



Regional Working Group Report

ECOSYSTEM

**UNDP/GEF Project Entitled “Reducing
Environmental Stress
in the Yellow Sea Large Marine Ecosystem”**

Report of First Meeting

Goeje Is., R.Korea, 10~13 May 2005



About this publication:

This publication contains the report of the First Meeting of the Regional Working Group for the Ecosystem Component, under the UNDP/GEF Project, “Reducing Environmental Stress in the Yellow Sea Large Marine Ecosystem.” The report includes a summary of the discussions and agreements from the Meeting. Data and information to be collected for the Yellow Sea Transboundary Diagnostic Analysis are listed in the Annex to the report.

For reference purposes, this report may be cited as:

UNDP/GEF 2005. Reducing Environmental Stress in the Yellow Sea Large Marine Ecosystem, Report of the First Meeting of the Regional Working Group for the Ecosystem Component. UNDP/GEF/YS/RWG-E.1/3.

Cover design: Ms. YUN Euidea

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**REDUCING ENVIRONMENTAL STRESS
IN THE YELLOW SEA
LARGE MARINE ECOSYSTEM**

**Report of the First Meeting of the
Regional Working Group for the Ecosystem Component
UNDP/GEF Yellow Sea Project**

Goeje, Republic of Korea, 10 to 13 May 2005



**UNDP/GEF Project entitled “Reducing Environmental Stress in the
Yellow Sea Large Marine Ecosystem”**

UNDP/GEF/YS/RWG-E.1/3
Date: 13 May 2005
English only

**First Meeting of the Regional Working Group
for the Ecosystem Component**
Goeje, Korea, 10-13 May 2005

Meeting Report

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1 OPENING OF THE MEETING

1.1 Welcome addresses

- 1.1.1 On behalf of the United Nations Development Programme (UNDP) and United Nations Office for Project Services (UNOPS), Mr. Yihang Jiang, Project Manager, opened the meeting and welcomed the members of the Regional Working Group-Ecosystem (RWG-E) and observers to Goeje. He informed participants of the previous three Regional Working Group Meetings' (Pollution, Fisheries, Biodiversity) results, and highlighted the objectives of this Meeting, namely, the data and information collection, formulating a list of activities, and the workplan for the first two years of project implementation.
- 1.1.2 On behalf of the Korea Ocean Research and Development Institute (KORDI), Mr. Sinjae Yoo, welcomed all participants.

1.2 Introduction of members

- 1.2.1 RWG-E members and other participants were invited to introduce themselves and give a brief introduction on their background and roles in the Project. The list of participants is attached to this report as [Annex I](#).

2 ORGANISATION OF THE MEETING

2.1 Designation of Officers

- 2.1.1 Mr. Mingyuan Zhu nominated Mr. Sinjae Yoo as Chairperson. Members agreed and Mr. Yoo was duly elected as Chairperson. The PMO was responsible for secretariat functions of the Meeting.

2.2 Documentation Available to the Meeting

- 2.2.1 Mr. Yoo invited the Secretariat to introduce this agenda item. Ms. Connie Chiang of the Project Management Office (PMO) introduced the Meeting's working and information documents prepared by the PMO, with a brief explanation on the Terms of Reference (TOR) for the RWG-E and regional calculation cost that was discussed further during the relevant agenda items.
- 2.2.2 Mr. Jiang drew the member's attention to Document UNDP/GEF/YS/RWG-E.1/6, on a regional criteria to calculate activity costs. He stated that the other RWGs had felt that this task was beyond their responsibility to decide. Nevertheless, members were asked to consider this issue, such as to suggest some ways in which the costs for activities might be calculated.

2.3 Organisation of Work

- 2.3.1 The PMO presented the provisional working programme for the Meeting (Document UNDP/GEF/YS/RWG-E.1/inf.3), stating that this was a general guide for the Meeting. The PMO added that the working programme was flexible, and could be changed according to the Meeting's progress.

2.3.2 The Chairperson informed the Meeting about the organisation of work. It was agreed that, due to the nature of the agenda items to be discussed, the Meeting would be organised in plenary as far as possible. Sessional working groups would be formed if deemed necessary.

2.3.3 The meeting was conducted in English.

3 ADOPTION OF THE MEETING AGENDA

3.1 The Chairperson introduced the Provisional Agenda (Document UNDP/GEF/YS/RWG-E.1/1) and Annotated Provisional Agenda (Document UNDP/GEF/YS/RWG-E.1/2), prepared by the Project Management Office. The Chairperson emphasised the three main focal areas for the Meeting: 1) terms of reference for the RWG-E; 2) data and information collection; and 3) list of activities and workplan.

3.2 Mr. Jiang suggested that the members consider the joint survey cruise that is to be carried out in January 2006 with the other RWGs. Members decided to discuss this topic during Agenda Item 7.

3.3 Members also agreed to move Agenda Item 5.4, "Co-operation with other project components and relevant activities in the region," to Agenda Item 7 (Required actions and workplan), as these two issues were closely related.

3.4 Following the above decisions, members adopted the revised agenda that is attached as [Annex II](#) to this report.

4 DRAFT TERMS OF REFERENCE FOR THE REGIONAL WORKING GROUP FOR ECOSYSTEM (RWG-E)

4.1 Ms. Connie Chiang introduced the Terms of Reference (TOR) for the RWG-E, as listed in the Project Document. She explained that from the time of writing the TOR to the present, conditions of project implementation had changed. Members were asked to review the TOR, and make suggestions to revise the TOR to better reflect the current status of the RWG-E and Project objectives.

4.2 Members posed questions regarding the roles of the RWG, procedures to issue activity contracts, TDA/SAP preparation, and the Priority Investment Portfolio, which were duly clarified by the PMO staff. Members then carefully reviewed the RWG-E's TOR, and made changes to the background, membership, meeting procedure, and tasks.

4.3 Following the discussions, members agreed to the revised TOR to be submitted to the Project Steering Committee (PSC) for approval. The revised TOR is attached to this report as [Annex III](#).

5 OVERALL PROJECT AND COMPONENT OBJECTIVES

5.1 General description of activities contained in the Project Implementation Plan

5.1.1 Due to the member's differences in familiarity of the Project, Ms. Chiang gave a presentation on the Project, including the goals of producing the Transboundary Diagnostic Analysis (TDA) and Strategic Action Programme (SAP), and highlighted

the ecosystem component's activities. She also gave a brief introduction on the work to be accomplished by the 1st RWG-E Meeting.

- 5.1.2 Ms. Young Shil Kang asked about the co-financing amounts from the governments. The PMO explained the history and development of the Project, noting the increased co-financing contribution by both governments during the 2nd Regional Technical Meeting and the 1st meeting of the Project Steering Committee.
- 5.1.3 The members noted the information provided, in particular the relevant parts in preparing the TDA and SAP.

5.2 Reporting responsibilities of the RWG-E

- 5.2.1 The Secretariat introduced Document UNDP/GEF/YS/RWG-E.1/inf.5, and gave an overview on contracting procedures and reporting responsibilities of the contractors. Members noted that as the Project operates within the framework of United Nations, relevant UN rules and procedures should be followed.
- 5.2.2 Mr. Yoo posed the question on the different types of contracts that will be issued. The PMO gave a brief explanation, and informed the members that the procedure to carry out the contracts were the same, regardless of the types of contracts.
- 5.2.3 Mr. Jiang emphasised the bidding process used by the United Nations in issuing contracts, and explained that this procedure is used to ensure a transparent contract-issuing process, and to obtain the best value for money. He also explained that countries could recommend a waiver of bidding with ample justification.
- 5.2.4 Mr. Yoo then asked how the PMO would proceed should the minimum number of bids not be obtained. Mr. Jiang replied that a waiver of bidding would likely be applied in these cases. He also mentioned that government's preferences for contractors would be considered by the PMO and UNOPS, if submitted with supporting statements and appropriate justifications.
- 5.2.5 The Meeting took note of the reporting requirements that will be applied during implementation of project activities.

5.3 Required outputs and outcomes from the 1st RWG-E Meeting

- 5.3.1 Ms. Chiang introduced this agenda item, explaining the required outputs and outcomes of this Meeting, and how the outputs would contribute to the later stages of the Project, particularly the TDA/SAP development. Members were invited to consider whether these outputs and outcomes are realistic for the Meeting to achieve in four days.
- 5.3.2 Ms. Kang asked for clarification on the responsibilities of contractors in data and information collection. Ms. Chiang explained that when the members considered the required activities, they should also recommend specific tasks and/or responsibilities for the contractors in carrying out the activities.
- 5.3.3 Mr. Jiang emphasised that: 1) the data and information requirements identified at the meeting should include both natural and socio-economic data and information; and 2) the causal chain analysis to be carried out would be a preliminary one. Any

necessary improvement and finalisation would be done during the preparation of the TDA when more data and information from participating countries are available.

6 DATA AND INFORMATION NEEDS FOR THE ECOSYSTEM COMPONENT

6.1 Discussion on Yellow Sea ecosystem problems, identification of data and information requirements, and agreement on their format

- 6.1.1 The PMO presented Document UNDP/GEF/YS/RWG-E.1/5, and members were invited to complete the table listing the problems, data and information requirements to support or refute the problems, data format, and temporal and spatial scales of data to be collected. An example of the causal chain and governance analysis tables was also presented. Ms. Chiang then showed the data tables of the pollution, fisheries, and biodiversity working groups to give the members an idea of the end result, and how the completed table could steer the members to recommend the necessary activities.
- 6.1.2 Mr. Jiang emphasised two points: 1) focus on identifying the problems and required data and information; and 2) the causal chain analysis that the Meeting will deliberate on is only a preliminary analysis, and will help to identify necessary socio-economic and legal data and information.
- 6.1.3 The ensuing discussions to identify the ecosystem-related problems touched upon various issues. Ms. Kang suggested that the members should define the scope of the RWG-E's work. The Meeting felt that it would be appropriate to keep the scope of RWG-E's work as wide as possible. However, at present, the collection of required data and information should focus on lower trophic levels.
- 6.1.4 Mr. Daeseok Kang noted that the problems should focus on transboundary issues, and that the term "transboundary" should also be clearly defined.
- 6.1.5 Mr. Jiang explained "transboundary" as defined by the Global Environment Facility: 1) an event originating from one side of a water body that will affect another side(s); and 2) a problem that is a common phenomenon on more than one side.
- 6.1.6 Mr. Won Duk Yoon asked if the Project was limited to specific "borders" when considering the ecosystem issues, e.g. should inland issues be considered. Members agreed that "borders" would be problem-specific. Mr. Yoon also stated that it would be important to define ecosystem and the types of indicators to determine ecosystem change.
- 6.1.7 Mr. Jae-Sang Hong suggested that, as ecosystem problems were inter-related with problems identified by other working groups, perhaps the Ecosystem Group could use data from the other groups. He further stated that the types of habitats had to be made clear from the onset.
- 6.1.8 Mr. Fangli Qiao suggested that the problems could focus on: 1) human-related activities; 2) response of ecosystem to climate change; and 3) lack of evaluation skills for ecosystem status.
- 6.1.9 Following the discussion, all members proposed problems and indicators to detect each problem. When completing the causal chain and governance analysis, members agreed that immediate and underlying causes should be related one-to-one.

6.1.10 All participants contributed their knowledge, and spent a sizeable amount of effort to produce the table of required data and formats. Members also discussed the causal chain and governance analysis and produced a preliminary causal chain analysis. The agreed tables are attached to this report as [Annex IV](#).

6.2 Country presentations on available data/information on state of the ecosystem, data requirements to estimate carrying capacity, causal chain analysis, information gaps for ecosystem stressors

6.2.1 Mr. Yoo asked if inter-calibration of the data would be a necessary exercise. Mr. Jiang mentioned the pollution group's proposed inter-calibration exercises. Mr. Yoo then reminded members to consider inter-calibration of the data when discussing the actions to be taken.

6.2.2 The main topics under this agenda item were already discussed under other agenda items, and are captured in the respective parts in this report.

7 REQUIRED ACTIONS AND WORKPLAN

7.1 Required actions for TDA preparation

7.1.1 Ms. Chiang introduced the Full Time Equivalent (FTE), as a proposed method for the Project to have a regional guideline to calculate the costs of activities. She informed the members of the background and rationale of this agenda item, namely it was a task charged to the PMO by the 2nd Regional Technical Meeting. As mentioned earlier, previous RWG meetings had felt that this task was beyond their responsibility, and the FTE was introduced here just for information purposes.

7.1.2 Mr. Jiang added that this issue had been discussed by PMO, UNDP, and UNOPS, and it would be more appropriate that a regional standard for calculating the costs would not be used by the project. Calculating costs would be activity specific, therefore the meeting only needed to review the list of activities agreed at the first two regional technical meetings, but were flexible, and subject to revision.

7.1.3 Mr. Jiang emphasised that although the list of activities was flexible, the budget for the component activities should be within the total budget approved by the PSC. He also mentioned that the timeline for all activity implementation had been shifted to begin after the first round of RWG meetings.

7.1.4 Mr. Yoo asked whether the collection of data and information was limited to TDA preparation. Mr. Jiang explained that the data and information collected could be used for other purposes, such as producing additional valuable reports, e.g. status of the Yellow Sea ecosystem.

7.1.5 Mr. Yoo gave a brief history on how the list evolved from five years ago. Two technical meetings had agreed to rearrange the structure in a more logical way. He added that the current list of activities would address the trend in state of the ecosystem through historical data review, assess current ecosystem status, and evaluate the most significant stressors and corrective actions to take. Mr. Yoo further mentioned that carrying capacity for this component is defined as productivity potential, particularly of lower trophic levels, and will assist with assessment of carrying capacity in fisheries resources.

- 7.1.6 A brief visit was made to the data and information table to determine how much time would be needed to complete each activity. The Meeting reviewed the requirements for data and information, and examined whether the participating countries had minimum data or not enough data for each problem identified. Additional notations were added in the table to denote which items would be collected by the ecosystem group, and which would be taken from the other groups.
- 7.1.7 Following the discussions and clarifications, members reviewed the list of activities and actions required for preparation of the ecosystem component of the TDA. Participants felt that the activities discussed and agreed during the 2nd Regional Technical Meeting are appropriate for the first 2 years of project implementation, but required some minor changes. Participants agreed that the timeline for the carrying capacity activities should match that of the carrying capacity of the Fisheries Component. The meeting made some changes in the list of activities, and agreed on the activities, actions, and timetable during the first two years of project implementation.
- 7.1.8 The revised agreed list of activities and workplan is attached to this report as Annex V.

7.2 Information gaps and actions required for the field survey

- 7.2.1 Mr. Jiang reported on his discussions with the Chairperson of the RWG-Fisheries for the joint cruise. He informed the meeting that:
- (i) Initially, 6 cruises were planned in the original project document prepared 5 years ago, but due to increase in oil prices and other costs, the Project budget allocated for this purpose can afford only 2 cruises;
 - (ii) It was also agreed that joint cruises should be more appropriate with all relevant project components, as this would be more cost efficient; and
 - (iii) After careful examination at the first two technical meetings, it was agreed to use the Chinese research vessel, named "Bei Dou," belonging to the Yellow Sea Fisheries Research Institute's, due to lower operational costs.
- 7.2.2 The survey would cover the entire Yellow Sea, but excluding the 12-mile territorial area. The survey station settings and observation lines will depend on each RWG's requirements. Tentative dates for the first survey will be 4 to 25 January 2006. The second cruise is proposed for April – May, as this is the spawning season for fish.
- 7.2.3 Mr. Jiang informed the Meeting that all coastal countries should be informed six months before the cruise, according to United Nations Convention on the Law of the Sea (UNCLOS). Therefore, the cruise plan should be sent to both governments for approval.
- 7.2.4 Mr. Jiang also alerted the Meeting to the issue of bringing additional equipment from Korea to the research vessel. As the boat will not land in Korea, due to logistic difficulties, there would be a need for customs clearance in China, should any Korean scientists need to bring additional equipment. Members noted that this issue needed further examination.

- 7.2.5 Mr. Yoo asked members to consider prioritising the data parameters to be collected. He also mentioned the need of inter-calibration before or during the joint survey.
- 7.2.6 Members agreed that the Project Manager will inform all RWG Chairpersons, via e-mail, of his discussions on the joint cruise, and will ask relevant RWG Chairpersons to co-ordinate the technical and logistical requirements for each RWG. The Chairperson agreed to co-ordinate amongst the members on the parameters to collect from the joint cruise, and will produce a table listing the parameters for members to review.

7.3 Workplan for 2005 to 2006

- 7.3.1 The Regional Working Group-Ecosystem's workplan for 2005-2006 was discussed, amended and agreed. The workplan is included in [Annex V](#).

7.4 Co-operation with other project components and relevant activities in the region

- 7.4.1 The Chairperson invited members to introduce relevant national programmes and projects to which the Project would co-operate with. Mr. Zhu mentioned the upcoming national project in the southern part of the Yellow Sea coastal area in China. The project will start next year for two years, comprising of four cruises.
- 7.4.2 Ms. Kang presented Korea's monitoring programmes that could co-operate with this Project. She mentioned the four monitoring programmes on oceanographic conditions, coastal environment, HAB, and small scale areas. She mentioned each programme's monitoring schedules and the chemical, physical, and biological parameters.
- 7.4.3 In terms of regional co-ordination, Mr. Jiang mentioned that the Project had signed a Memorandum of Understanding with World Wide Fund for Nature's Yellow Sea Eco-region Planning Programme.
- 7.4.4 Mr. Jiang informed the Meeting that the PMO was in the process of discussing co-operative mechanisms with the UN Environment Programme's Northwest Pacific Action Plan (NOWPAP). He informed participants that a NOWPAP HAB workshop will be held in Toyama, Japan, and any members interested in attending could obtain more information from the PMO or NOWPAP offices.
- 7.4.5 Mr. Jiang suggested that IOC/WESTPAC would be an organisation the Project should consider approaching. He also mentioned that the Korea-China Joint Ocean Research Center would be another good partner for the Project.
- 7.4.6 Participants engaged in a brief discussion on co-ordination among the Project partners. It was noted that sharing of data and information, and having RWG Chairpersons join other RWG meetings could be a start to addressing the cross component issues. Members noted that good co-operation and co-ordination within and beyond the Project partners would have long-term benefits to the scientific community; thus, more co-operation and co-ordination should be encouraged.

8 OTHER BUSINESS

- 8.1 The Chairperson invited participants to raise any other issues that needed to be considered by this meeting. There was no other business raised by the participants.

9 DATE AND PLACE FOR NEXT RWG-E MEETING

- 9.1 The Chairperson invited members to consider the date and place for the 2nd RWG-E Meeting.
- 9.2 Members agreed to have the next RWG-E Meeting in Shanghai, China, 15 to 18 November 2005. The PMO will contact all members, should there be any changes.

10 ADOPTION OF THE MEETING REPORT

- 10.1 The Chairperson led the discussion of the draft meeting report prepared by the Secretariat. The report was reviewed, amended, and adopted by the Meeting.

11 CLOSURE OF THE MEETING

- 11.1 The Chairperson thanked all participants from China and Korea and the PMO staff for their hard work. He declared the Meeting a success, as the tasks of the RWG-E had been made clearer after the discussions.
- 11.2 On behalf of all participants, Mr. Jiang thanked the Chairperson for his leadership. He also thanked all participants for their contributions to the discussions.
- 11.3 The Meeting closed at 11:20 hours on 13th May 2005.

Annex I

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Annex II

Agenda

1. OPENING OF THE MEETING

- 1.1 Welcome addresses
- 1.2 Introduction of members

2. ORGANISATION OF THE MEETING

- 2.1 Designation of Officers
- 2.2 Documentation Available to the Meeting
- 2.3 Organisation of Work

3. ADOPTION OF THE MEETING AGENDA

4. DRAFT TERMS OF REFERENCE FOR THE REGIONAL WORKING GROUP FOR ECOSYSTEM (RWG-E)

5. OVERALL PROJECT AND COMPONENT OBJECTIVES

- 5.1 General description of activities contained in the Project Implementation Plan
- 5.2 Reporting responsibilities of the RWG-E
- 5.3 Required outputs and outcomes from the 1st RWG-E Meeting

6. DATA AND INFORMATION NEEDS FOR THE ECOSYSTEM COMPONENT

- 6.1 Discussion on Yellow Sea ecosystem problems, identification of data and information requirements, and agreement on their format
- 6.2 Country presentations on available data/information on state of the ecosystem, data requirements to estimate carrying capacity, causal chain analysis, information gaps for ecosystem stressors

7. REQUIRED ACTIONS AND WORKPLAN

- 7.1 Required actions for TDA preparation
- 7.2 Information gaps and actions required for the field survey
- 7.3 Workplan for 2005 to 2006
- 7.4 Co-operation with other project components and relevant activities in the region

8. OTHER BUSINESS

9. DATE AND PLACE FOR NEXT RWG-E MEETING

10. ADOPTION OF THE MEETING REPORT

11. CLOSURE OF THE MEETING

Annex III

Revised Terms of Reference for the UNDP/GEF Yellow Sea Project Regional Thematic Working Group - Ecosystem

Background:

To facilitate the achievement of the goals and objectives of the YSLME Project, Regional Thematic Working Groups (RWG) for each component (Ecosystem, Biodiversity, Fisheries, Pollution, and Investment) shall be established with overall responsibility for ensuring effective management and implementation of project activities.

Membership:

Each of the five RWGs will include:

- four scientists (social and natural), two from each country;
- two additional experts drawn from the legal, regulatory, investment, and/or environmental management fields, one from each country;
- One additional expert will be elected and serve as the Chairperson, as agreed in the Project Document;
- The Working Group Chairpersons will be members of the Regional Science and Technical Panel.

Working modalities:

Each RWG will represent the regional perspective. Working “without walls,” the RWGs will communicate primarily through email, with one or two working meetings annually. Each RWG will operate on a consensus basis. The RWGs report to the Regional Scientific and Technical Panel through the Chairperson.

Meetings:

The Project Management Office, in consultation with the Chairpersons, shall convene meetings of the RWGs according to an agreed schedule. The RWG Meetings should be included as part of the agreed work plan and timetable of the Project.

The Project Management Office shall act as Secretariat to the RWGs, and shall ensure that reports of the meetings and other activities are circulated to all members of the working groups, and are copied to the members of the RSTP.

Tasks:

- Co-ordinate relevant activities and contribute scientific knowledge in the area of expertise to the development of the TDA
- Assist in development of the Regional Strategic Action Programme (SAP) and National Yellow Sea Action Plans (NYSAPs), and implementation of agreed demonstration/pilot activities
- Contribute to the development of the Priority Investment Portfolio (PIP)
- Provide technical inputs/comments for the project workplans in their respective areas of competency
- Develop annual and quarterly work plans and assist with implementing activities in respective thematic area, based on and fully integrated in the project workplan

- Monitor and evaluate the implementation through reviewing the annual and quarterly progress reports, and provide advice where necessary
- Be responsible for regional coordination within area of competency
- Facilitate creation of effective national thematic network
- Identify the needs for necessary capacity building and training for all stakeholders of the Project, and facilitate implementation of identified activities on capacity building and training
- Assist, through the Chair, in effective Project Management by assisting with scheduling, scoping, and budgeting for various interlinked activities
- Contribute scientific and technical advice to the formulation of proposals for national and regional actions and donor funding to continue implementation of approved SAP
- Liaise closely with PMO

MAJOR RESPONSIBILITIES OF REGIONAL THEMATIC WORKING GROUPS

4. Ecosystem Management Working Group

Location of WG Chair: Republic of Korea

Tasks:

- Assess the status and trend of the Yellow Sea ecosystem. Identify data and information gaps and develop strategies for better assessment.
- Establish regional scientific and technical framework for monitoring the changing status of the Yellow Sea ecosystem.
- Assess the carrying capacities of the Yellow Sea ecosystem under changing human-induced and natural variabilities.
- Identify stressors to the Yellow Sea ecosystem, and recommend corrective measures to minimize the human-induced stresses to the ecosystem. Facilitate development and implementation of regional policies and legal measures.

Annex IV

Data & Information Requirements for the Ecosystem Component and Causal Chain Analysis for Yellow Sea Ecosystem-Related Problems

Table 1. Data and information requirements.

| Problems | Indicators | Kinds of data needed | Data Format | Temporal Scale | Spatial Scale (W, C, O)* | ROK Has Data? (Y, N, TP, SP, taxP, ?)** | PRC Has Data? (Y, N, TP, SP, taxP, ?)** |
|--------------------------------------|--|-----------------------------|--------------------------------|-----------------------|---------------------------------|--|--|
| Change in ecosystem structure | zooplankton ^{***, km, cm} | composition (biodiversity) | species list | seasonal for decadal | W | tax P, SP | TP, SP |
| | | abundance | # per volume | " | " | tax P, SP | TP, SP |
| | | biomass | ash-free dry weight per volume | " | W | Y (wet wt), SP, taxP | TP, SP (mostly wet wt) |
| | phytoplankton ^{***, km, cm} | composition (biodiversity) | species list | weekly for decadal | W | SP, TP | SP, TP |
| | | abundance | # per volume | " | " | SP, TP | SP, TP |
| | | biomass | chlorophyll a | " | " | SP, TP | SP, TP |
| | benthic community ^{***, km, cm} | composition (biodiversity) | species list | seasonal for decadal | W | SP, TP | SP, TP |
| | | abundance | # per area | " | " | SP, TP | SP, TP |
| | | biomass | ash-free dry weight per area | " | " | SP, TP (wet wt) | SP, TP (wet wt) |
| | HAB events ^{****, km, cm} | species | species list | annual for decadal | C, O | Y | SP, TP |
| | | density | # per volume | " | " | Y | SP, TP |
| | | area | sq km | " | " | Y | SP, TP |
| | | # events | events per year | " | " | Y | SP, TP |

| Problems | Indicators | Kinds of data needed | Data Format | Temporal Scale | Spatial Scale (W, C, O)* | ROK Has Data? (Y, N, TP, SP, taxP, ?)** | PRC Has Data? (Y, N, TP, SP, taxP, ?)** |
|-----------------|---|-----------------------------|---|--------------------------|---------------------------------|--|--|
| | | duration | days | " | " | TP, SP | SP, TP |
| | | damage to fisheries | money lost | " | " | Y | SP, TP |
| | | | | | | | |
| | jellyfish events ^{***} kn, cn | species | species list | annual for decadal | W | SP, TP | N |
| | | density | # per sq km | " | " | N | N |
| | | distribution | # per volume | " | " | N | N |
| | | duration | days | " | " | N | N |
| | | | | | | | |
| | trophic levels ^{***} , kn, cn | composition (biodiversity) | species list | seasonal for decadal | W | SP, TP, tax P | SP, TP, tax P |
| | | abundance | # per area | " | " | SP, TP, tax P | SP, TP, tax P |
| | | HPLC | phytoplankton pigment wt per wt predator | " | " | N | N |
| | | gut content | preys per stomach | seasonal for every 3 yrs | " | N | N |
| | | lipid analysis | phytoplankton pigment wt per wt predator, fatty acid wt per wt predator | " | " | N | N |
| | | | | | | | |
| | fish community ¹ | composition (biodiversity) | species list | seasonal for decadal | W | ? | ? |
| | | abundance | # per area | " | " | ? | ? |
| | | | | | | | |
| | marine mammals ² | species, , | species list | seasonal for decadal | W | ? | ? |
| | | distribution | # per area | " | " | ? | ? |
| | | population size | population | " | " | ? | ? |

| Problems | Indicators | Kinds of data needed | Data Format | Temporal Scale | Spatial Scale (W, C, O)* | ROK Has Data? (Y, N, TP, SP, taxP, ?)** | PRC Has Data? (Y, N, TP, SP, taxP, ?)** |
|---|---|---|--|--|---------------------------------|--|--|
| | birds ² | species, distribution population size | species list # per area population | annual for decadal " " | C " " | ? ? ? | ? ? ? |
| | macro algae ² | composition (biodiversity) abundance biomass | species list, % coverage # per area ash-free dry weight per volume | seasonal for decadal " " | C " " | SP, TP SP, TP SP, TP | SP, TP SP, TP SP, TP |
| | seagrass | species distribution area biomass | species list aerial coverage dry wt per sq m wet /dry wt per unit area | seasonal for decadal " " " | C " " " | N N N N | N N N N |
| Change in ecosystem productivity | primary productivity ^{***} , km, cm | primary production chlorophyll a | Carbon weight per sq m per day chl a wt per vol | seasonal for decadal " | W " | SP, TP SP, TP | SP, TP SP, TP |
| | secondary productivity ^{***, kn, cn} | secondary production | Carbon weight per sq m per mth or yr | seasonal for decadal | W | N | N |
| | benthic production ^{***, kn, cn} | community production | C wt per sq m per yr | seasonal for decadal | W | taxP | N |

| Problems | Indicators | Kinds of data needed | Data Format | Temporal Scale | Spatial Scale (W, C, O)* | ROK Has Data? (Y, N, TP, SP, taxP, ?)** | PRC Has Data? (Y, N, TP, SP, taxP, ?)** |
|-----------------------------|---|--|-------------------------------------|-----------------------|---------------------------------|--|--|
| | microbial loop production ^{***, kn, cn} | bacterial / micro zooplankton production | Carbon weight per sq m per day | seasonal for decadal | W | N | N |
| | sediment profiles for POC PON | profiles | ON, OC per depth of sediment column | decadal | O | N | N |
| | | sediment dating | Pb-210 dating | | | N | N |
| Habitat modification | change in habitat areas and types ² | aerial coverage and type | sq km, types | annual for decadal | C | N | TP, SP |
| | physical characteristics of habitat ^{***, km, cm} | temperature | deg C | monthly for decadal | C, O | SP, TP | SP, TP |
| | | salinity | psu | " | " | TP, SP | TP, SP |
| | | current | cm per sec, direction | " | " | TP, SP | TP, SP |
| | | transparency | m | " | " | TP, SP | TP, SP |
| | chemical characteristics of habitat ³ | nutrients | wt per vol | monthly for decadal | C, O | TP, SP | TP, SP |
| | | DO | % saturation | " | " | TP, SP | TP, SP |
| | | pH | pH | " | " | TP, SP | TP, SP |
| | | SS | mg per vol | " | " | TP, SP | TP, SP |
| | sedimentary characteristics of habitat ^{***, km, cm} | sediment types | types | seasonal for decadal | W | SP, TP | SP, TP |

| Problems | Indicators | <u>Kinds of data needed</u> | <u>Data Format</u> | <u>Temporal Scale</u> | <u>Spatial Scale (W, C, O)*</u> | <u>ROK Has Data? (Y, N, TP, SP, taxP, ?)**</u> | <u>PRC Has Data? (Y, N, TP, SP, taxP, ?)**</u> |
|---|-------------------|------------------------------------|---------------------------|------------------------------|--|---|---|
| | | redox potential | mvolt | " | " | N | ? |
| | | grain size | mm | " | " | TP, SP | TP, SP |
| Notes: * W=entire Yellow Sea; C=coastal area; O=offshore | | | | | | | |
| ** Y=have data; N=do not have data; TP=have partial temporal data; SP=have partial spatial data; taxP=taxonomically coarse; ?=not sure | | | | | | | |
| ***=RWGE will collect data | | | | | | | |
| 1=get data from RWGF; 2=get data from RWGB; 3=get data from RWGP | | | | | | | |
| cm = China has minimum data for the indicator; km = Korea has minimum data for the indicator | | | | | | | |
| cn = China does not have enough data for the indicator; kn = Korea does not have enough data for the indicator | | | | | | | |

Table 2. Preliminary causal chain analysis.

| <u>Problem</u> | <u>Environmental Impacts</u> | <u>Socio-economic impacts</u> | <u>Immediate causes (technical)</u> | <u>Underlying causes</u> | <u>Root causes</u> | <u>Governance analysis</u> | <u>Legal data</u> |
|--------------------------------------|---|--|-------------------------------------|--|---------------------------------|---|--|
| Change in ecosystem structure | reduction in value of commercial fishery resources | loss in fisherman's income | pollution | refer to RWGP | | | refer to RWGP |
| | changes in benthic resources | loss of aesthetic and recreational value for tourism | over harvesting | inc demand for fishery products, illegal fishing activities | refer to RWGF | inadequate fisheries management, enforcement of laws | refer to RWGF |
| | | loss in fisherman's income | oceanographic conditions | regional climate system | climate change | | |
| | changes in biodiversity | loss of aesthetic and recreational value for tourism | introduction of exotic species | inc in cargo traffic, introduced species for aquaculture | | lack of ballast water regulation (national)?, regulations on exotic species | relevant national laws, regulations, articles, acts, strategies, plans |
| | | loss of potential value of biological resources | eutrophication | changes in land use patterns, insufficient treatment, increased use of fertilizers | population inc in coastal areas | insufficient investment plans, lack of guidelines for agricultural practices, lack of appropriate development plans | " |
| | increased vulnerability to harmful marine organisms | threats to human health | decreased freshwater input | damming, diversion | economic expansion | inappropriate investment plans | " |
| | | decrease in fisheries | | | urbanisation | | " |

| <u>Problem</u> | <u>Environmental Impacts</u> | <u>Socio-economic impacts</u> | <u>Immediate causes (technical)</u> | <u>Underlying causes</u> | <u>Root causes</u> | <u>Governance analysis</u> | <u>Legal data</u> |
|---|---|--|--|-----------------------------------|-------------------------------|---|--|
| | | consumption | | | | | |
| | increased vulnerability to perturbation | increased management costs | aquaculture | demand for fishery product | population, lifestyle | refer to RWGF | " |
| | | | | | | | |
| Change in ecosystem productivity | deteriorating water quality | increased management costs | pollution | refer to RWGP | | | refer RWGP |
| | | loss of aesthetic and recreational value for tourism | increased sediment input | change in land use, construction | increased demand for land | lack of appropriate development plans | relevant national laws, regulations, articles, acts, strategies, plans |
| | source and sink capacity | vulnerability to natural disasters | atmospheric deposition | natural and anthropogenic sources | urbanisation, desertification | lack of appropriate understanding of processes, insufficient investment | " |
| | | | change in nutrient availability & freshwater input | construction, damming, diversion | economic expansion | inappropriate investment plans | " |
| | fishery recruitment | loss in fisherman's income | | | | inappropriate investment plans | " |
| | | loss of employment | oceanographic conditions | regional climate system | climate change | inadequate capacity in prediction and preparedness | " |

| <u>Problem</u> | <u>Environmental Impacts</u> | <u>Socio-economic impacts</u> | <u>Immediate causes (technical)</u> | <u>Underlying causes</u> | <u>Root causes</u> | <u>Governance analysis</u> | <u>Legal data</u> |
|-----------------------------|--------------------------------------|--|-------------------------------------|---|--|--|--|
| | | | | | | | |
| Habitat modification | change in coastal landscape | loss of cultural resources | change in sediment input | damming, diversion, construction activities on land | pop, econ expansion | lack of appropriate development plans | " |
| | loss of spawning and nursery grounds | loss in fisherman's income | sand extraction | inc. in demand for construction materials | pop, econ expansion | insufficient enforcement, inappropriate management | " |
| | biodiversity | loss of aesthetic and recreational value for tourism | bottom trawling | inc. demand for demersal fish | refer to RWGF | insufficient enforcement | refer to RWGF |
| | | loss of potential value of biological resources | coastal development (reclamation) | inc land demand | population, urbanisation, econ expansion | lack of appropriate development plans | relevant national laws, regulations, articles, acts, strategies, plans |
| | habitat diversity | loss of aesthetic and recreational value for tourism | | | | | |
| | | vulnerability to natural disasters | | | | | |
| | | | | | | | |

Note: thick lines around immediate and underlying causes show a one-to-one relationship between each immediate cause and its underlying cause.



Global Environment Facility
United Nations Development Programme

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in the Yellow Sea Large Marine Ecosystem**

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