservation and Management of Marine Ecosystems (2009-2018), Korea has increased the number of marine life species placed under protection, systematically protected marine organisms under protection, and promoted policies for expanding biological diversity through the restoration of the functions of habitats and breeding grounds.
- As a result, the Ministry of Oceans and Fisheries has placed 77 species of marine organisms under protection as of 2018.
  - The trend of designated marine organisms under protection since 2006 is outlined in **Table 3.65**.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 98 7/4/2019 5:39:37 PM

Table 3.65 Trend of Marine Organisms Designated as Under Protection (2006)

Base year	2006	2012	2016
Number of designated species	46 species	52 species	77 species
Note	Upon the enactment of the Conservation and Management of Marine Ecosystems Act	Added 8 species	None
Major organism groups	whales and coral	Sea turtles, Indo-Pacific bottlenose dolphins, seahorses, and clithons	Finless porpoises, whale sharks, scalloped hammerhead sharks, longnose seahorses, marine clamworms, and 14 species of seabirds

Source: Assessment of the Implementation of the Basic Plan for the Conservation and Management of Marine Ecosystems, Ministry of Oceans and Fisheries (2018).

- In addition, various notices and guidelines have been established, in accordance with the Act, to create a systematic basis for the protection of endangered marine life.
  - "Official Announcement on the Management of and Support for Organizations Dedicated to Rescuing and Treating Marine Animals" (2015), "Guidelines on the Designation, Operation, and Provision of Support for Ex-Situ Conservation Institutions for Marine Organisms" (2016), and "Measures to Conserve Endangered Marine Organisms" (2016), etc.
- In addition, the number of ex-situ conservation institutions for marine organisms was increased (total 11), along with the number of designated institutions specializing in the rescue and treatment of marine organisms (total 8). Moreover, systems were implemented to improve artificial habitats for marine life and reduce illegal activities such as animal abuse.

Promotion of projects, such as the conservation of target organisms

- The Ministry of Oceans and Fisheries, Ministry of Environment, NGOs, and other relevant organizations have promoted projects to protect endangered marine organisms.
  - Since 2006, a survey of the habitat conditions of spotted seals in Baengneyong Island (Ministry of Oceans and Fisheries) and a survey of the habitat conditions by the Han River Basin Environmental Office (Ministry of Environment) have been conducted, and a service providing real-time video of the spotted seal habitat on Baengneyong Island was provided (2017).

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 99 7/4/2019 5:39:37 PM

Table 3.66 Changes in Population of Spotted Seals in Korea (2006-2011).

Year	Past	2006	2007	2008	2009	2010	2011
Ministry of Environment projects	110 (2005)	74	122	123	50	74	182
Ministry of Oceans and Fisheries projects	340 (2002)	274	139	213	250	193	246

** Based on monitoring, 391 were counted in 2017 and 316 in 2018.*

Figure 3.34 Real-time video service of the spotted seal habitat on Baengneyong Island.

- In addition, the Korean government promoted various projects, including: rescuing sea turtles, securing the basis for marine life to reproduce indoors, protecting the habitat of marine species under protection, establishing measures to restore the population of each species of marine organism under protection, and raising public awareness of the protection and management of marine life.

Management Goal 10	Maintenance of habitats according to standards and regulations of 2007
Background	Maintain the size of habitats based on the regulations and standards that were in effect in 2007 by preventing the destruction of coastal habitat areas due to various development activities

1. Implementation Assessment Indicators and Content

- Management Goal 10 focuses on maintaining the current habitats through various management activities in an effort to prevent the destruction of coastal habitats in the Yellow Sea, where reclamation activities have resulted in significant reductions of natural coastlines and habitats.
- The management actions carried out to achieve this goal included: (i) supplement plans for coastal management areas; (ii) create a network of marine protected areas (MPAs); (iii) manage newly reclaimed coastal areas; and (iv) promote awareness of the benefits of biodiversity conservation.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 100 7/4/2019 5:39:37 PM

- The indicators used to assess the implementation of the management actions were: (i) development of supplemental plans for coastal management areas and revision of relevant laws; (ii) number of designated MPAs; and (iii) number of coastal reclamation projects and activities to increase public awareness of biodiversity.

Table 3.67 Management actions and Indicators for Management Goal 10.

Management action	Indicators	Content
10.1: Supplement and effectively implement plans for coastal management areas and develop guidelines for the preservation of coastal habitats	Supplementation of plans for coastal management areas, revision of laws regarding the protected areas, and development of local guidelines	- Supplementation of plans for coastal management areas in consideration of environmental changes and other conditions, allowing the plans to be applied to new circumstances
10.2: Expand, effectively manage MPAs and establish a network of MPAs	Number of designated MPAs	- Designation of MPAs and network activities to manage MPAs
10.3: Control new coastal reclamation demand and implement a proper management	Number of newly reclaimed coastal areas	- Analysis of the number of coastal reclamation areas in Korea (West Sea) since 2011
10.4: Promote public awareness of the benefits of biodiversity conservation	Activities to increase public awareness of biodiversity preservation (government, local governments, and NGOs)	- Various activities conducted to increase public awareness of biodiversity conservation

2. Implementation Status and Major Results

Action Plan 10.1 Supplement the coastal management plan and develop guidelines for effective habitats conservation and implementation

- The purpose of this management action was to develop rational local guidelines for coastal habitats in order to prevent the loss and destruction of coastal habitats due to unplanned development activities.
- The indicators used to assess the implementation of this management action were the development of guidelines for coastal management and revision of relevant laws.
- Korea has been making efforts to manage reclamation activities and prevent the destruction of natural coastlines, notably through the enactment and revision of the Coast Management Act and other related laws.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 101 7/4/2019 5:39:37 PM

- In addition, by reflecting current conditions and environmental changes, Korea has been supplementing regional plans when necessary and enacting and implementing various plans and regulations to function as guidelines.

Δ **Yes, the Coast Management Act has been implemented, and plans are being regularly established and supplemented in consideration of environmental changes. Guidelines for preserving coastal habitats have also been implemented by law.**

Establishment of various legal systems for coastal management and supplementation of plans for coastal management areas

- Through the enactment and revision of the Coast Management Act and other related laws, Korea has implemented various policies on integrated coastal management (ICM), wetland conservation, marine ecosystems, and environmental protection in an effort to restrain unplanned reclamation projects and manage activities that are destroying the country's natural coastlines.
  - In particular, Article 6 of the Coast Management Act stipulates the formulation of a plan for ICM every 10 years, and Article 8 of said Act stipulates that local governments must formulate plans for coastal management areas.
- The Ministry of Oceans and Fisheries conducted a feasibility review of the Second Integrated Coastal Management Plan, established in 2011, and created a revised plan (2016-2021) that reflects recent changes in coastal conditions.

Table 3.68 Main Content of the Five Promotion Strategies in the Revised Plan.

Advancement of coastal space management tools	Expansion and strengthening of coastal disaster response system	Maintenance of healthy coastal ecosystem and environment	Rational utilization of coastal areas and value enhancement	Strengthening of support for and management of ICM
Strengthen the effectiveness of the "Coastal Water Zoning System" and organize a scientific coastal management system	Strengthen the interconnection between related policy measures and expand science & technology infrastructure	Strengthen management tools to sustain and maintain healthy coastal ecosystem and scenic views	Implement policies in a rational and scientific manner and create coastal spaces for leisure and recreation	Establish the basis for a comprehensive coastal policy support system and integrated management support

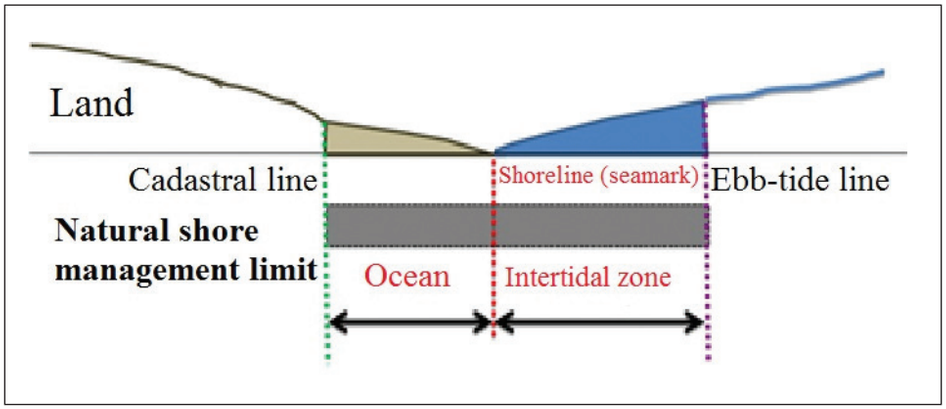
YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 102 7/4/2019 5:39:37 PM

- Accordingly, local governments are currently revising the regional plans for coastal management to reflect the main revisions and key directions of the revised plan. Moreover, Korea has established a revised plan (2016-2021) by conducting a feasibility review and reflecting new changes in conditions in the Second Plan for Integrated Coastal Management.
- Plans for coastal area management are currently being supplemented to reflect the revised Second Plan for ICM, and each local government is currently identifying specific methods, including setting the basic goal of coastal area management and policy directions (since 2012).
- Of all the 74 local governments in coastal areas of Korea, 46 (62%) have completed the formulation of the Second Plan for Coastal Management.

Implementation of the Natural Coast Management Goal System and setting of the management goal for the Natural Marine Coast System (November 2011)

- In addition, the Ministry of Oceans and Fisheries established the Natural Coast Management Goal System and Natural Coast Management Goals in order to create a comprehensive national system for natural disaster management.
  - This measure was implemented to enable the government to systematically manage all natural shores, mudflats, and coastal habitats at the national level. The standards and methods for setting up natural shore surveys and ocean status maps for basic local governments in coastal areas have been specified in order to promote the management and maintenance of natural shores.

Figure 3.35 Marine Management Targets and Scope of the Natural Coast Management Goal System.

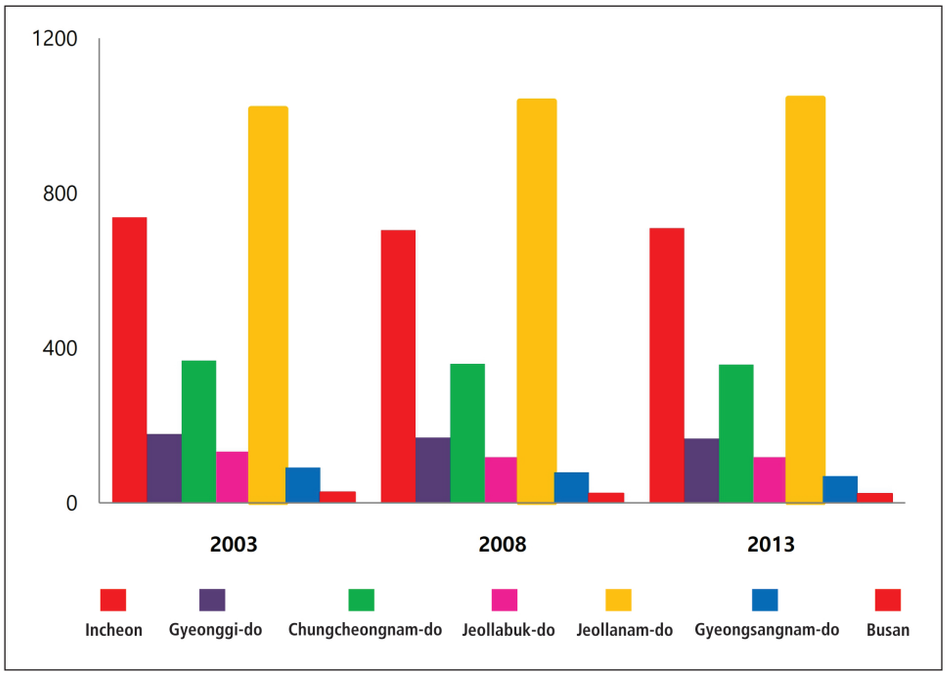


YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 103 7/4/2019 5:39:37 PM

Changes in the area of mudflats by local government

- The total area of mudflats along the coast of the Yellow Sea generally appears to be increasing.
  - When reflecting the new coastlines of islands in Incheon at a scale of 1:5,000, the total area of mudflats was found to have increased by 5.7 km^2, from 703.9 km^2 in 2008 to 709.6 km^2.
  - As the coastlines of islands in Ganghwa-gun and Ongjin-gun were not reflected in the project, parts of the land areas were included as mudflats, which increased the total area of mudflats (2.8 km^2 in Ganghwa-gun and 3 km^2 in Ongjin-gun).
  - Due to reclamation for the construction of fishing port facilities in Hwaseong and reclamation for agricultural land in Gimpo, Gyeonggi-do's mudflats were found to have decreased by 2.9 km^2, from 168.8 km^2 in 2008 to 165.9 km^2.
  - Due to reclamation for the construction of fishing port facilities near Jeongok Port in Hwaseong and the reflection of the new coastlines, the total area of mudflats in Hwaseong has decreased by 0.3 km^2.
  - Mudflats are distributed evenly along the coasts in Taean-gun (Chungcheongnam-do), with Anmyeon Island at the center. Due to the development of industrial complexes, the total area of mudflats has decreased by 1.8 km^2, from 358.8 km^2 in 2008 to 357.0 km^2.
  - When reflecting the data on the new coastlines of islands in Jeollabuk-do, the total area of mudflats in Gunsan, Buan-gun, and Gochang-gun has decreased slightly, while the total area of all mudflats in the province has increased by 0.5 km^2, from 117.7 km^2 in 2008 to 118.2 km^2.
  - As numerous islands and Korea's largest mudflats are located in Jeollanam-do, the province was greatly affected by the new coastlines, with the total area of its mudflats increased by 7.5 km^2, from 1,036.9 km^2 in 2008 to 1,044.4 km^2.

Figure 3.36 Changes in total area of mudflats by area.



YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 104 7/4/2019 5:39:38 PM

Action Plan 10.2 Expand, effectively manage MPAs and establish a network of MPAs

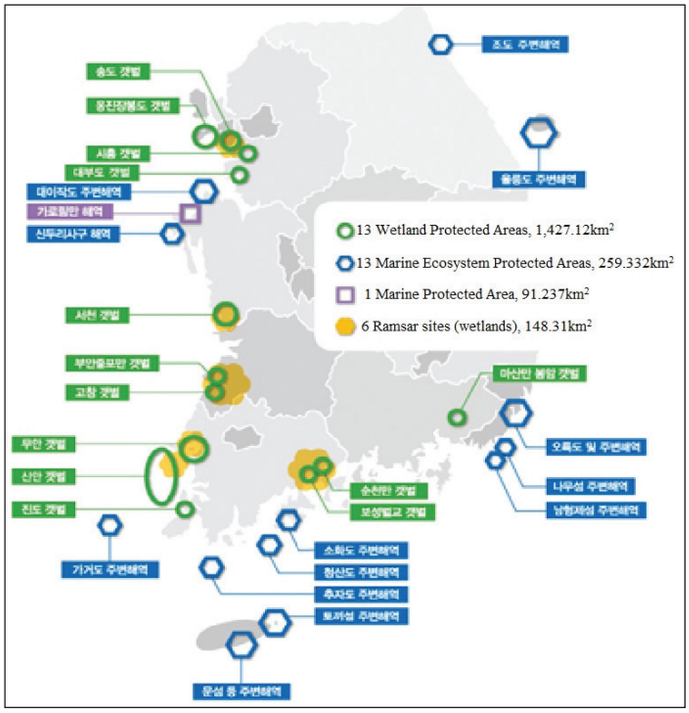
- The aim of this management action was to establish an international network of MPAs and promote the preservation of ecological resources by expanding the MPAs and forming a network of MPAs.
  - The indicators used to assess the implementation of these management actions were identification of the trend of the expansion of MPAs, and the revision of the domestic system to identify trends of the expansion of MPAs and the effective management of MPAs.
- Based on various laws, Korea designates areas with high ecological value and that require resource protection as MPAs, and has established a system for managing the tasks involved in making such designations.
  - The MPA Management Team and MPA of the Korea Marine Environment Management Corporation are effectively and systematically managing domestic MPAs, showing that management activities are being conducted quite actively.

Δ **Yes, it involved various tasks, including the establishment of a special Marine Protected Area Management Team, expansion of the MPAs, and conducting of networking activities.**

Designation and expansion of MPAs

- In Korea, areas with high ecological value and that require resource protection are designated as MPAs based on various laws.
- The total area of the MPAs is 586.372 km^2, consisting of wetland protected areas (235.81 km^2), marine ecosystem protected areas, (259.332 km^2), and marine organism protected areas (91.237 km^2). As of 2017, a total of 28 MPAs have been designated.

Figure 3.37 Designated Marine Protected Areas in Korea. (as of 2018)



YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 105 7/4/2019 5:39:38 PM

- Since 2011, the number of MPAs have been increasing by an average of one or two every year.

Table 3.69 Number of survey stations by year (2011-2017).

Category	2011	2012	2013	2014	2015	2016	2017
Number of designated MPAs	1	3	3	1	2	2	2
Cumulative number of MPAs	15	18	21	22	24	26	28
Area of newly designated MAPs	0.100	71.690	71.755	39.440	13.500	91.830	9.540
Cumulative area	288.624	360.314	432.069	471.509	485.009	576.839	586.379

Establishment of MPA networks and operation of dedicated agency

- Korea has been working to establish a domestic and international network of MPAs.
  - First, for the establishment of a domestic network of MPAs in Korea, KOEM has been leading the expansion of the "mudflat center network" to create a "regional MPA network," strengthening the basis for cooperation to vitalize MPAs.
  - As of 2017, a total of 15 organizations are participating in the network to share information, engage in exchanges, and cooperate to vitalize MPAs.
- In addition, the Korea Marine Environment Management Corporation's MPA Management Team has been playing the role of an MPA center by carrying out programs, including the conservation and restoration of MPAs, establishment of the foundation for the sustainable use and management of MPAs by strengthening domestic and international networks, and improvement of the brand value of MPAs by raising public awareness of MPAs.

Figure 3.38 Table of the MPA Team of the Korea Marine Environment Management Corporation.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 106 7/4/2019 5:39:38 PM

Action Plan 10.3 Control new coastal reclamation demand and implement a proper management

- This management action was designed to prevent new wetland reclamation and properly manage reclamation activities in order to prevent the release of hazardous pollutants into the marine environment and damages to mudflats caused by reclamation and development activities, such as the urbanization of coasts.
- The indicators used to assess the implementation of this management action were the government's policy efforts, such as improvements to relevant laws in order to regulate or properly manage wetland reclamation in Korea, and the changes in the size of reclaimed areas.
- Korea has enacted various laws that are directly or indirectly related to wetland reclamation, clearly stipulating the sustainable use of public waters and efficient use of reclaimed land.
  - To prevent unplanned development and promote the reasonable use of public waters, Korea has been maintaining a proper management system, establishing plans every ten years, and conducting a feasibility test and making revisions to the plans every five years.

Δ **Yes, based on policies or laws, reclamation activities are restricted in Korea, which has been made possible through means such as the improvement of legal systems in accordance with environmental changes.**

Implementation of reclamation-related policies and systems

- The Korean laws directly related to coastal reclamation are the Public Waters Reclamation Act and Public Waters Management Act. Both laws stipulate the eco-friendly conservation and reclamation of public waters and efficient use of reclaimed lands.
  - Through the implementation of the Public Waters Management and Reclamation Act, Korea has been promoting the conservation and management of public waters and the sustainable use and efficient utilization of reclaimed land through eco-friendly reclamation.
- To prevent the unplanned development of public waters and foster the rational use and management of public waters, Korea has been establishing a basic plan for public waters reclamation every ten years and reviewing the feasibility of and making changes to the plan every five years.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 107 7/4/2019 5:39:38 PM

Table 3.70 Third Basic Plan for Public Waters Reclamation and Main Content of the Revised Plan.

Category	Basic Plan	Revised Plan
Spatial scope	Coasts of Korea (except Jeju Island)	Coasts of Korea (except Jeju Island)
Temporal scope	2011-2021	2016-2020
Target districts	Total 53 districts, 2,321,695 m^2	Total 25 districts, 331,938 m^2

- Onsite inspection has been made mandatory in order to minimize the reclamation of public waters, and improvements have been made to decrease the illegal use of public waters. As a result, the number of illegal activities, such as illegal reclamation, decreased from 2,662 incidences to 1,547 incidences (reduction of 59.1%) in 2014.
- To strengthen the management of public waters, laws were amended to cancel reclamation licenses and public waters usage permits that were obtained using false information or in an illegal manner.

Changes in the size of reclaimed area

- The reclamation of public waters in Korea since 2011 is outlined in **Table 69**.

Table 3.71 Public Waters Reclamation in Korea by Year. (Unit: m^2)

Year	2011	2012	2013	2014	2015	2016	2017
Area	1,638,539	1,125,773	789,507	14,904,237	274,525	775,670	235,549

Source: Ministry of Oceans and Fisheries' Coastal Portal

Action Plan 10.4 Promote public awareness of the benefits of biodiversity conservation

- This management action was designed to lay the foundation for biodiversity conservation by promoting greater awareness and understanding of the benefits of biodiversity and importance of biodiversity conservation among the public, who are the fundamental agents of conservation efforts.
  - The indicators used to assess the implementation of this management action were the various activities conducted and the establishment of a promotion system for raising public awareness of marine biodiversity.
- Since 2006, Korea has been consistently carrying out projects to increase public awareness of the management of MPAs and developing various programs to elicit the general public's interest.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 108 7/4/2019 5:39:38 PM

- In addition, with the opening of the National Marine Biodiversity Institute of Korea in 2015, Korea has been widely promoting permanent and special exhibitions and various events to help people become more aware of marine biodiversity.
  - The National Marine Biodiversity Institute of Korea, an organization in charge of promoting public awareness of biodiversity conservation, has developed a well-structured system.

Δ **Yes, various activities have been actively carried out, led by key organizations, such as the Ministry of Oceans and Fisheries and National Marine Biodiversity Institute of Korea.**

Public lectures and events to raise awareness of biodiversity

- The Ministry of Oceans and Fisheries, Ministry of Environment, their affiliated organizations, and NGOs have been leading and organizing various citizen-participatory events and activities as well as regular projects and programs.
- In cooperation with KOEM, the Ministry of Oceans and Fisheries has been carrying out an education and training project related to MPA management (since 2006), promoting citizen monitoring of MPAs (since 2006), and organizing events for World Wetlands Day (every year).
- The Ministry of Environment is currently carrying out various projects, including the development of wetlands education and international cooperation on wetland conservation.
- In particular, the Ministry of Oceans and Fisheries and KOEM have been organizing MPA Conventions, under various themes and featuring diverse contents, every year since 2008.
  - The main contents and details of the MPA Conventions held since 2008 are listed in **Table 3.72**.

Table 3.72 Details of the MPA Conventions (since 2008).

No.	Dates	Location	Main content
1	August 28-29, 2008	Ganghwa-gun, Incheon	• Introduction to management policies for MPAs and expert lectures • Presentation on outstanding examples and workshop on MPA management • Hands-on events, such as an introduction to mudflat ecosystem
2	August 27-28, 2009	Jeungdo, Sinan-gun	• Presentation on management policies and examples of local governments • Workshop to establish management plans and hands-on mudflat ecosystem experience
3	July 8-10, 2010	Sea turtles, Indo-Pacific bottlenose dolphins, seahorses, and clithons	• Presentation on management examples and discussion on measures for improving management • NOAA cooperative project workshop and ecology trips

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 109 7/4/2019 5:39:38 PM

Table 3.72 Details of the MPA Conventions (since 2008). (cont.)

No.	Dates	Location	Main content
4	September 1-2, 2011	Busan	• Management contest and discussion on measures for assessing management projects • Discussion on establishing strategies to boost ecotourism • International cooperative project briefings and network meeting • Exploration of Oryuk Island, Busan, and other surrounding MPAs
5	May 17-19, 2012	Jeungdo, Sinan-gun	• Joint events for World Wetlands Day and MPA Convention • Management contest, wetlands academic forum, assessment of management improvements, citizen monitoring network workshops, etc. • Mudflat eco-tour, cultural performances, promotion booths, etc.
6	October 10-11, 2013	Legend Hotel Daejeon	• Analysis of contest case studies and discussion of solutions • Mudflat Center network, expert monitoring, creation of MPAs where people want to live, snipes network, etc.
7	July 11-12, 2014	Songdo Convensia	• Joint events for World Wetlands Day and MPA Convention • Plans for follow-up activities for guidelines and management assessment • Contest for outstanding MPA management performance of local governments, etc.
8	May 14-15, 2015	Siheung ABC Happy Town	• Ecotourism seminars • Contest for outstanding MPA management performance of local governments • Excursions to tidal channels in Siheung and discussion on their conservation, etc.
9	October 17-18, 2016	International Wetland Center at Suncheon Bay National Garden	• Special lecture for local residents on the status of MPA management • Contest for outstanding examples of cooperative public-private governance • Measures for vitalizing MPAs in cooperation with local residents • Breakout session on the establishment of the CEPA Action Plan
10	May 11-12, 2017	Mudflat Ecology Park in Julpo Bay, Buan-gun, Jeollabuk-do	• Contest for project ideas to vitalize MPAs • Discussion on measures for improving the brand value of local areas linked to MPAs • Exhibition of materials related to MPA education and specialty products

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 110 7/4/2019 5:39:38 PM

- In addition, various events were held to increase the awareness of students and young people, such as biodiversity camps, marine organism study events, and other hands-on activities.

Figure 3.39 Various Activities and Events Held to Increase Awareness of Marine Biodiversity.

Display of the Permanent Collection at the National Marine Biodiversity Institute of Korea as well as the institute's exhibitions and efforts to increase public awareness

- Opened in 2015, the National Marine Biodiversity Institute of Korea has been raising public awareness of the importance of biodiversity through various means, including permanent and special exhibitions, 4D video screenings, hands-on activities, and various events and lectures.
- The National Marine Biodiversity Institute of Korea is responsible for establishing mid- to long-term plans for the sustainable use of marine bioresources, securing Korea's rights to marine bioresources in the international community, laying the foundation for the industrial use of marine bioresources, and conducting activities to increase public awareness of marine bioresource conservation.

Figure 3.40 Facilities, Including the Exhibition Halls at the National Marine Biodiversity Institute of Korea.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 111 7/4/2019 5:39:38 PM

Management Goal 11	Monitoring of the dangers posed by introduced species
Background	Need to monitor various aspects of introduced species in order to reduce the damages caused by the inflow of introduced species into the Yellow Sea

1. Implementation Assessment Indicators and Content

- Management Goal 11 focused on monitoring the risk of the inflow of introduced species, which cause economic and social losses by disturbing stable ecosystems.
- The management actions carried out to achieve this goal include: (i) control and monitor ballast water discharge; and (ii) efficiently control the inflow of non-native species through preliminary and preventive approaches.
  - The indicators used to assess the implementation of the management actions were: (i) development of devices and technology for monitoring and controlling the inflow of introduced species via ballast water discharge; and (ii) implementation of a system for managing harmful marine organisms and organisms causing disturbances in marine ecosystems.

Table 3.73 Management actions and Indicators for Management Goal 11.

Management action	Indicators	Content
11.1: Control and monitor inflow of non-native species by discharge of ship ballast water	Development of related devices and technology (monitoring and control) and management activities	Review the technology development, system, and management activities to control the inflow of introduced species from ballast water discharged by vessels
11.2: Control non-native species efficiently with precautionary approach	Implementation of system for managing harmful marine organisms and organisms causing disturbances in marine ecosystems (strengthen management and supervision)	Establish legal hazard assessment standards, methods, and procedures necessary for the systematic management of and preventive responses to harmful marine organisms and organisms causing disturbances in marine ecosystems

2. Implementation Status and Major Results

Action Plan 11.1 Control and monitor inflow of non-native species by discharge of ship ballast water

- This management action was designed to reduce the impact of introduced species in ecosystems by controlling and monitoring the inflow of such marine organisms from ballast water discharge.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 112 7/4/2019 5:39:38 PM

- The indicators used to assess the implementation of this management action include: the development of technologies and devices to prevent and manage the inflow of introduced species, establishment of related laws and systems, and performance of various activities.
- Since 2012, Korea has developed various devices and systems for monitoring and controlling the inflow of introduced species from ballast water discharge through KIOST's "Development of Ballast Water Discharge Regulation and Response Techniques" project.
  - Through this project, it became possible to effectively control and monitor harmful aquatic organisms introduced through ballast water.

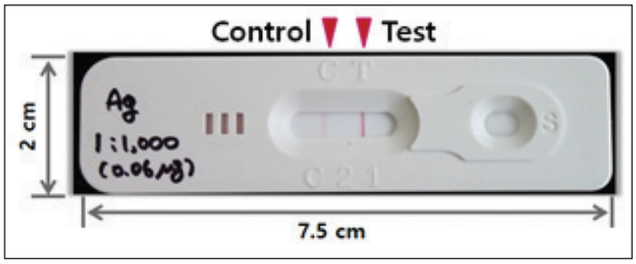
Δ **Yes, large-scale national research and development projects, technology development and monitoring, and systems and policies applicable to control and management have all been implemented.**

Development of various devices for managing harmful marine organisms in ballast water

Device for monitoring harmful marine organisms in ballast water

- KIOST developed "rapid kits" (sampling kits) to detect and monitor harmful marine organisms (microalgae) in ballast water.
  - There are three of these kits, featuring: monoclonal antibodies that detect a-tubilin proteins in harmful microalgae species (Heterocapsa triquetra), monoclonal antibodies that detect RuBisCo L-subunit proteins, and monoclonal antibodies that detect Alexandrium tamarense PSI-subunit 9 proteins.
  - Among them, the kit for detecting a-tubulin proteins in Heterocapsa triquetra was found to be the most effective for onsite use.

Figure 3.41 Kit for the Rapid Detection of Harmful Microalgae.

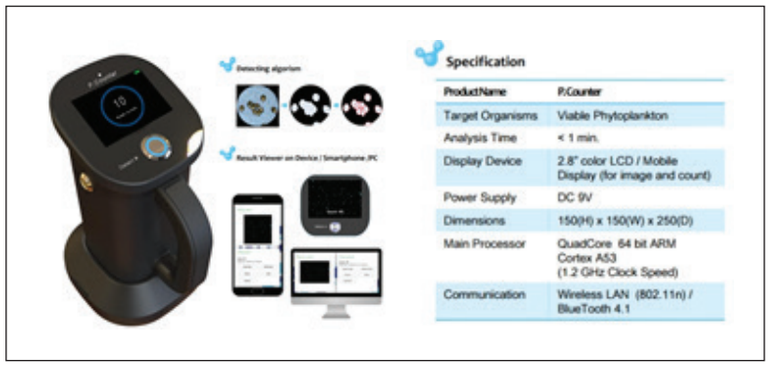


YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 113 7/4/2019 5:39:38 PM

Simplified portable device for detecting phytoplankton in ballast water

- A simplified portable device for detecting phytoplankton in ballast water was developed to make it easier to monitor introduced species that could enter the ecosystem through ballast water.
  - This device identifies plankton by analyzing images and the fluorescence of plankton in ballast water. It also enables the verification of compliance with the discharge conditions stipulated in the Ballast Water Management Convention.

Figure 3.42 Simplified Portable Device for Detecting Phytoplankton in Ballast Water.



Portable device for digitalizing the detection of microalgae in ballast water (2015-2016)

- A portable reader was developed to digitalize and quantify the analog signals generated by kits for rapidly detecting harmful microalgae in ballast water. The device has an accuracy rate with an over 95 percent confidence level.

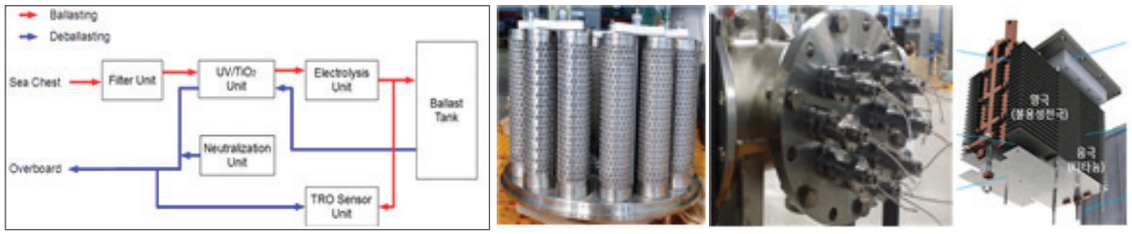
Figure 3.43 Rapid Kit Digital Reader.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 114 7/4/2019 5:39:38 PM

Ballast water facilities that comply with USCG Phase II standards (2013-2017)

- In addition, Korea developed ballast water treatment facilities that comply with standards that are 1,000-times stricter than the International Convention for the Control and Management of Ship's Ballast Water and Sediments.
  - This is a hybrid system that combines three technologies and is 1,000-times more effective at destroying harmful organisms compared to existing ballast water treatment facilities that received approval on model.

Figure 3.44 Ballast Water Treatment Facilities.



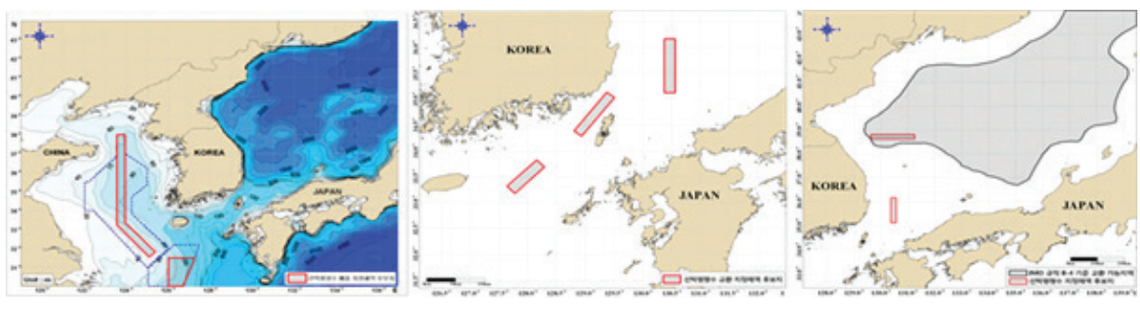
System's ballast water treatment | Filters | UV/TiO2 | Electrolysis

Proposal of candidate sites for the discharge of ballast water

Device for monitoring harmful marine organisms in ballast water

- Korea reviewed and proposed candidate sites for the discharge of ballast water in the waters surrounding the country based on the guidelines for designating areas for the exchange of ballast water in the International Convention for the Control and Management of Ship's Ballast Water and Sediments.

Figure 3.45 Candidate Sites for Ballast Water Exchange in the Waters Surrounding Korea.



YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 115 7/4/2019 5:39:38 PM

Improvement of the treatment of ballast water and related systems

- Domestically, Korea implemented the Ballast Water Management Act in order to systematically manage ballast water.
  - Concurrently with the entry into effect of the Ballast Water Management Convention* (September 2017), Korea enacted the Ballast Water Management Act to strengthen the regulations on ballast water management.

Ballast Water Management Convention

- A convention in which the International Maritime Organization (IMO) made it compulsory for countries to install ballast water treatment facilities on ships as a means of preventing disturbances in the ecosystem through the inflow and discharge of ballast water.
- The convention went into effect on September 8, 2017. Ships constructed after the convention went into effect are required to immediately install treatment facilities, while ships constructed before the convention went into effect must install the facilities in phases during regular inspection periods, in accordance with the International Oil Pollution Prevention Certificate.

* Ships were divided into two groups—those that received regular inspections prior to September 8, 2014 and those that received regular inspections after September 9, 2014—in order to schedule the installation period of ballast water treatment facilities. Depending on the inspection period, the installation period can be extended to 2024.

Act on Ballast Water Management

- Purpose: Include the key ideas of the Ballast Water Management Convention in Korean laws to restrict the reckless discharge of ballast water from ships and require the installation of ballast water management facilities, thereby preventing the transfer of harmful aquatic organisms to Korea's territorial waters through ballast water or sediment and preventing the destruction of marine ecosystems.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 116 7/4/2019 5:39:39 PM

Legalization of ballast water reporting and establishment and operation of the reporting system

- For the management and monitoring of the inflow and outflow of ballast water, Korea has made it compulsory for vessels seeking to enter the waters under its jurisdiction to report the history of any ballast water that they took on before entering its territorial waters by submitting the Ballast Water Reporting Form.
  - Vessels must provide various items of information, including vessel information, ballast water and ballast water tank information, and ballast water history (taking on, discharge, etc.), on the Ballast Water Reporting Form.
  - The function of reporting ballast water in port has been added to the existing Port-MIS (Port Management Information System), which manages related records in a database.
- Expansion of infrastructure and support for national research and development projects for ballast water management
- Korea has been continuously providing support for the research and development of ballast water management at the national level and expanding related infrastructure.
  - Through the government-led establishment and operation of land-based and movable facilities for testing ballast water treatment devices, Korea established land-based facilities for testing ballast water treatment devices in order to secure the confidence of the international community in its ballast water management (February 2013).
  - In addition, through the establishment of movable facilities for testing ballast water treatment devices (September 2017), Korea secured the capability to test ballast water treatment devices in saltwater, fresh water, and brackish water, in accordance with the IMO standards.

Land-based facilities for testing ballast water treatment devices

Movable facilities for testing ballast water treatment devices

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 117 7/4/2019 5:39:39 PM

International forum on ballast water and expert training

- Korea held international forums by inviting experts on ballast water from Korea and abroad to share related information and engage in discussions on the improvement of the Ballast Water Management Convention and implementation methods.
  - In addition, a basis for systematic education on ballast water management has been laid through the designation and operation of a specialized ballast water management educational organization (March 2018).

2015 International Ballast Water Tech Cooperation Forum

Venue: Paradise Hotel, Busan

Dates: November 3-4, 2015

Main discussion points

- Discussion on international standards: discussion and information exchange on the revision of the guidelines for the approval of ballast water management systems (G8) of the International Maritime Organization (IMO).
- Official approval of the US: latest trends of the US' official approval and introduction of the official approval procedure and test schedule of the Korean Register of Shipping, which was designated as an independent testing agency of the US.
- Technical cooperation and promotion: promotion of Korean technology and status of the development of next-generation ballast water treatment technologies

2016 International Ballast Water Tech Cooperation Forum

Venue: Paradise Hotel, Busan

Dates: November 8-9, 2016

Main discussion points

- Ballast Water Management Convention: issues and prospects of the implementation of the Ballast Water Management Convention, issues and prospects of the US ballast water management strategies, etc.

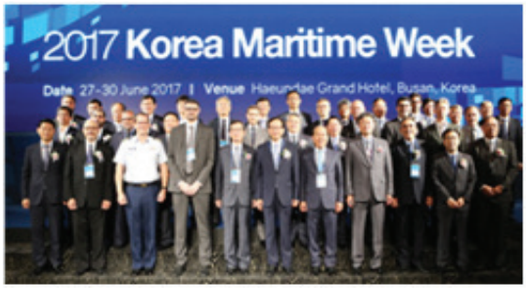
YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 118 7/4/2019 5:39:39 PM

- Official approval test: official approval of the US and issues related to the official approval of the management convention, etc.
- Technological cooperation and promotion: issues related to the development of ballast water treatment technologies, explanation of remodeling technique for vessels required to install ballast water treatment equipment, etc.

2017 Korea Maritime Week (industrial forum)

Venue: Grand Hotel, Busan

Date: June 28, 2017



Main discussion points

- Current issues and prospects of the implementation of the Ballast Water Management Convention, etc.
- Announcement of the US policy on ballast water
- Technological cooperation and promotion, such as the development of next-generation ballast water treatment methods

- Discussions on the designation of ballast water exchange areas have been completed through joint surveys and the establishment of an analytical system for the designation of ballast water exchange areas in the region (Yellow Sea and bodies of water in Northeast Asia).
  - Korea and China have conducted discussions to review the designation of ballast water exchange areas in the Yellow Sea, with both parties agreeing that it would be difficult to designate ballast water exchange areas in the Yellow Sea.

Reasons for Not Designating Areas for Ballast Water Exchange in the Yellow Sea

- To protect water resources in the Yellow Sea
- 50 to 60 percent of ship operating hours are necessary for ballast water exchange
- Risk assessment needs to be conducted for the designation of an exchange area
- Environmental protection is a priority

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 119 7/4/2019 5:39:39 PM

Action Plan 11.2 Control non-native species efficiently with precautionary approach

- This management action was designed to develop policies, systems, and technologies for the early detection and response to non-native organisms, such as preventive-oriented monitoring systems.
  - The purpose was to minimize ecological and socioeconomic losses resulting from the inflow of non-native species.
- The indicators used to assess the implementation of this management action were the reorganization of policies, institutions, technologies, and systems implemented to control the inflow of non-native species and the implementation of projects.
- To prevent the inflow of non-native species, Korea has revised various regulations and systems in order to define the risk assessment, standards, management methods, and related procedures necessary for the management of harmful marine organisms.
- In addition, Korea has been promoting the development of technologies for managing harmful organisms in an effort to prevent the mass-generation of and remove non-native species and harmful organisms. Moreover, it has conducted activities to raise awareness of harmful organisms and engaged in international cooperation activities.

Δ **Yes, various management activities were performed, including activities to implement and revise preventive legal systems, technology development, and other related activities.**

Revision of the regulation on and management system for the introduction of non-native species

Establishment of a comprehensive system for the management of the inflow of non-native organisms

- Korea has prepared a systematic basis for the management of harmful marine organisms by enacting and revising laws on the regulation and management of harmful marine organisms and organisms causing disturbances in marine ecosystems and enacting the "Notice on the Designation and Management of Harmful Marine Organisms" (November 2015). In addition, to prevent the inflow of non-native species, Korea has continued to revise various regulations, institutions, and systems for the purpose of regulating the risk assessment, standards, management methods, and related procedures for the management of harmful marine organisms.
  - The details of the procedure for designating harmful marine organisms as well as the standards and methods of risk assessment necessary to manage harmful marine organisms have been revised.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 120 7/4/2019 5:39:39 PM

Table 3.74 Risk Assessment Standards for the Designation and Removal of Harmful Marine Organisms.

Assessment standards	Detailed assessment standards
Physiological and ecological characteristics of marine organisms under evaluation	Characteristics of ecological distribution: temporary or recurring
	Post-incident impact range: localized or multiple emergence
	Diffusion speed: limited distribution, diffusion by currents (tides), etc.
Characteristics of the damage caused by marine organisms under evaluation to humans and other organisms	Toxicity carried by target marine organisms
	Secondary damages (suffocation of other organisms, etc.)
	Adverse effects on the aesthetics of ecosystems (increased aversion)
Characteristics of the damage caused by marine organisms under evaluation	Repeated occurrence of damage
	Level of force majeure that humans cannot control
	Need for national response measures

Revision of the Enforcement Regulations of the Conservation and Management of Marine Ecosystems Act (September 2017)

- In addition, organisms that were found to be of concern through monitoring and assessment have been legally designated as organisms that cause disturbances in marine ecosystems (from no species to 1 species), and the designation of harmful marine organisms has been expanded (from 13 species to 17 species).
- Details on the designation of harmful marine organisms and organisms causing disturbances in marine ecosystems are listed in **Table 3.75**.

Table 3.75 Marine ecosystem disturbance organism and harmful marine organism designation.

Category	Classification	Common name	Scientific name	Note
Organisms causing disturbances in marine ecosystems (1 species)	Chordate	Ciona robusta	*Ciona robusta*	New in 2017
7 harmful marine organisms (17 species)	Phytoplankton	Pseudo-nitzschia	*Pseudo-nitzschia spp.*	
		Alexandirum	*Alexandrium spp.*	
		Chattonella	*Chattonella spp.*	
		Cochlodinium	*Cochlodinium polykrikoides*	

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 121 7/4/2019 5:39:39 PM

Table 3.75 Marine ecosystem disturbance organism and harmful marine organism designation. (cont.)

Category	Classification	Common name	Scientific name	Note
7 harmful marine organisms (17 species)	Cnidarians	Nomura's jellyfish	*Nemopilema nomurai*	
		Moon jelly	*Aurelia aurita*	New in 2016
		Portuguese man o' war	*Physalia physalis*	
		Box jellyfish	*Carybdea brevipedalia*	New in 2017
		Japanese sea nettle	*Chrysaora pacifica*	New in 2017
	Echinoderms	Blue bat star	*Asterina pectinifera*	
		Northern Pacific seastar	*Asterias amurensis*	
	Bryozoa	Membranipora tuberculata	*Membranipora tuberculata*	
		Tricellaria occidentalis	*Tricellaria occidentalis*	
		Watersipora subovoidea	*Watersipora subovoidea*	
	Plants	Saltmarsh cordgrass	*Spartina alterniflora*	New in 2016
		Common cordgrass	*Spartina anglica*	New in 2016

Designated Organisms Causing Disturbances in the Marine Ecosystem and Harmful Marine Organisms.

Epidemiological and damage study for non-native species and creation of an information system

Establishment of a comprehensive system for the management of the inflow of non-native organisms

- Monitoring and surveys of damages caused by the inflow and movement of non-native species have been conducted, and an information system with a database containing related information has been created.
  - In 2011, Korea conducted monitoring of introduced species in major ports and water surrounding Korea[13] and identified the status of non-native species. The results are shown in **Table 3.76**.

[13] 10 ports: Guryongpo, Ulsan, Busan, Tongyeong, Gwangyang, Jeju, Seogwipo, Mokpo, Gunsan, and Incheon.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 122 7/4/2019 5:39:39 PM

Table 3.76 Introduced Species in Ten Ports by Classification.

Category	Total	Guryongpo	Ulsan	Busan	Tongyeong	Gwangyang	Jeju	Seogwipo	Mokpo	Gunsan	Incheon
Sponges	1(1)	-	1(1)	-	1(1)	-	-	-	-	-	1(1)
Cnidarians	8(3)	2(2)	1(1)	2(1)	1(1)	1(1)	3(1)	-	1(1)	2	2(1)
Mollusks	44(2)	13(2)	5(1)	5(1)	7(1)	7(1)	10	11	3(1)	8(1)	5(1)
Arthropods	12(4)	6(3)	7(4)	6(2)	6(3)	5(1)	7(1)	4(1)	4(2)	2	4(1)
Bryozoans	10(5)	6(3)	2(2)	4(1)	6(4)	2(1)	2	9(4)	5(2)	-	4(1)
Echinoderms	13	8	1	3	3	6	2	3	2	-	3
Chordates	10(5)	5(3)	1(1)	6(4)	8(3)	4(3)	1	4(3)	4(3)	-	5(3)
Marine algae	74(6)	20(3)	10(2)	9(2)	40(3)	6	25(2)	11	6(1)	3	19(4)
Total	172(26)	60(16)	28(12)	35(11)	72(16)	31(7)	50(7)	42(8)	25(10)	15(1)	43(12)
2010	176(23)	54(14)	30(11)	42(12)	62(13)	39(12)	69(7)	42(9)	37(12)	17(3)	37(9)

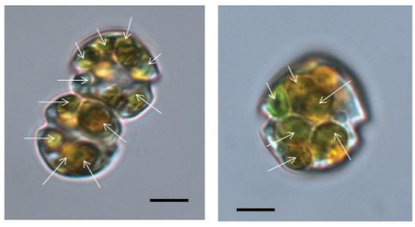
- Since 2013, through the development of technology for managing harmful marine organisms and organisms that cause disturbances in marine ecosystems, Korea has been studying the distribution and physiological and ecological properties of such organisms, which led to the development of effective management, prediction, and forecasting technologies.
  - The main results of this project are summarized below.

Main Results of the Project (2014-2016)

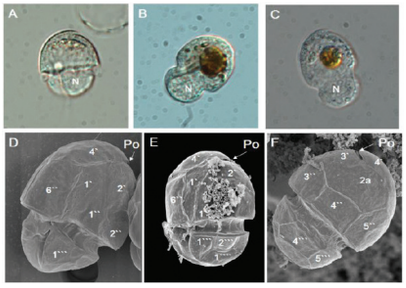
- Classification and analysis of harmful marine organisms and organisms causing disturbances in marine ecosystems

* (2014) 13 organisms legally defined as harmful marine organisms, (2015-2016) 18 organisms (candidates) designated as likely to cause disturbances in marine ecosystems

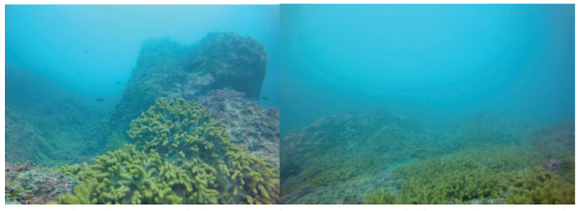
- Confirmation of toxic moon jellies wintering in Korea for the first time and development of a detection kit and early detection primer for algal blooms
- Finger leather coral, native to subtropic regions, found off the shore of Jeju Island for the first time



Ansanella granifera



Aduncodinium glandula



Finger leather coral (encroaching on a rock foundation in the sea of Tosan-ri (Seogwipo), first discovered in February 2016)

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 123 7/4/2019 5:39:39 PM

Project to eliminate harmful marine organisms

- Korea has been developing technologies, revising related systems, and continuously promoting projects to eliminate harmful marine organisms.
  - In particular, Korea has been able to prevent jellyfish blooms through the removal of moon jellies (polyps) from 2013 to 2017, reducing damage to the fisheries industry and restoring the health of marine ecosystems as a result. Various other projects to remove harmful marine organisms have been conducted as well.
  - The major results of this project can be summarized as follows:

Effect of jellyfish polyp removal: change in the number of adult jellyfish

- Sihwa Lake: before removal (2011), 14/m^3 › after removal (2017), fewer than 1/m^3
- Masan Bay: before removal (2013), 27 /m^3 › after removal (2017), fewer than 2/m^3

Number of Jellyfish Polyps Removed

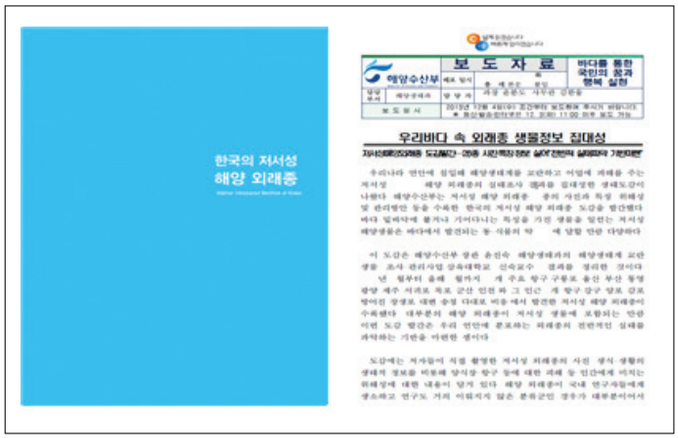
Year	Sea areas for removal and exploration	Number removed	Note
2013	Sihwa Lake	Removed 160 million polyps	Removal project
	Masan Bay	Removed 75 million polyps	Pilot removal project
2014	Masan Bay	Removed 230 million polyps	Removal project
	Saemangeum	Removed 250 million polyps	Pilot removal project
2015	Saemangeum	Removed 220 million polyps	Removal project
	Gamak Bay	Removed 10 million polyps	Pilot removal project
2016	Saemangeum	Removed 250 million polyps	Complete removal
	Gamak Bay	Removed 210 million polyps	Removal project
	Yeojaman	Removed 930,000 polyps	Pilot removal project
	Deungryang Bay	Removed 38 million polyps	Emergency removal
	Janggil-ri Port, Pohang	Discovered 1 polyp habitat (504 m^2)	Polyp exploration
2017	Six areas in the south of Jeollanam-do (Haenam, Wando, Gangjin Bay, Gogeumdo, Joyakdo, and Gamak Bay)	Removed 404 million polyps	Removal project
		Explored 441 locations in 30 areas of Korea and discovered 156 jellyfish polyp habitats	Polyp exploration

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 124 7/4/2019 5:39:39 PM

Raise public awareness of and draw attention to the inflow of introduced species

- Korea created publications and held symposiums to draw people's attention to and raise awareness of the inflow of introduced species.
  - "Benthic Marine Introduced Species in Korea",[14] which includes the results of monitoring conducted so far, was published and distributed (December 2013) to promote public interest in and understanding of the existence of introduced species and the damage they inflict on marine ecosystems.

Figure 3.46 Cover of the Publication and Related Press Releases.



  - A symposium on the integrated management of marine ecosystems was held to promote exchange and cooperation among experts in the private and public sectors, industry, schools, and research institutes and encourage them to share information and seek ways to reduce and manage harmful marine organisms (November 2017).

Figure 3.47 Symposium on Raising Awareness of Harmful Organisms and Related Press Release.

[14] Results of a survey of introduced benthic marine species that infiltrate domestic coastal waters, disturb marine ecosystems, and damage the fishing industry (published photographs, characteristics, hazards, and management methods for the 26 introduced marine species).

[15] Introduction of methods for managing harmful marine organisms and organisms that disturb the marine ecosystem, such as ciona robusta, moon jelly, saltmarsh cordgrass, etc., and progress made on removing moon jelly polyps, etc.

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 125 7/4/2019 5:39:39 PM

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 126 7/4/2019 5:39:39 PM

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 127 7/4/2019 5:39:39 PM

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 128 7/4/2019 5:39:39 PM

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 129 7/4/2019 5:39:39 PM

UNDP/GEF YSLME Phase II Project Management Office
Email: info@yslmep.org
Website: www.yslmep.org

Incheon Secretariat
5th floor
G-Tower
175 Art center-daero, Yeonsu-gu,
Incheon 22004
RO Korea
Tel: +82 (0)32 859 7711

Beijing Office
6 Qiwang Fen Bei Road,
Beianhe Sujiatuo,
Haidian District,
Beijing, PR China
Telephone: 010-6249 2548
Cel no.: 13552538239

YSLME IRR of Project Implementation of NSAP - RO KOREA.indd 130 7/4/2019 5:39:39 PM