About this publication:

This publication describes the "Small Grants Programme 2007" conducted under the UNDP/GEF Project, "Reducing Environmental Stress in the Yellow Sea Large Marine Ecosystem." In co-operation with partner organisations, including local governments and NGOs, the Project has implemented five activities from 2007 through 2008 to encourage participation from all stakeholders and strengthen their capacities to deal with marine environmental issues that affect the local livelihood. The publication contains the reports prepared by the partner organisations, that summarise the processes and results of the activities.

For reference purposes, this report may be cited as:

UNDP/GEF 2008. Small Grants Programme 2007: Final Reports. UNDP/GEF Yellow Sea Project, Ansan, Republic of Korea (58 pages).

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Small Grants Programme 2007
Final Reports

UNDP/GEF Project entitled
"Reducing Environmental Stress in the Yellow Sea Large Marine Ecosystem"

United Nations Development Programme/
Global Environment Facility

Ansan, Republic of Korea

March 2009

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Eco-Horizon Institute, Republic of Korea

Promoting Civil Participation in Coastal Conservation Utilizing the Muan Tidal Flat Visitors' Center

Eco-Horizon Institute, Republic of Korea

1. Summary

From Oct. 7, 2007 to Sept. 8, 2008, Eco-Horizon Institute, supported by the Yellow Sea Large Marine Ecosystem (YSLME) Project, conducted the research 'Promoting Civil Participation in Coastal Conservation Utilizing the Muan Tidal Flat Visitors' Center' in Muan-gun, Jeollanam-do. The purpose of this project is to preserve the tidal flat by promoting understandings of local residents in Muan-gun and to operate the Tidal Flat Visitors' Center economically and environmentally. For the Muan Tidal Flat Wetland Protection Area, a regional network was build up in association with local and central government, research institutes of local universities, local NGOs, and citizens in the area. A comparative survey was performed to develop the project. 4 workshops were held on developing concrete ideas and plans for the successful management of the Muan Tidal Flat Visitors' center.

These programs have reinforced the project with several ideas; those reaffirmed ecological and cultural importance of the Muan tidal flat which was poorly managed and preserved for 7 years by local authority; and those acknowledged that the establishment of visitors' center is closely connected not only to the conservation of Muan tidal flat, but also to the local economy; and those recognized spontaneous participation of citizens is the key ingredient of the successful project. In particular, with the participation of local residents in community development and environmental activities, unexperienced local authority has realized the importance of building civil network and of searching for material and human resources in the community.

2. Background of activities

2.1. Value of the Muan Tidal Flat

The Muan tidal flat is one of the pristine areas with diversity of life (Figure 1). The tidal flat is one of the major spawning areas of migratory fish in Korea. Having terrestrial soils of natural erosion and sand dunes, its geological features are unique and ecologically important. Jagged shorelines and sand-rich environment provide good habitats for fish, coastal plants, benthos and birds.

In December 2001, the Ministry of Maritime Affairs and Fisheries designated the coastal area of 35.6km^2 in Hamhae Bay, Hyeongyeong-myeon and HaeJae-myeon of Muan as the nation's first Tidal Flat Wetland Protection Area.

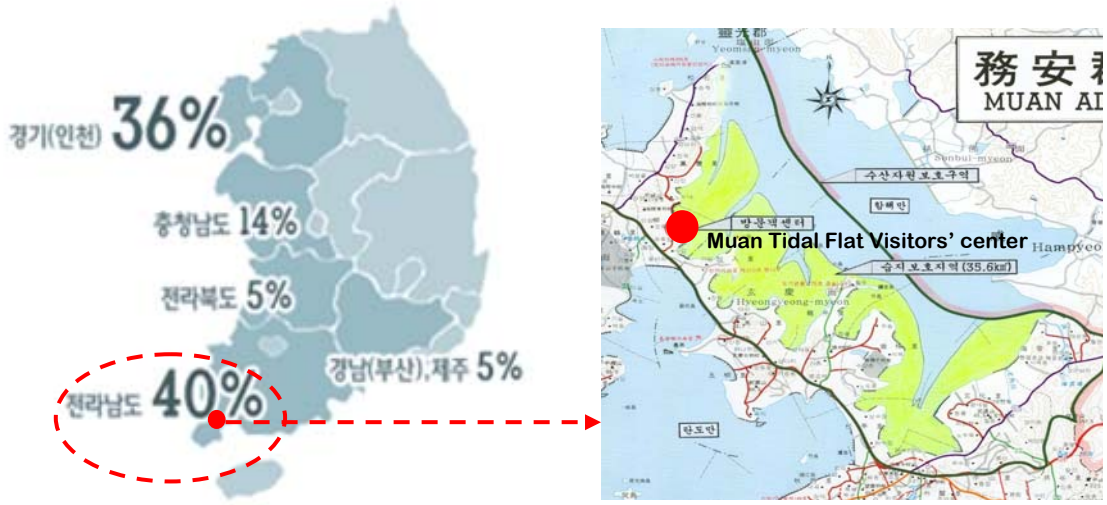
2.2. Current status of Muan Tidal Flat Wetland Protection Area Management

After designation of Tidal Flat Wetland Protection Area in 2001, the management plan was set up by Muan-gun authority in 2003.

Seven years have passed since its designation, yet the responsible bureau is still inexperienced and lack of overall capacity in wetland preservation and management.

Korean Tidal Flat
Distribution Status

Muan Tidal Flat
Wetland Protection Area



Muan Tidal Flat Wetland Protection Area located In Jeollanam-do

- ○ Nation's First Tidal Flat Wetland Protection Area(35.6㎢)
- ○ Designation: 2001. 12. 28
- ○ Muan Tidal Flat Visitor's Center will be open in May 2009

Figure 1: Location and Status of Muan Tidal Flat Wetland Protection Area

The Muan Tidal Flat Visitors' Center is expected to open in May 2009. Muan-gun authority is responsible for the visitors' center administration supported by the ministry of land, transport and maritime affairs (MLTM); however, lack of relevant knowledge and experience, the authority has lots of difficulties. Since the construction of center's building was completed in July 2006, the interior design has been ongoing until now. But the education programs are not yet decided.

The area is more likely to be threatened by development capitals and development demands of local residents. For example, Muan-gun is also operating state-led large-scale Entrepreneurial City projects. So some robust conservation and restoration plan should be set up beforehand.

2.3. Main Functions Expected by Muan Tidal Flat Visitors' Center

- Educating values and functions of wetland to citizens who visit the center
- Researching ecological changes of Muan tidal flat
- Observing and supervising the wetland to preserve the ecological values and functions
- Dedicating to sustainable development of the local economy to promote environmental understandings of citizens

3. Objectives of activities

- Supporting Muan Tidal Flat Visitors' Center facility and education program development

- Promoting civil participation in establishing the management system of the Center
- Networking of regional political actors and promoting ownership of Muan Tidal Flat Wetland Preservation Area

4. Target audiences

- Local Residents: People who use the tidal flat for living and live around the MuanTidal Flat Visitors' Center
- Local NGOs: NGO which can educate the ecological importance of tidal flats to the people, and communicate with local stakeholders
- Local Universities and Research Institutes: Supply scientific data through research for tidal flats as well as fundamental data for systematic preservation activity and management plan
- Local Authority: Authorities responsible for preserving and managing the tidal flat
- Central Government: Authorities in charge of promoting national policy to preserve tidal wetland
- Cooperative experts: Continuous participation of experts supporting Muan tidal wetland preserving activities

5. Activities

5.1. Preparation for Muan Project

5.1.1. Proposing the Regional Network of Muan Tidal Flat

- Period: May 15 ~ May 16, 2007
- Interviews with Institute of Island Culture at Mokpo University, Mokpo KFEM, and officials of Muan-gun authority besides site-visits to Muan Tidal flat

5.1.2. Preliminary Workshop

- Period: May 31 ~ June 1, 2007
- Place: Faculty Center of Mokpo National University
- Subject: Key Point of The Wadden Sea Tidal flat preservation policy and its applicability to Tidal Flat Wetland Protection Areas in Korea
- Joint Auspices: Institute of Island Culture and Tidal flat Institute of Mokpo National University, Eco-Horizon Institute, Mokpo KFEM
- Topics and Speakers:
  - Key Point of The Wadden Sea Tidal Flat Conservation Policy (Dr. Harald Marencic, Deputy Secretary, Common Wadden Sea Secretariat
  - A Long Term Ecological Research and Monitoring for Tidal Flat Conservation (Dr. Hong, Sun Ki, Institute of Island Culture at Mokpo National University)
  - Function of Muan Tidal Flat Conservation and Civil Monitoring on the Ecology of Muan Tidal Flat (Mr. Kim, Kyung Wan, Mokpo KFEM)

- Participants:
  Mr. Kim, San (Member of Muan-gun Council)
  Mr. Kim, Hae Jung (Chief of Woldu village at Muan-gun, fisherman)
  Mr. Cho, Soon Hyung (Local autonomy head of Mokpo Citizens' Coalition for Economic Justice)

- Site-visit: Visits to Muan Tidal Flat Wetland Protection Area and Muan Tidal Flat Visitors' Center now under construction

5.1.3 Preliminary Activities

- Period: Aug. 2 ~ Aug 4, 2007
- Participation in Ecotourism Program of Muan Tidal Flat (Sponsorship: Mokpo KFEM)
- Meetings of interested persons in order to prepare for promoting Muan project supported by the YSLME Small Grants Program (Institute of Island Culture at Mokpo National University, Mokpo KFEM, Muan-gun municipal officer)
- Survey of the progress of Shinan-gun Jeung-do Tidal Flat Olympic and Shinan-gun Jeung-do Tidal Flat Ecology Exhibition Center, and survey of Salt Gallery

5.2. Workshops and Site-visits

5.2.1. Purpose

- Implementing education programs in order to improve recognition of stakeholders of the regional network
- Sharing fundamental information to establish a strategy and plan with education
- Supporting interior design of the Muan Tidal Flat Visitors' Center and development of education programs
- Establishing a basis to include local stakeholders into operating Muan Tidal Flat Wetland Protection Area and Visitors' Center

5.2.2. Workshops

5.2.2.1. 1st Workshop

- Date: Nov. 2, 2007
- Place: Conference Room of Muan-gun County Office
- Subject: Establishment of the regional network in order to conserve the Muan Tidal Flat and its functions
- Joint Auspices: Eco-Horizon Institute, Institute of Island Culture of Mokpo National University, Muan-gun municipality
- Topics and Speakers:
  - Plan to conserve Muan Tidal Flat and progress of the Muan Tidal Flat Visitor's Center (Mr. Bae, Heung Tae, Maritime Affairs and Fisheries Department, Muan Municipal office)
  - Characteristics of the culture of Muan Tidal Flat and sustainable fishery (Dr. Kim, Jun, Institute of Island Culture, Mokpo National University)

- The ecological importance of the Muan Tidal Flat and necessity of establishing the regional network (Prof. Chun, Seung Su, Chonnam National University/President of Eco-horizon Institute)

- Participants:
  Mr. Song, Man Seong (Mokpo Citizen's Coalition for Economic Justice)
  Mr. Kim, Kyung Wan (Mokpo KFEM)
  Mr. Seo, Jeong Chan (Association of Muan Cultural Tourism Interpreters)

- Site-visit: Woldu village within the Muan Tidal Flat Wetland Protection Area
- Result of the Workshop:

  Ecological and cultural values of Muan Tidal Flat being newly understood, we could share the progress of establishment of the Muan Tidal Flat Visitors' Center with local residents.

  Especially, throughout recognizing the characteristics and values of Muan Tidal Wetland, the importance of the sustainable fishery was discussed and it was sought after how to connect preserving the Muan tidal flat with local economy including plan to develop communities based on the tidal flat culture.

  It is a common interest to help building and operating the Muan Tidal Flat Visitors' Center via cooperating local residents, experts, NGOs, and responsible authorities through the regional network to conserve Muan Tidal Flat.

5.2.2.2. 2nd Workshop

- Date: Dec. 10 2007
- Place: Haejae-myeon Office of Muan-gun
- Subject: Plan to activate the Muan Tidal Flat Visitors' Center and to help local residents participate
- Joint Auspices: Eco-Horizon Institute, Institute of Island Culture of Mokpo National University, Association of Muan Cultural Tourism Interpreters, Muan-gun municipality
- Topics and Speakers:
  - Plan to build and display exhibition at the Muan Tidal Flat Visitors' Center (Mr. Kim, Seung Hwan, Manager of Project Planning & Design Division, MILESEUM)
  - Plan to connect the participation of local residents with local tourist industry through the Muan Tidal Flat Visitor's Center (Prof. Chun, Seung Soo, Chonnam National University/President of Eco-horizon Institute)

- Panels:
  Mr. Cho, Sun Hyeong (Association of Muan Cultural Tourism Interpreters)
  Mr. Yun, Haeng Yong (Yongyu Fishing Village Cooperatives of Muan-gun)
  Ms. Cho, Kyeong Ran (Eco guide, Suncheon city)
  Dr. Kim, Jun (Institute of Island Culture, Mokpo National University)
  Mr. Bae, Heung Tae (Maritime Affairs and Fisheries Department of Muan-gun)

- Site-visit: Muan Tidal Flat Visitors' Center

- Result of the Workshop:

  This workshop was held at Haeje-myeon, where the Muan Tidal Flat Visitors' Center is located. Detailed plans related to interior exhibition of the center were shared among local residents for the first time.

  Experts and local NGOs stressed the importance of participation of local people and activation of communities using tidal flats wisely, introducing domestic and abroad success cases via conserving tidal flat.

  Local residents hoped the Visitors' Center to help sell local products, develop programs connecting traditional culture, connect neighborhood schools so that it contributes to activate the economy of Muan-gun and help local residents participate.

  We promised to provide various opportunities of participating and conducting programs together in order to activate the Muan Tidal Flat Visitors' Center, conserve the Muan tidal flat, and activate local economy when the Muan Tidal Flat Visitors' Center is operated.

  We came to the conclusion that it is necessary for the civil - and government - sector to work together in order to help build the Visitors' Center through preparing the civil – and government - sector cooperation programs which connect local residents before establishing the center and supporting to build the center via collecting various ideas.

5.2.2.3. 3rd Workshop

- Date: June 26, 2008
- Place: Conference Room of Seungdal Culture and Art Hall at Muan-gun
- Subject: Commemoration the Designation of Muan Tidal Flat Wetland Protection Area as Ramsar Site and Supporting Successful Opening of Muan Tidal Flat Visitors' Center.
- Joint Auspices: Eco-Horizon Institute, National Fisheries Research and Development Institute: Tidal-flat Research Center, Institute of Island Culture of Mokpo National University, Muan-gun municipality
- Topics and Speakers:

  Commemoration on Ramsar Site Designation of Muan Tidal Flat Wetland Protection Area
  - Progressive report on the registration process of Muan Tidal Flat Wetland Protection Area as Ramsar Site (Dr. Koh, Byoung Seol, Researcher at Tidal-flat Research Center of National Fisheries Research and Development Institute)
  - Ceremony for delivering letter of certificate
  - Commemoration photographing

Successful opening of Muan Tidal Flat Visitors' Center and Plans to Strengthen Its Activity

- State of construction process of Muan Tidal flat Visitors' Center (Ms. Kim, Ok, Chief of Maritime Affairs and Fisheries Department, Muan-gun Municipal office)
- Roles of the center and policy development at a national level (Mr. Shin, Jae Young, Official of Marine Ecology Department, MLTM)
- Roles and functions of the center for cooperation between Muan tidal flat conservation and local economic progress (Prof. Chun, Seung Soo, Chonnam National University/President of Eco-horizon Institute)
- Cultural, historical importance of Muan tidal flat and plans to promote residents participations for active center programs (Dr. Kim, Jun, Research at Ecotourism team, Jeonnam Research Institute)

Case Studies ; Regional Tidal Flat Visitors' Center

- Suncheon Bay tidal flat ecological center and its education programs (Mr. Lee, Ki Jeong, Tourism Promotion Department of Suncheon City)
- Nakdong River estuary eco center and its education programs (Ms. Lee, Yong Ae, Coordinator of Nakdong River Estuary Eco Center)
- Tidal Flat Visitors' Center in UK and its education programs (Mr. Nial Moores, Director of Birds Korea)
- Muan Tidal Flat and citizen's monitoring (Prof. Lim, Hyun Sik, Tidal Flat Institute of Mokpo National University)

- Panels

  Mr. Kim, Seok Won (Member of Jeollanam-do Provincial Assembly)
  Ms. Na, Kyung Ju (Chief of Yongsan Village at Haeje-myeon Muan-gun)
  Mr. Kim, Kyung Wan (Mokpo KFEM)
  Mr. Cho, Soon Hyung (Local autonomy head of Mokpo Citizens' Coalition for Economic Justice)

- Site-visit: Muan Tidal Flat Wetland Protection Area and Muan Tidal flat Visitors' Center now under construction
- Result of the Workshop:

  The commemorate workshop aimed at celebrating the designation of Muan Tidal Flat as Ramsar Site on January 2008, and preparing successful establishment of Muan Tidal Flat Visitors' Center along with Muan tidal flat conservation and management policy. The president of Muan-gun county made it clear that he will make great efforts to conserve Muan Tidal Flat, while central government also clarified that the government will support the local community as well.

  To activate the visitors' center, it was discussed that developing clear vision and goal as well as step-by-step growing plans and surveys had to be implemented beforehand. Also, the importance of long-term plans such as future program development, strengthening professional human resources for the center operation, promoting international cooperation and developing awareness program for local residents was emphasized.

The workshop was a great opportunity for stakeholders such as local residents, NGOs, experts, local and central governments to cooperate together for local economic progress and conservation of Muan tidal flat. Especially, the regional network of Muan tidal flat which was supported by the YSLME Project, motivated close cooperation system among the participants that led to a successful project.

Supported by Muan-gun County with 10,000,000 KRW additional funds, the workshop became a nationwide level where experts interested in wetland conservation, representatives from central and regional governments or NGOs were able to participate in to share various in-depth strategies to conserve Muan Tidal Flat.

5.2.2.4. 4th Workshop

- Date: Sep. 11, 2008
- Place: Community Center of Yongsan Village
- Subject: Round-table conference to bridge Muan Tidal Flat Visitors' Center and participation of Yongsan villagers.
- Joint Auspices: Eco-Horizon Institute, Residents of Yongsan village, Institute of Island Culture and Tidal Flat Institute at Mokpo National University, Muan-gun municipality
- Site-visit: Yongsan village, Muan Tidal Flat Visitors' Center now under construction
- Speakers:
  Prof. Chun, Seung Su (President of Eco-horizon Institute)
  Prof. Cho, Kyung Man (Mokpo National University)
  Prof. Lim, Hyun Sik (Tidal Flat Institute of Mokpo National University)

- Result of the Workshop:

  This workshop was an official opportunity to share the process and situation of Muan Tidal Flat Visitors' Center with residents of Yongsan village and to listen to opinions of the residents.

  Yongsan village which is bounded by the Muan Tidal Flat Viistors' Center plays important role in supporting and providing various program for visitors of center. Especially residents of the village provided the building site for visitor's center at a low price. However, as there had been no specific plans developed that are connected to the village, questions and distrusts on the center aroused among the residents.

  Construction of the visitors' center building does not guarantee the success, indeed, the collaboration with close villages and the residents are the essential source for the successful management of center. Yongsan village, in collaboration with visitors' center, must be recognized as the most important resource that provides accommodation, meals and various work-study programs.

  It was notified that Yongsan village has youth group of 30 young people who can contribute to the growth of visitors' center as well as sustainable

development of the village. Also residents at the village have wished to undertake the community improvement through the visitors' center in phases.

Residents of Yongsan village have agreed to launch the building up of village that is linked to the tidal flat visitors' center and decided to secure basic resources in implementing the project by formulating master plans. Therefore, as a way of cooperation, it was decided that the sustainable network should be organized to support the center in various areas; understanding the condition of the village, gathering residents who can join in the center managing programs, verifying various sources that can be connected to the center programs such as experience programs of tidal flat and fishery, eco-tourism, local special product, agriculture and accommodation.

5.3. Comparative Site Visit to Other Tidal Flat Wetland Preservation Areas and Visitors' Centers

5.3.1. Visit to Suncheon Bay Tidal Flat Wetland Protection Area and Eco-Museum

- Date: Oct. 23, 2007
- Joint Auspices: Eco-Horizon Institute, Association of Muan Cultural Tourism Interpreters
- Participants: 28 persons
- Characteristics of Suncheon Bay Tidal Flat Ecosystem:

  Tidal flat wetland ecosystem is well conserved at Suncheon Bay, where various lives live in the tidal flat (about 26.4 km²), about 1 km² of which is a reed bed where aquatic lives reside and the core to conserve tidal ecosystem. It's where rare migratory birds such as Hooded Crane, Saunders' Gull, and Shelduck visit.

  Suncheon Bay tide flat was designated wetland protection area in December, 2003, and was registered as a Ramsar site. (Itis the first one among coastal wetlands of Korea).

  It plays important roles such as cleaning the nature, eco-tourism, and eco-education.

- Specifications of Suncheon Bay Eco-Museum:
  - Area: 2,303 m^2
  - Structure: 3 stories on the ground (about 998 m^2 of exhibition area)
  - Number of exhibition rooms: 1 special exhibition room, 3 ordinary exhibition rooms, 1 theater
  - Maximum capacity: about 200
  - Viewing time: 50 minutes

- Results of Comparative Site Visit:

  Related to Tidal Flat Conservation and Economical Influences: Suncheon city has been voluntarily conserving Suncheon Bay since 2000, and preparing a local development plan related to it. Suncheon city opened Suncheon Bay Eco-Museum in 2004, and many people have visited it as a result of active

advertisement of its ecological values and beauty. Economical influences on the local community, therefore, are increasing. This is an important local example which shows conserving tidal flat gives better economical benefits than reclaiming them.

Various Contents Needed to Be Developed: Suncheon Bay Eco-Museum, which has been built to help conserve, investigate, and study tidal flat ecosystem, is used as an eco-education center for observance appliances are installed outside. Interior exhibition rooms, however, have remained the same since its opening in 2004. It is necessary, therefore, to continuously establish a special exhibition plan, develop various experiential learning programs, and develop new contents in order to attract more people to the importance of the ecosystem of Suncheon Bay tidal flat.

Roles of Nature Interpreters Should Be Enhanced: The nature interpreter who works at the Suncheon Bay Eco-Museum guides visitors only at the inside of the museum. Visitors who are interested in Suncheon Bay and its reed Bed, however, want to be guide through the outer eco park. The nature interpreter, therefore, is required to guide visitors both inside and outside of the museum. It is also required to supplement the ad board in case there isn't a nature interpreter.

Scarcity of Participation of Local People: There are few interchanges between the Suncheon Bay Eco-Museum and local people. Local people guide visitors to the bay and the reed bed via boats, but they are in conflict with the museum. It is because Suncheon city did not encourage its residents to understand it and participate while designating Suncheon Bay Tidal Flat as a Wetland Protection Area. It is, therefore, necessary to establish a regional network which connect local residents and the Eco-Museum, and help local residents participate in operating the museum. It is also required to plan various programs using seminar rooms and eco schools, and to hold local events.

5.3.2. Visit to Jeung-do Tidal Flat Ecological Exhibition and Salt Gallery of Shinan-gun

- Date: Feb. 28, 2008
- Joint Auspices: Eco-Horizon Institute, Association of Muan Cultural Tourism Interpreters, Jeonnam Research Institute
- Participants: 20 persons
- Purpose:
  - To arouse peoples' interest and promote their awareness in Muan Tidal Flat by making comparative site visits between Muan-gun and Shinan-gun.
  - To gather ideas for improvement in Muan Tidal Flat Visitors' Center.

- Results of Comparative Site Visit:

Jeung-do Tial flat Ecological Exhibition, established with budget of 14 billion KRW, is currently not well-managed. Visiting the site, the importance of developing and managing various contents and work-study program as well as participation of the residents, was once more emphasized.

Several good program examples were found at the Jeung-do Salt Gallery such as entertaining the visitors with beautiful nature and industry at Jeung-do, where Natural Sea Salt is being produced in saltpan of about 463ha. Programs in summer include visiting nearest tidal flat or making Natural Sea Salt such as driving watermill, shoving along the salt, and salinity checking.

5.3.3. Onsite Survey in order to Review the Plan for Building an Outside Landscape Architecture of the Muan Tidal Flat Visitors' Center

- Date: Dec. 04 2007
- Participants: Nial Moores (Birds Korea), Christi Nozawa (BirdLife International, Asia Division), Ju, Yong Ki (Getbol Forum Korea), Officials of Muan municipality, Researchers of Eco-horizon Institute
- Purpose:
  - Review the plan for building an outside landscape architecture of the Muan Tidal Flat Visitors' Center
  - Collect expert opinions related to setting up a bird-watching station at the Visitors' Center and others establishment plans

- Results of Survey:

  The location and the form of the bird-watching station without influencing it artificially, considering the kinds of migratory birds which reside near the Muan Tidal Flat Visitors' Center.

  Children's Swimming pool is to be removed to backward of the center in order to minimize the influence onto the tidal flat ecosystem, or cancelled. (It was pointed as the most serious problem related to the outer architecture of the Muan Tidal Flat Visitors' Center.)

6. Produced outputs and outcomes

6.1. The Regional Network for Muan Tidal Flat

6.1.1. Purpose

- To make conservation efforts more effective, it is crucial to raise public awareness of tidal flat's ecological services amongst local communities and to bridge conservation and local economic progress in an adequate manner.
- To ensure communication and participation to conservation strategy and action plan making and implementation, it is effective to formulate a network of local stakeholders.
- To promote local stakeholder participation through the education program development and Center's operation.

6.1.2. Organization of the Regional Network

- Local Residents: Residents of Woldu and Yongsan village
- Local NGOs: Association of Muan Cultural Tourism Interpreters, Mokpo KFEM

- Local Universities and Research Institutions: Institute of Island Culture of Mokpo National University, Tidal Flats Institute of Mokpo National University, Jeonnam Research Institute
- Local Authority: Muan-gun municipality
- Central Government: MLTM
- Cooperative experts: National Fisheries Research and Development Institute: Tidal-flat Research Center, Seoul National University, Chonnam National University

6.1.3. Working of the Regional Network

The regional network of Muan tidal flat is operated through various activities and programs. In preparing some programs, such as workshop, comparative field investigation, seminar, and civil participation programs, we have built a natural cooperation and communication.

Supported by YSLME project, this network program plays as an important model, as local residents operate environmental programs spontaneously to protect tidal wetland. For this reason, Muan-gun municipality, MLTM, Korea Marine Environment Management Corporation, and the Yellow Sea Ecoregion Support Project (YSESP) provide additional financial supports.

We expect that the civil network will contribute to developing activity and education programs of the Visitors' Center

6.2. Development of Educational Programs for Local Residents

6.2.1. Informal discussion with local residents

It is common feelings of local residents that they are always excluded from a political decision. Especially in designation process of preservation area so much more do they feel. Actually, there are frequent occasions when Local municipalities are too passive to listen to the opinions of local residents.

Therefore, to keep cooperative relationship between authority and local residents, informal discussion is very important. With this direct solution, we have to organize the visitors' center making full use of their idea.

6.2.2. Folk show performed with residents in Woldu village

Tidal wetland means a way of life to fishermen, however, they hardly express their affectionate mind formally as workshop. So, for the effective education program, it is very important to make the programs at the level of their eyes.

Residents in Woldu village have performed a religious ritual for tidal wetland. We develop this ritual into a folk show which is a type of traditional art. They tied into preparing the folk show. This show has become a popular content in Korea more than this area. This show was invited to the 10th Ramsar convention in 2008. This show has confirmed the values of the tidal wetland to the residents. This project was supported by Yellow Sea Ecoregion Support Project (YSESP)

6.2.3. Remodeling Yongsan village as a liaison village to the visitors' center

For the effective operation of the visitors' center, it is indispensable to gain a support from local residents in Yongsan village. So we need to remodel the village as a main center village. For example, functions such as accommodation, dining, and hand-on experience programs should be provided.

Based on the result of the human and material survey in Yongsan village, we need step-by-step programs to educate residents (softwares) and to develop infrastructures of the village (hardwares) such as accommodation and dining. For this reason, we make plans to get a financial support, that we organize the union or residents in Yongsan village. This project has been designated as a 2009 YSESP Support program.

6.3. The Concept of Muan Tidal Flat Management Plan throughout the Participation of Local Residents

Step 1: Survey on cultural and historical resource which is relevant with tidal flat
Step 2: Communicate with local residents. Cooperate with local municipalities
Step 3: Discover hidden talent of local residents
Step 4: Build a support system of experts
Step 5: Cultivate education program to attract the residents.
Step 6: Build a development strategy, which proves that the conservation of tidal flat and local economy are closely related. Run each plans in cooperation with local residents.

6.4. Publications: Published 4 workshop material kits

- "Key Point of The Wadden Sea Tidal flat preservation policy and its applicability to Tidal Flat Wetland Protection Areas in Korea"
- "Establishment of the regional network in order to conserve the Muan Tidal Flat and its functions"
- "Plan to activate the Muan Tidal Flat Visitors' Center and to help local residents participate"
- "Commemoration the Designation of Muan Tidal Flat Wetland Protection Area as Ramsar Site and Supporting Successful Opening of Muan Tidal Flat Visitors′ Center"

7. Evaluation: Effectiveness of implemented activities

Various kinds of programs to conserve Muan Tidal Flat were implemented by establishing cooperative regional network between local stakeholders at Muan-gun, local authorities, experts, NGOs and local residents.

Public understanding on the Muan Tidal Flat Visitors' Center among the local community was changed from negative to positive, where they can now share various opinions, ideas, human resources, and expand opportunity to participate in this mission.

Many experts' ideas collected by workshops, comparative site visits etc. were the basis of concept in order to present various plans and alternatives for successful conservation of Muan tidal flat and management of Visitors' Center as well as local economic progress.

8. Conclusions and recommendations for future work

The public awareness and participation of local stakeholders are crucial in conserving main tidal flat ecosystem. In order to achieve this goal, discussions, networking, educations and activities among various stakeholders should be implemented along with continuous tidal flat ecosystem monitoring.

Concrete management plans for Muan Tidal Flat Visitors' Center should be first established prior to opening the visitors' center on May 2009. Meanwhile it is also necessary to set up specific roles for each stakeholders and programs where they can participate in, as well as developing continuous cooperative activities to strengthen the regional network for Muan Tidal Flat.

Since Yongsan Village is mostly influenced by the visitors' center, its is important to improve awareness of the residents towards center throughout program called 'village remaking,' while providing accommodation and meal services or ecological programs to experience tidal flat life to the visitors at the center is also essential.

The successful opening and management of Muan Tidal Flat Visitors' Center must be based on not only itself of tidal flat, but also on cooperative program formed by Muan community as a whole. Therefore it is necessary to discover agricultural, historical, and cultural ecological resources in the community and to develop programs to be linked up with integrated ecological tourism. When these programs and ideas are coordinated, tidal flat can be conserved in connection with local economic progress that changes in the public awareness towards tidal flat conservation and promotes active participation among them.

9. Contact information

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II. Fishermen's self monitoring of marine litter in Boryeong, Western Korea

Dae-sik Hwang, Korea Marine Rescue Center in Boryeong

Fishermen's self monitoring of marine litter in Boryeong, Western Korea

Dae-sik Hwang, Korea Marine Rescue Center in Boryeong

1. Summary

'Fishermen's self monitoring of marine litter' was conducted by Korea Marine Rescue Center (KMRC) in Boryeong with Moochangpo fishing village cooperative in Boryeong city, Chungcheongnam-do from Sep. 2007 to June 2008. Main activities of the program were retrievals of marine litter and recordings of litter log sheets. We gathered opinions of fishermen on marine litter issues and decided the method of self monitoring. Supplements such as trash containers, stickers for ships, and zippered files were distributed to ships of participants. Debris log sheets were bundled with sailing list card and deposited in the branch office of coast guard. Total number of participants was about 20 persons, but only six recorded and submitted log sheets. A workshop was held to introduce marine debris issues and main policies of government to fishermen and to listen to their opinions about that. Clean up campaigns were conducted twice by the fishermen group. KMRC in Boryeong organized International Coastal Cleanup (ICC) event with the municipality of Boryeong and several schools. Questionnaire survey was carried out in wrap-up meeting. The result shows that intentions of the program were good, but the practical methods for raising awareness of fishermen need more careful considerations about characteristics of them. Long term interests and approaches should be settled down in community level. For development of fishermen education program, it is needed to deeply consider the usual ways of working, behaviors on board, degree of recognition, culture, etc.

2. Background information

Korea and China are potential sources of marine litter in the Yellow sea. Coastal residents and local governments in both sides of the sea are necessarily required to share protection effort from pollutants.

The geographic area covered in this project is part of Ungcheon-eup, Boryeong city in the middle part of western coastline of Korean peninsula (Figure 2). Its coastal line is 114.9km in length and it has 74 islands and about 100,000 residents. Fishermen consist of 5.5% of the population and contribute to local economy as much as 37% (Boryeong statistics annual report, 2005). They are the major stakeholders and have relatively low awareness about marine conservation and passive attitude in management although they are the direct beneficiaries of marine resources.

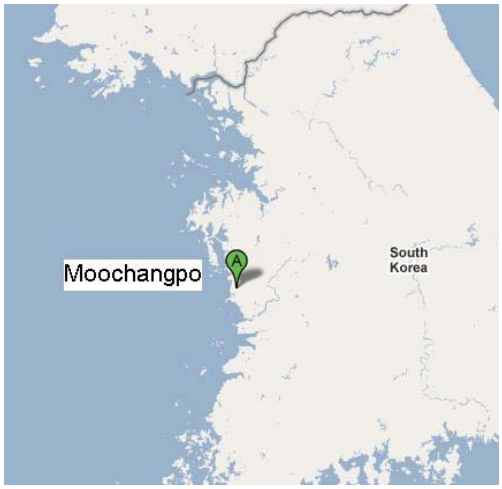


Figure 2: Location of area covered in the program

The result of ICC in Korea has shown that 'ocean & waterway activities' account for more than 20% of marine litter (e.g. MOMAF, 2007). The trend is almost same in Boryeong. Fishermen can be the first proper destination of the marine litter-related program. Government has tried various measures to get rid of derelict fishing gears and to make fishermen retrieve them. However, the relative cost effectiveness of management measures is questionable (Brown & Macfadyen, 2007).

Through the activities relevant to marine debris for years, we clearly recognize that the most effective way to reduce marine litter is raising public awareness and then changing behaviours based on partnership among various stakeholders. It is, however, real that there are rare programs for raising fishermen awareness.

The program is for fishermen group and an NGO to have enough time to deal with marine debris problem through gear retrieval and recording log sheets and to communicate for months. The worst accident of oil spill in history occurred in Taean where is not far from the program area on 7th, Nov. 2007. Most of the fishermen in Moochangpo could not work normally. They all participated voluntary activities on oil prevention, not marine debris. And some members of KMRC in Boryeong had to monitor if oil film might spread near Moochangpo. The accident definitely and negatively affected this program.

3. Rationale and objectives

3.1. Rationale

Of the coastal stakeholders, fishermen are mostly not interested in and rarely participate in marine conservation programs. The reason is probably that there are rare opportunities for promoting fishermen's awareness in local levels. We need to excavate and educate fishermen who are willing to take the initiative for reducing marine litter. It can also contribute to raise their leadership.

One-sided lecture by professionals, one-time forum or debate, visiting model communities are effective to induce temporal change in recognition but have some difficulties for stakeholders to take the concerns and actions into daily lives. This program focuses on fishermen who are major polluters and victims at once in marine litter problem. It is planned that fishermen themselves retrieve discarded fishing gear and their garbage without any economical incentives, record the amounts and sorts, and suggest better ways to effectively reduce marine debris.

We provided various opportunities to help for fishermen to keep their concern to this problem during the period: ICC in Boryeong with children and NGO members; beach cleanups by fishermen themselves; preparation and launching meetings; promotion materials like trash containers and stickers for ship, etc.; log sheets for daily self checking; workshop for education and raising awareness; wrap-up meeting; awards of certificates; questionnaire for evaluation and listening to opinions, etc.

It is important for fishermen to know that they have partners who are very supportive and cooperative to solve the same problem. They can open their mind and try to suggest alternatives and the best way how to deal with through this program.

3.2. Objectives

- To increase stakeholders' awareness of marine litter handling problems from fisheries and to educate fishermen and any stakeholders concerned with fisheries

- To develop the self monitoring program of marine litter, give its action to fisheries and change behaviours causing problems
- To reduce marine litter with proper prevention and disposal through joint conservation activities
- To build up partnership for marine environment governance in local level

4. Target audience

This program focuses on marine debris problem originated from fisheries. So main target audience is fishermen group, especially boat owner who uses nets and ropes for fishing. We selected one cooperative of fishermen village, which is a basic unit of fishery community. The cooperative has 203 of fishermen members who earn their living on 124 fishing boats, 25 angling boats and aquacultures.

Main products are a kind of octopus (Octopus ocellatus), finespotted flounder, shrimp, swimming crab, flatfish, etc. This is why there have been held seafood festivals such as "Octopus Festival (around Mar. and Apr.) and Shrimp Festival (around Sep. and Oct.)". Moochangpo beach is very famous for the so-called "Moses' Miracle" which is a phenomena of exposure of low tidal zone at spring tide. Numbers of tourists visit to enjoy the phenomena, beautiful beaches, diverse seafood, leisure boating, and fishing.

5. Activities implemented

5.1. International Coastal Cleanup:

We organized the 'ICC in Moochangpo Beach on Sep. 14th 2007 where 190 volunteers participated (Figure 3). The volunteers consisted of members of KMRC in Boryeong (20), children from 4 preschools (120), officers from Boryeong City and Ungcheon Eup (10), fishermen from Moochangpo Fishing Village (20) and others from Kwandang Branch Office of Taean Coast Guard, Society of Tourism in Moochangpo, and Meeting of Merchants (20). The site captain (Mr. D.S. Hwang) and staffs educated participants about marine debris problem. We picked up 2,266 trashes, filled data cards, measured the weight (194kg) and sorted according to composition for recycling. Figure 3 shows the source of collected marine litter.

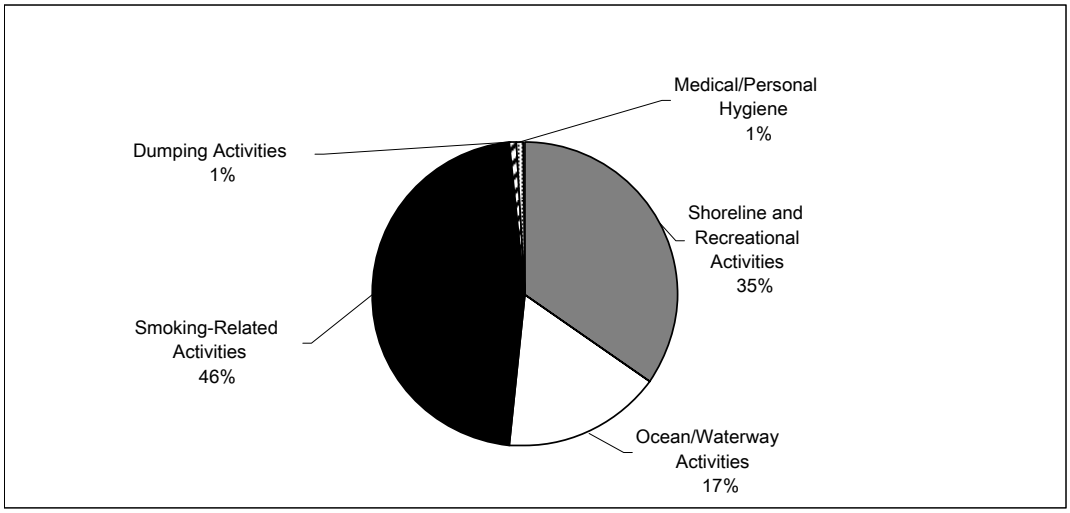


Figure 3: Source of marine litter picked up on Moochangpo Beach

5.2. Preparation meeting

- Title: Preparation meeting for 'Fishermen's self monitoring of marine litter program
- Date: Oct. 5th, 2007
- Location: Dehero restaurant, Moochangpo Beach, Boryeong, Choongchungnam-do
- Lecturers: Ms. Sunwook Hong & Mr. Jong Myoung Lee (KMRC)
- Participants: 12 people in total (Moochangpo fishing village cooperatives, Boryeong City, KMRC in Boryeong, Taean Coast Guard)

We contacted 'Moochangpo fishermen village cooperative' which is related to fishing crabs and shrimps, aquaculture of sea cucumbers and ear shells, and angler's boating. We introduced 'Yellow Sea Project and Fishermen's self monitoring of marine litter program by KMRC in Boryeong' and lecturers explained status of marine litter in coastal area in Boryeong, based on the results of marine litter monitoring and ICC since 2000.

We figured out fishermen's situation in Moochangpo, awareness and actions for reduction of marine litter, conflicts among different types of fishing activities, the most common marine litters, and urgent problems in solving marine litter, preference to supplements for encouraging voluntary participation, required administrative support, etc.

5.3. Developing log sheets and supplements for voluntary participants

Based on the interview in the preparation meeting, we developed the log sheet which contains most common items usually collected on boat. We categorized items from fishing work (nets, ropes, traps, etc.) and litters on their boat (food wrappers, plastic bottles, etc.).

There can be seen unique items, i.e. parachute and light bomb. The air force has used an island called Hwangjuk-do nearby as a shooting camp since 1980. It has usually dropped light bombs with parachute for midnight shooting training. Synthetic parachutes, metallic light bombs, and even rocket bombs are marine debris in this area, threatening seriously safety of residents, commercial fishing and leisure boating, and marine ecosystem.

We also developed supplements such as trash containers, stickers for boat, wind jacket, etc. which fishermen preferred to litter bags, flags, and caps. The supplements were used for encouraging participation and concern to this program.

5.4. Launching meeting and Providing voluntary participants' supplements

- Title: Workshop on Fishermen's Self Monitoring of Marine Litter
- Date: Nov. 9th, 2007
- Location: Office of Moochangpo fishing village cooperatives, Boryeong, Choongchungnam-do
- Lecturers: Daesik Hwang & Seong Su Choi (KMRC in Boryeong)
- Participants: 20 people in total (Moochangpo fishing village cooperatives, Boryeong City, KMRC in Boryeong, Taean Coast Guard)
- Main themes: Introduction of aims of fishermen's self monitoring program, stimulation of voluntary participation, and distribution of materials for promotion such as log sheets (Figure 4), zippered files, trash cans, stickers for ships, and wind jackets

We had a meeting with 20 boat owners who were interested in the program and encouraged them to involve the program with supplements. We introduced 'Self monitoring of marine litter' again and discussed practical types of fishing activities, the

most common marine litters and urgent problems in solving marine litter, required administrative support, etc. We could understand they had a problem in recording log sheets right after their work. Officials of Korea Coast Guard in Boryeong got to help fishermen to check when they brought back their garbage, derelict fishing gear or something.

([Name of Ship]) Self monitoring log sheet

Month / Day									
Litters pulled out of the water	Fishing Net	[number·weight]	·						
	Traps	·	·						
	Rope	·	·						
	Buoys	·	·						
	Land-based ML	·	·						
	Parachute & Light Bomb	·	·						
	Others (Concerned items)	·	·						
		·	·						
		·	·						
		·	·						
Marine Litter on Board	Food wrappers·containers	·	·					·	·
	Bottles of water·beverage	·	·	·	·	·	·	·	·
	Fishing stuffs	·	·	·	·	·	·	·	·
	Fuel bottles	·	·	·	·	·	·	·	·
	Others								
Total – Number/ Weight(kg)		·	·	·	·	·	·	·	·

Figure 4: Example of log sheet

5.5. Workshop for local stakeholders

We held a workshop for raising awareness on sea-based marine debris. Invited experts gave lectures about advanced cases of derelict fishing gear retrieval and net recycling program in America, grass root activities by NGO nationwide, and national marine debris management plan. We had an active discussion on prevention and control of marine debris and contracted 'Memorandum of Understanding among Moochangpo cooperative of fishing village, KMRC in Boryeong, Boryeong City and Taean Coast Guard' at the end.

- Title: Workshop on Fishermen's Self Monitoring of Marine Litter
- Date: Dec. 7th, 2007
- Location: Office of Moochangpo fishing village cooperatives, Boryeong, Choongchungnam-do

- Lecturers: Daesik Hwang (KMRC in Boryeong), Sunwook Hong, Jong Myoung Lee (KMRC), (Boryeong City)
- Participants: 26 people in total (Moochangpo fishing village cooperatives, Boryeong City, KMRC in Boryeong, Taean Coast Guard)
- Main themes:
  Lectures:
  - Introduction to YSLME, Small Grant Program and Fishermen's self monitoring program
  - Grassroots activities and model cases for reduction of derelict fishing gears
  - National policies and management plan for marine debris control
  - Boryeong City's policy for marine environment and debris management

  Video show: Volunteer activities for marine environmental protection from marine debris
  Discussion and opinion collection
  MOU contracting among fishermen and NGO

5.6. Beach cleanup

- Title : Beach cleanup by fishermen themselves
- Date: Nov. 9th, 2007 (after workshop)/May 31st, 2008
- Location: Moochangpo Beach and port
- Participants: 30~40 people (Moochangpo fishing village cooperative, KMRC in Boryeong, Coast Guard)

Fishermen have implemented to clean debris on the beach and the port monthly. Program conductors joined twice. The amount of derelict fishing gear seems not to decrease in spite of regular cleanups.

5.7. Self monitoring of marine litter (Nov. 2007 ~ June 2008)

- Bringing back garbage on board and derelict fishing gear in trash container
  - Check the number and weight of the can
  - Recording log sheets with help of Korea Coast Guard in Boryeong
  - Keeping the sheets in zippered file in the Coast Guard office where every boat owner is supposed to declare whenever he or she leaves or enters port
  - Collection of sheets at the final meeting

5.8. Final meeting

- Title: Wrap-up meeting for 'Fishermen's self monitoring of marine litter program'
- Date: June 18th, 2008
- Location: Office of Moochangpo fishing village cooperatives, Boryeong, Choongchungnam-do
- Lecturers: Ms. Sunwook Hong & Mr. Jong Myoung Lee (KMRC)
- Participants: 17 people in total (Moochangpo fishing village cooperatives, KMRC in Boryeong, Taean Coast Guard)
- Main themes:
  - Oral report on the progress and result of fishermen's self monitoring program in Moochangpo during the project period
  - Implementation of questionnaire
  - Awarding ceremony of certificates for six volunteers
  - Listening to fishermen's opinion

We organized a wrap-up meeting with approximately 20 participants who attended to present and share the result of the self monitoring program. A questionnaire survey was conducted at the end of the meeting. We listened to what active fishermen say about government's potential policy and measures such as marine debris gathering barge, paying retrieved fishing gear, fishing gear identification system, etc.

6. Produced outputs

According to the proposal, we produced outputs below (Table 1).

Table 1: List of produced outputs

Date	Title	Numbers	Content
Sep. 14th	International coastal cleanup in Boryeong	190 volunteers	Joined an international effort
Nov. 9th/ May 31st	Beach Cleanup	20 fishermen	
Dec. 7th	Workshop MOU Beach cleanup	26 participants	Proceeding of workshop (Hebei Oil Spill)
Nov. '07~ June '08	Self monitoring by target audience	6 boat owners 35days in total 5.5days per boat	Log sheet sign, plastic trash container, zippered file wind jacket
June 18th	Wrap-up meeting	23 participants	
	Questionnaire	18 responses	
	Certificate award	6 fishermen	
June 26th	Stickers*	10,000 in number	"When bring back own garbage, ocean comes back to life"

Note: * Based on the discussion with fishermen, we published 10 thousand copies of sticker in stead of brochure.

7. Evaluation: Effectiveness of implemented activities

We conducted the survey to evaluate the program by fishermen. It contained an overview, not detailed, with several questions. The detailed result is given in the Proceeding of Workshop. Numbers in brackets indicate point of each question.

The result of survey showed that the subject of this program, marine debris, was appropriate. Many fishermen thought that marine debris problem was the most seriously affecting (4.61) marine environmental problem to their fisheries than any other problems,

such as oil pollution and global warming. And it was also good to make a fishing village cooperative as main target audiences.

The approach to the fishermen with marine debris monitoring could be motivation to keep the action for reduction. Their practical activities in the program were participation of education opportunities, meetings, beach cleanups, bringing back litter they generated from their work places, and recording debris log sheets. The result said that more fishermen had joined if we should have made full use of monthly-based regular meeting itself and they preferred community-based voluntary activities as educational ways (3.6). We had 4 times of meetings and workshop, so they had to come to meeting places on purpose, which was not preferable for them (2.92). But to program manager it was a good opportunity to take much information and their views on marine debris management policies.

We had done two times beach cleanups and one time ICC event in the program. The fishermen have participated in beach cleanups regularly and recognized the need of the activities (3.83). But they showed low participation in ICC than we expected. It seemed they had difficulties in cooperating with different groups and in organizing the activities related marine environmental problem by themselves. The ICC in Boryeong was held at the beginning of the program (14th Sep.) with lack of communication with fishermen, which could be possibly a part of reasons.

'Paying retrieved fishing gear' ranked top (4.22) in the marine debris policies. We had ever questioned what if there were no rewards for retrieved fishing gear. However, Moochangpo fishermen's response implicated they have considered the part of 'retrieval' larger than 'paying'.

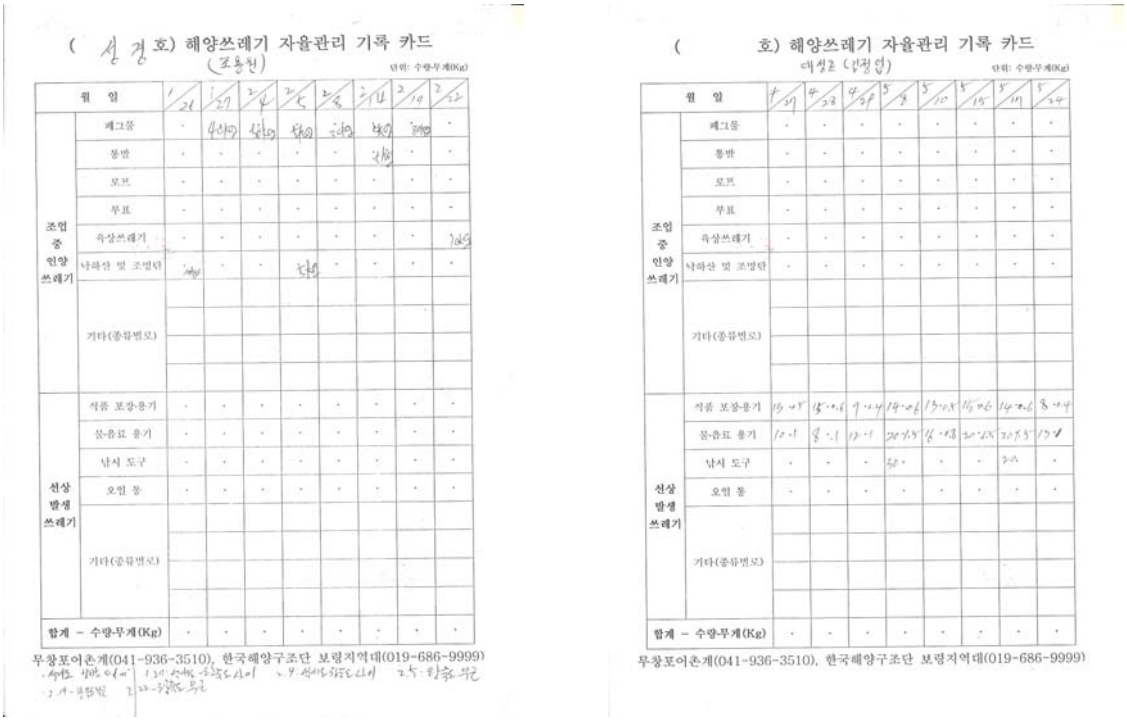
There were only 6 participants recording the cards for several reasons. Most of fishermen were passive because of troublesome work (3.43), Hebei oil spill accident (3.42), or no meaning (3.00). On that score, we had lack of full consideration of their work and life pattern. There were some reasons to hard recording log sheets. Usually one or two fishermen work on their fishing vessel. So they have no hand to record the cards. And when they come into port, they need to carry their catch somewhere as fast as possible. Besides, they have wet hands.

Log sheets possibly helped to lead fishermen to retrieve their debris. Actually we found that they used to bring their debris generated while fishing back to port and reception facility. However, only six fishermen having own fishing boat recorded log sheets we developed. They recorded 34 days in total, which was 5.5days per person. Two of them actively joined this program for 14 to 15 days. They are regarded as potential leaders in marine environmental activities in fishermen communities with proper capacity building.

The quantitative conclusion is not clearly given because the number of log sheets is very low. However, the log sheets they finished to record showed some implication. One of active participants recorded to bring back tens of kilograms of nets whenever he operated in the sea (Figure 5a). He could mark the approximate locations where he found during fishing. In addition, military debris were still found, posing serious safety risks for fishers although the shooting training using light bombs and parachute was recently stopped. Another one's sheets showed if he did not bring back the garbage (food wrappers, plastic bottles or something) on board, which could be found on some other beaches (Figure 5b). One fishermen wrote down even the exact longitude and longitude he found, which could be very good information for governmental agency to clean sea bottom.

Boryeong City has strengthened to administratively and financially support Moochangpo cooperative since the start of the program. It is known that the city has assisted with

budget in the activities such as debris cleanup at port, extermination of starfish (regarded as a marine evasion organism in fishing zone), and leisure fishing which produces less problem in fishing debris issue with budget. Based on mutual understanding, the positive relationship among fishermen, NGO and local government and authority would contribute to save management cost and cleaner coastal environment and then to develop a model case about fishing gear control by fishermen themselves in future.



(설경호) 해양쓰레기 자율관리 기록 카드
(조용원)

단위: 수량무게(Kg)

월	일	1/21	1/27	2/4	2/5	2/12	2/18	2/19	2/22
조업 중 인양 쓰레기	폐그물	·	4.5kg	5kg	5kg	3kg	4kg	3kg	·
	통발	·	·	·	·	·	2kg	·	·
	로프	·	·	·	·	·	·	·	·
	부표	·	·	·	·	·	·	·	·
	육상쓰레기	·	·	·	·	·	·	·	1kg
	난파선 및 조업단	1kg	·	·	5kg	·	·	·	·
	기타(종류별로)								
선상 발생 쓰레기	식품 포장용기	·	·	·	·	·	·	·	·
	음·음료 용기	·	·	·	·	·	·	·	·
	낚시 도구	·	·	·	·	·	·	·	·
	오염 물	·	·	·	·	·	·	·	·
	기타(종류별로)								
합계 – 수량무게(Kg)		·	·	·	·	·	·	·	·

무창포어촌계(041-936-3510), 한국해양구조단 보령지역대(019-686-9999)

(a)

(호) 해양쓰레기 자율관리 기록 카드
대성호 (김정엽)

단위: 수량무게(Kg)

월	일	4/27	4/28	4/29	5/3	5/10	5/15	5/21	5/24
조업 중 인양 쓰레기	폐그물	·	·	·	·	·	·	·	·
	통발	·	·	·	·	·	·	·	·
	로프	·	·	·	·	·	·	·	·
	부표	·	·	·	·	·	·	·	·
	육상쓰레기	·	·	·	·	·	·	·	·
	난파선 및 조업단	·	·	·	·	·	·	·	·
	기타(종류별로)								
선상 발생 쓰레기	식품 포장용기	13.5	13.6	9.4	14.6	13.5	15.6	14.6	8.4
	음·음료 용기	10.1	9.1	13.1	20.5	16.3	20.5	20.5	13.7
	낚시 도구	·	·	·	5kg	·	·	2kg	·
	오염 물	·	·	·	·	·	·	·	·
	기타(종류별로)								
합계 – 수량무게(Kg)		·	·	·	·	·	·	·	·

무창포어촌계(041-936-3510), 한국해양구조단 보령지역대(019-686-9999)

(b)

Figure 5: Examples of log sheets recorded by fishermen

8. Conclusion

The 'Fishermen's self monitoring program of marine debris' is a meaningful trial to KMRC in Boryeong, a nonprofit organization which has been involved in efforts to reduce marine debris for years. This program is more valuable in the way that it targets on fishermen who earn their living on resources of the Yellow Sea and polluters at once. Fishermen group has been recognized as one of the major sources of marine debris in the country. Aging, apathy due to decreasing resource by overfishing and pollution or low education level seem to have interrupted to activate education and public awareness programs for them.

Most of the people who think it is essential to educate fishermen for solving marine debris problem don't know much about the processes and behaviors which produce debris in the sea. It is needed to excavate and train fishermen leaders who have strong concerns and intentions and to give more roles for raising awareness.

Moochangpo cooperative of fishing village has ever awarded as a self-control model community on resources by government. The head and members have relatively highly recognized the importance of resources and environment in the Yellow Sea. They were eager to share and solve the problem with NGO activists. Their active response in several meetings and workshop was admirable and hopeful even to us. Continuous backup and support would produce more valuable outcome in the area in future.

Some of participants can play roles as good instructors if they would get properly trained on education skill or program leading. Moochangpo cooperative has an enough potential to be a model case on marine debris self-management. It is worth to develop further programs including field trips where people from other districts can join.

The most valuable outcome is to listen to various opinions about sea-based marine debris. The new important facts we get to know are like below.

First, government has a plan to disseminate debris gathering barges for easy collection of fishing gear. However, fishermen say it is more important and effective to get rid of marine debris on time and quickly.

Second, conflicts among different fishing methods can be one of major reasons. Government needs to play a role to induce sharing information and volunteer agreement between fishermen groups action, which can directly help for reduction.

Third, fishermen have recorded the location of derelict fishing gear they encounter during fishing on the ship navigator. This information can be very useful and cost-effective to clean fishing zone by government.

Problem to be solved

It is not easy to make fishermen voluntarily record and find out alternatives for reduction of marine debris. Long term interests and approaches should be settled down in community level. For development of fishermen education program, it is needed to deeply consider the usual ways of working, behaviors on board, degree of recognition, culture, etc.

Fishermen hesitated to give notice of location of abandoned fishing gear because they have less confidence in coast guards and government. We clearly found that confidence-building between government and fishermen is necessary for better management measures and policies against marine debris.

9. Contact information

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Annex I: Result of Questionnaire Survey

Target: Participants of wrap up meeting (23 persons including lecturers and program conductors)

Date and time: 16:00~17:00, 18th June, 2008

Method: Questionnaire

Participants: 18 persons

Contents of the questionnaire survey

The survey included four fields: 1. recognitions of impacts of marine environmental problems to fisheries, 2. evaluation of national marine debris policies in progress, 3. educational methods of marine environmental awareness for fishermen, 4. reasons for low participation of recording log sheets. Each field has several questions. The respondents need to make a decision on their level of agreement, on a five degree scale (i.e. strongly disagree, disagree, undecided, agree, strongly agree) with a statement.

The first field has questions about how seriously they feel about impacts of marine environmental problems on their fisheries. We furnished respondents with several problems of oil pollution, marine debris and global warming as marine environmental problems.

The second is for marine debris policies in progress (MOMAF, 2007). We mentioned 7 policies, such as 'Paying retrieved fishing gear', 'Fishing zone Cleanups', 'Fishing gear identification system', 'Education for fishermen', 'Beach cleanups', 'Debris reception barges' and 'Styrofoam compactors'.

The third is about educational methods of marine environmental awareness for fishermen. It included 'Voluntary activities of fishing village corporation', 'Monthly meeting of fishing village cooperative', 'Fishermen education by municipal government', 'Separate schedule only for education', 'Posters', 'Leaflets', 'TV campaign' and 'Radio campaigns'.

The last is about reasons of low participation in the self monitoring program we designated. It included 'Uselessness of recordings', 'Hardness of recordings' and 'Hebei oil spill accident'.

Results

Each question was measured in Likert type scale.
Responses of questions can rate on a 1-to-5 response scale where:
1 = strongly disagree
2 = disagree
3 = undecided
4 = agree
5 = strongly agree

Recognitions of impacts on fishery from marine environmental problems

	Average	Responses	Rank
Oil pollution	3.83	18	2
Marine debris	4.61	18	1
Global warming	3.78	18	3

Marine debris policies evaluations

Paying retrieved fishing gear	4.22	18	1
Fishing zone Cleanups	3.39	18	6
Fishing gear identification system	3.61	18	3
Educations for fishermen	3.44	18	5
Beach cleanups	3.83	18	2
Debris reception barges	3.47	17	4
Styrofoam Compactors	3.24	17	7

Evaluations about educational methods of marine environmental awareness for fishermen

Voluntary activities of Fishing village corps.	3.60	15	1
Monthly meeting of Fishing village corps.	3.31	13	2
Fishermen educations by municipal government	3.15	13	4
Separate educations	2.92	13	7
Posters, leaflets	3.08	13	5
TV campaign	3.29	14	3
Radio campaigns	2.93	14	6

Reasons of low participation in the self monitoring program

Uselessness of recordings	3.00	12	3
Hardness of recordings	3.43	14	1
Because of Taean oil spill accident	3.42	12	2

1. Recognitions of impacts on fishery from marine environmental problems

The average of item about ‘marine debris problem’ was 4.61 point, showing the fishermen consider it very severe. ‘Oil pollution’ remarked 3.83 point and there wasn’t much different from ‘global warming’, 3.78 point. The gap between ‘oil pollution’ and ‘marine debris problem’ was 1.00 point instead. One of the reasons of the result was that the participants on the survey understood this program related with marine debris problem as well. Although Hebei oil spill accident was an extremely severe and huge accident we haven’t met before, the fishermen understood that oil pollution was not a primary reason affecting on their usual fisheries.

2. Evaluation of marine debris policies

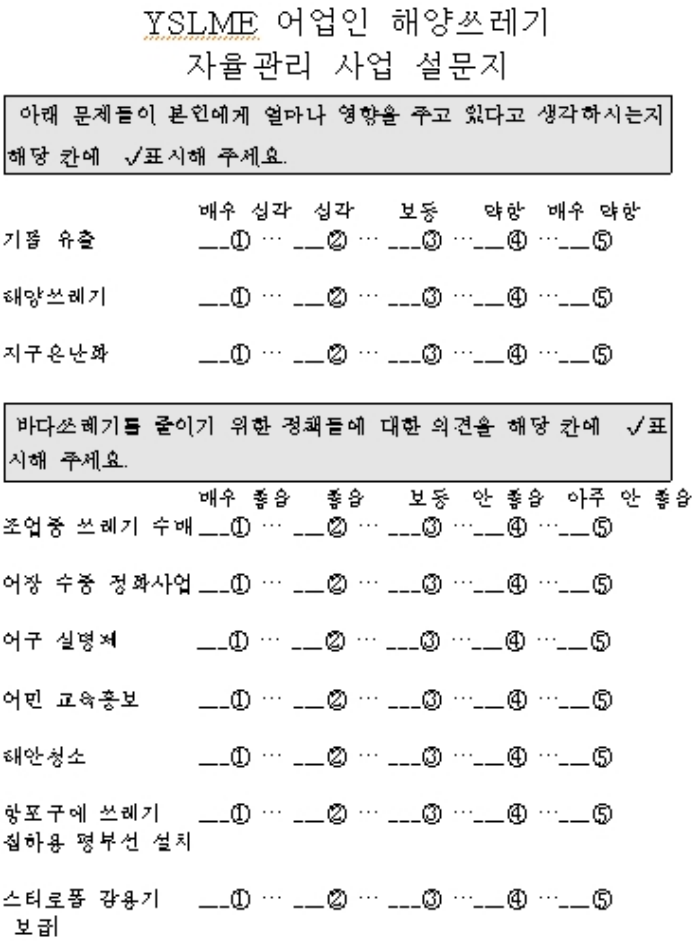
'Paying retrieved fishing gear' got highest score of 4.22, 'Beach cleanup' 3.83, 'Fishing gear identification system' 3.61 and other four policies got higher than the average. The respondents evaluated all policies we mentioned above the average score (3 point) in this survey.

3. Educational methods of marine environmental awareness for fishermen

'Voluntary activities of fishing village cooperative' has highest scored of 3.60, the next score 3.31 was to 'Monthly meeting of fishing village cooperative'. 'Separate schedule for only educations' ranked the lowest with 2.92 point. It showed fishermen preferred community-based activities like self action program and conjugation of monthly meeting rather than separate schedules for only education.

4. Reasons for low participation in recording log sheets

They were answered like: Recording was hard and troublesome (3.43); target people were not fully concerned because of oil spill accident (3.42); and recording is meaningless (3.00). It tells the oil spill accident somewhat affected the self monitoring program and hard to record their monitoring card while at work.



YSLME 어업인 해양쓰레기
자율관리 사업 설문지

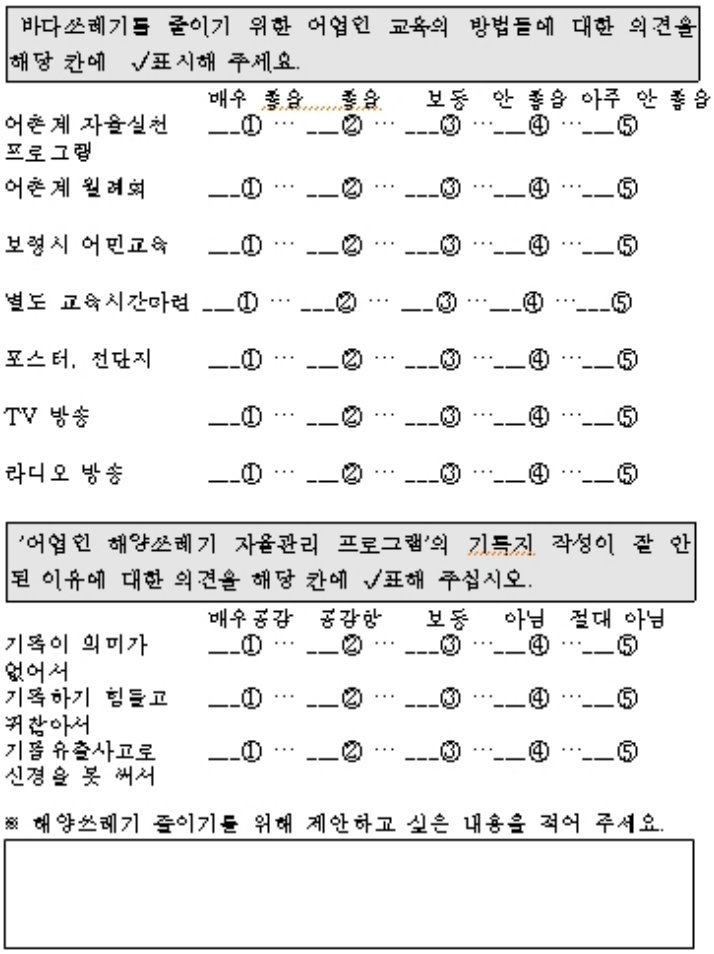
아래 문제들이 본인에게 얼마나 영향을 주고 있다고 생각하시는지 해당 칸에 √표시해 주세요.

	매우 심각	심각	보통	약함	매우 약함
기름 유출	①…	②…	③…	④…	⑤
해양쓰레기	①…	②…	③…	④…	⑤
지구온난화	①…	②…	③…	④…	⑤

바다쓰레기를 줄이기 위한 정책들에 대한 의견을 해당 칸에 √표시해 주세요.

	매우 좋음	좋음	보통	안 좋음	아주 안 좋음
조업중 쓰레기 수매	①…	②…	③…	④…	⑤
어장 수중 정화사업	①…	②…	③…	④…	⑤
어구 실명제	①…	②…	③…	④…	⑤
어민 교육홍보	①…	②…	③…	④…	⑤
해안청소	①…	②…	③…	④…	⑤
항포구에 쓰레기 침하용 평부선 설치	①…	②…	③…	④…	⑤
스티로폼 감용기 보급	①…	②…	③…	④…	⑤

Questionnaire page #1


바다쓰레기를 줄이기 위한 어업인 교육의 방법들에 대한 의견을 해당 칸에 ✓표시해 주세요.

	매우 좋음	좋음	보통	안 좋음	아주 안 좋음
어촌계 자율실천 프로그램	①…	②…	③…	④…	⑤
어촌계 월례회	①…	②…	③…	④…	⑤
보령시 어민교육	①…	②…	③…	④…	⑤
별도 교육시간마련	①…	②…	③…	④…	⑤
포스터, 전단지	①…	②…	③…	④…	⑤
TV 방송	①…	②…	③…	④…	⑤
라디오 방송	①…	②…	③…	④…	⑤

'어업인 해양쓰레기 자율관리 프로그램'의 기특지 작성이 잘 안 된 이유에 대한 의견을 해당 칸에 ✓표해 주십시오.

	매우공감	공감함	보통	아님	절대 아님
기록이 의미가 없어서	①…	②…	③…	④…	⑤
기록하기 힘들고 귀찮아서	①…	②…	③…	④…	⑤
기름유출사고로 신경을 못 써서	①…	②…	③…	④…	⑤

※ 해양쓰레기 줄이기를 위해 제안하고 싶은 내용을 적어 주세요.

Questionnaire page #2

Annex II: References

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III. Building the Partnership between Government Departments and Enterprises on Protecting the Marine Environment of Yalu River Estuary

Liaoning Ocean and Fishery Department, Liaoning Ocean and Fisheries Science Research Institute and Dandong Ocean and Fishery Bureau

Building the Partnership between Government Departments and Enterprises on Protecting the Marine Environment of Yalu River Estuary

Liaoning Ocean and Fishery Department, Liaoning Ocean and Fisheries Science Research Institute and Dandong Ocean and Fishery Bureau

1. Summary

In co-operation with the UNDP/GEF Yellow Sea Project Management Office (PMO), Liaoning Ocean and Fishery Department, Liaoning Ocean and Fisheries Science Research Institute and Dandong Ocean and Fishery Bureau conducted the activity of "Building the Partnership between Government Departments and Enterprises on Protecting the Marine Environment of Yalu River Estuary" as one of the public awareness activities from 5th September 2007 to 31st March 2008. In this Programme, the activity was organized for strengthening the capacities of science management of marine and coastal environments targeting local government and enterprises in Yalu river estuary. Liaoning Ocean and Fisheries Science Research Institute prepared this report to inform the PMO of the Process of and results from the implemented activities.

So far, all the public awareness activity has been implemented successfully in Dandong, China. The activity consisted of survey, communication between local government departments and enterprises, training of marine conservation for local enterprises, ensuring continuity of marine protection mechanism and a visit the Dandong Branch Company of Huaneng Power International Inc.. About 50 management staff from Dandong Branch Company of Huaneng Power International Inc. and Dandong Port participated in the activity to broaden their knowledge on estuary ecosystem management. 6 government officers from Liaoning Ocean and Fishery Department, Dandong Ocean and Fishery Bureau and Donggang Ocean and Fishery Bureau participated in the event, as they wished to encourage the enterprises as a partner of the government to participate in estuary ecosystem management. All the teaching materials were prepared in Chinese.

2. Background of activities

The Yellow Sea is an important part of the world ocean and the base of the residents' survival in the Yellow Sea's coastal area. But because of little awareness of the marine ecosystem and lacking effective management in this area, the biology resource and biology diversity is decreasing, and environment and ecosystem is degenerating, which is threatening the sustainable development of the Yellow Sea large marine ecosystem. The UNDP/GEF Yellow Sea Large Marine Ecosystem (YSLME) Project aims to protect, conserve and manage the Yellow Sea.

The water and sand from rivers in north Yellow Sea Area play an important role in shaping coast, continental sediment, hydrology and the marine ecosystem. The estuary area is an important marsh, biologic habitat and field for the valuable hydrophily organisms as spawning and feeding ground, and the naissance area of marine ecosystem. Therefore the estuary area is a very important component of large marine ecosystem. The Yalu River estuary is the biggest river in North Yellow Sea, and its contribution to Yellow Sea marine ecosystem is the largest. Recently, with rapid social and economic development in the Yalu River estuary, land resources of coastal regions are under big pressure. Because of high-intensity development of coastal land resources, the coastal areas with relatively high ecological value gradually decrease and the overall ecological quality is on the decline. Environmental issues have become increasingly prominent in the Yalu River. So the eco-friendly recycling and sustainable use of the Yellow Sea Large Marine Ecosystem are facing huge threats.

All along, the people do too much for exploitation to the Yellow Sea resources but too little for protection, and lack the cognition in scientific management of marine and coastal resources. Therefore, it is inevitable to strengthen the capacities building of the Yellow Sea coast stakeholders in the management of marine and coastal resources.

3. Objectives of activities

The activities follow the principles of ecosystem-based management and sustainable development, through survey, communication between local government departments and enterprises, training of marine conservation for local enterprises, ensuring continuity of marine protection mechanism and a visit the Dandong Branch Company of Huaneng Power International Inc., to encourage local government, enterprises involved in the sea and other stakeholders to actively participate in ecological management, to strengthen the capacities of their science management of marine, to promote the sustainable development of the Yellow Sea Large Marine Ecosystem.

4. Target audiences

Target audiences were local stakeholders, especially local enterprises and local government in Dandong City.

5. Activities implemented

5.1. Survey

Surveys on the Yalu River Estuary ecosystem were conducted to prepare basic information for implementing activities proposed from 5th September to 3rd November 2007. We collected information by reviewing journals, internet and report on the Marine Environmental Quality in Liaoning, P.R.C in 2006. The surveys revealed not only the current status and problems of the ecosystem, but also the pollution source (e.g., polluting enterprises). For example, cooling water drainage outlet of Huaneng Dandong Power Plant had been ever one of the main land-sourced pollutant-emission outlets. So Dandong Branch Company of Huaneng Power International Inc. was identified as the one of the major business enterprises, which contributed to the environmental degradation in the Yalu River Estuary. Besides, another source of marine pollution was ship and port discharge, so Dandong Port was also identified as the one of the major polluting enterprises. The subsequent proposed activities would target those identified enterprises to involve them as partners in estuary conservation activities.

5.2. Organising a meeting

The meeting with the representatives from the Liaoning Ocean and Fishery Department, Dandong Marine and Fishery Bureau, Donggang Marine and Fishery Bureau, as well as Dandong Port and Dandong Branch Company of Huaneng Power International Inc. was organised in Dandong on 22nd January, 2008. The meeting mainly discussed (i) how to encourage the enterprises as a partner of the government to participate in estuary ecosystem management and (ii) how to solve the conflicts between coastal development and marine environmental protection. The discussion helped in forming a basic strategy for establishing the partnership between the two sectors.

5.3. Organising a training workshop

The training workshop was conducted in Dandong on 22nd January, 2008. Four lectures were given to all participants:

- ‘Ecological protection and management of Yalu River Estuary’ presented by Mr. Meng Dexin from Liaoning Ocean and Fishery Department;
- ‘Enterprise behaviour of ecological protection’ presented by Mr. Wang Nianbin from Liaoning Ocean and Fisheries Science Research Institute;
- ‘Building the partnership to facilitate harmonious development of the circulation economy’ presented by Prof. Shao Mihua from Environmental Science College, Dalian Maritime University; and
- ‘Public-Private-Partnership and ecological protection of Coastal Estuary’ presented by Prof. Wen Quan from National Marine Environmental Monitoring Centre (NMEMC).

All the lectures in electronic edition had been transferred to Dandong Port and Dandong Branch Company of Huaneng Power International Inc. for reference materials. The workshop was attended by 50 management staff from Dandong Port and Dandong Branch Company of Huaneng Power International Inc.. Through the training workshop, the participants developed a basic understanding of Public-Private-Partnership and how to develop their business plans in harmony with the environment. The Deputy Director of Dandong Branch Company of Huaneng Power International Inc. firmly believed that their management staff had obtained great benefits from this training course.

5.4. Establishing a regular consultation meeting

To secure continuous efforts for marine environmental protection in the Yalu River Estuary, a regular consultation meeting with numerous stakeholders was organised in Dandong on 23rd January, 2008. The regular meeting would be organised every six months. The meeting aimed to facilitate harmonising management actions that stakeholders currently implemented and/or planed to implement individually. The meeting was attended by the representatives from Liaoning Ocean and Fishery Department, Dandong Marine and Fishery Bureau, Donggang Marine and Fishery Bureau, Dandong Port, Dandong Branch Company of Huaneng Power International Inc., Donggang Shellfish Culture Company and Dalian Marine University.

The meeting provided a good opportunity for government officers, research scientists and management staff from local business entities to exchange views and experiences on the issues of ocean protection and ocean management, and to share information and technical suggestions. At the ending of the meeting, local government agencies (e.g., Liaoning Ocean and Fishery Department, Dandong Marine and Fishery Bureau and Donggang Marine and Fishery Bureau), local business entities (e.g., Dandong port, Dandong Branch Company of Huaneng Power International Inc. and Donggang Shellfish Culture Company) and local universities (e.g., Dalian Marine University) signed a Memorandum of Agreement on how government and entities would work together to better protect and manage ecological environment in Yalu River Estuary.

5.5. Orgniasing a visit

A visit the Dandong Branch Company of Huaneng Power International Inc. with the members from the Dandong port, Donggang Shellfish Culture Company and local residents was conducted on 23rd January, 2008. Field visit was paid to circulating water cooling facilities, sewage treatment plants, the inlet and outlet of reservoirs, and power production process. The visiting group learned the advanced technologies and successful experiences from Dandong Branch Company of Huaneng Power International Inc. in the fields of energy-saving and environmental protection.

6. Produced outputs and outcomes (including materials produced)

The main produced outputs and outcomes of this programme are as follows.

- A Memorandum of Agreement on how government and enterprises would work together to better protect and manage ecological environment in Yalu River Estuary.
- Four reports including" Ecological protection and management of Yalu River Estuary'' (in Chinese), "Enterprise behaviour of ecological protection" (in Chinese), "Building the partnership to facilitate harmonious development of the circulation economy" (in Chinese) and "Public-Private-Partnership and ecological protection of Coastal Estuary" (in Chinese).
- About 100 digital photos recording the finest details of the activities.

7. Evaluation: Effectiveness of implemented activities

In general, all the public awareness activity has been held successfully. The activity has contributed to build the capacity of the local stakeholders to manage the marine and coastal environments. Local government and major business enterprises such as Dandong Branch Company of Huaneng Power International Inc. and Dandong Port established the partnership and signed a Memorandum of Agreement.

8. Conclusions and recommendations for future work

The recommendations for future work of this project are as follows.

- The Yalu River estuary has an important significance in ecology, including important spawning and breeding grounds for fishes, shrimps and shellfishes in the past as well as at present, so it should be given more attention of protection and management than before.
- Clean up the pollution of Yalu River and Dayang River - silt, bacteria and heavy metals that are killing marine life.
- Strengthen and expand the marine protected areas in Yalu River estuary.
- A long-term propaganda and education programme for Yalu River Estuary is still urgently needed and it seems possible with more effort from various stakeholders.

9. Contact information

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IV. Enhancing the ability of local stakeholders to effectively understand the impact and technical ways of sustainable mariculture in Sungo Bay

Fishery Technique Extending Station of Rongcheng City
Yellow Sea Fisheries Research Institute, Chinese Academy of Fisheries Science

Enhancing the ability of local stakeholders to effectively understand the impact and technical ways of sustainable mariculture in Sungo Bay

Fishery Technique Extending Station of Rongcheng City
Yellow Sea Fisheries Research Institute, Chinese Academy of Fisheries Science

1. Summary

Aquaculture has become one of most important ways to alleviate the demanding impact coming from the rising population for proteinic food. Among which, shellfish and seaweed culture is a profitable economic activity and being developed rapidly in coastal waters all over the world, especially in China, the annual yield of cultivated shellfish and seaweed were about 9,000,000 MTs and 1,300,000 MTs, respectively in 2006. However, it is widely accepted that aquaculture activities are associated with many types of impacts on the environment. For the reasons of high intensive culture with large scale, the mariculture industry faces serious problem e.g. high mortality rate, slow growth rate, outbreak of disease. Local stakeholders are looking for the new technique and sustainable cultivated mode.

For the purpose of improving the ability of local farmers to understand the importance and necessity of sustainable mariculture, the UNDP/GEF small grant project entitled "Enhancing the ability of local stakeholders to effectively understand the impact and technical ways of sustainable mariculture in Sungo Bay" was carried out from Sep. 2007 to July, 2008 by the Fishery Technique Extending Station of Rongcheng City and Yellow Sea Fisheries Research Institute, China.

By the method of visiting to demonstration areas, seminar, training course and publish newsletters, local stakeholders had chance to compare the difference of monoculture and polyculture, to see the change the environment in Sungo Bay after over 20 years' large scale mariculture and to get the basic theory of the sustainable polyculture.

2. Background of activities

Sungo Bay is located in Shandong Province of China (in the Northern of Yellow Sea; Figure 6). With an area of 140 km2 and depths varying gradually until approximately 20m at the sea boundary. It has been used for aquaculture for more than 20 years. As one of most important mariculture bases in China, the maximum annual yields of the main cultivated species kelp (Laminaria japonica), oyster (Crassostrea gigas), scallop (Chlamys farreri) arrived at 80000 tons, 40000 tons and 45000 tons, respectively. But for the reasons of high intensive culture with large scale, the mariculture industry faces serious problem e.g. high mortality rate, slow growth rate, outbreak of disease. Local stakeholders are looking for the new technique and sustainable cultivated mode.

As required by the mariculture industry, several national and international projects have been implemented in the Bay. And lots of results showed that the growth rate and mortality rate of bivalves had close relationship with the cultivated density. By decades research, several polyculture techniques and sustainable mariculture models have been applied. From the polycluture results we could find that with the polyculture of bivalves and kelp or with the bottom co-culture of scallop, sea cucumber and abalone, the economic benefits increased significantly comparing with the monoculture. In such polyculture, the bio-production of one species can be utilized by other species as a food source (Figure 7). Within a farmed area, for example, waste from scallop or oyster could be used by sea cucumber, while seaweeds on oyster lines could be used to feed a cultured grazer species, e/g. abalone. Polyculture, using these methods, will not only decrease the impacts of large

scale intensive culture on marine environment, but also will increase the yields and diversifying products. Sanggou Bay is one typical epitome of the Yellow Sea, therefore, extending polyculture technique and model in the Yellow Sea is urgently needed for sustainable development of mariculture industry in the marine ecosystem.

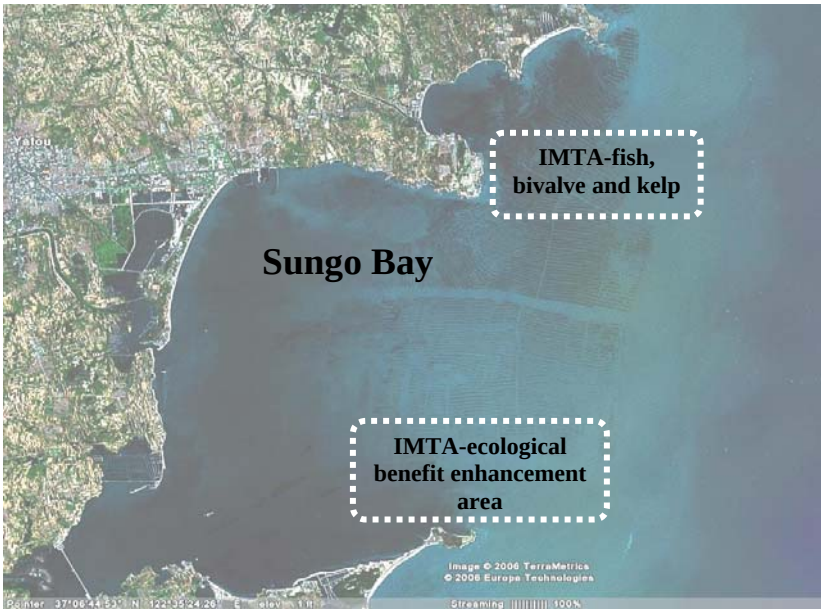

Figure 6: The demonstration area of polyculture in Sungo Bay

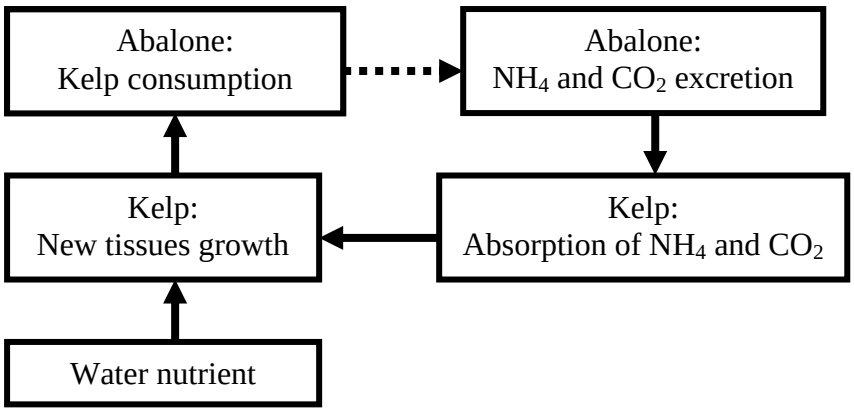

Figure 7: Diagrammatic representation of IMTA of long-line culture abalone and kelp

3. Objectives of the activities

- To improve knowledge of local communities in the impacts of mariculture to the marine environment, and sustainable the use of the marine and coastal resources for mariculture activity
- To transfer scientific technique and sustainable mariculture technologies to the local communities
- To share necessary information on sustainable mariculture with local stakeholders

4. Target audiences

Local farmers and local mariculture managers of Rongcheng City, Shandong province.

5. Activities implemented

5.1. Review and summary of existing data

6 sets of annual investigated data in Sungo Bay were collected and analyzed, which included: 1983-1984; 1989-1990; 1993-1994; 1999-2000; 2004, 2006-2007. Fellow environmental factors were including: temperature, salinity, dissolved oxygen, chlorophyll a, total suspended matter concentration, dissolved inorganic nutrients, primary production etc. By compared with the results of "pristine" ecosystem (before intensive aquaculture) in order to identify changes in pelagic environment and assess the impacts of long-term intensive aquaculture of shellfish and seaweed on the environment.

Figure 7 shows the annual yields of the scallop and oyster from 1985 to 2005 in Sungo Bay. From 1985 to 1996, dramatic increases occurred in shellfish production, with significant rising from 445 Mts per annum to approximately 84900 Mts. Since 1997, the yields of scallop declined for high mortality in summer, therefore, the mariculture of shellfish shift species from scallop to oyster recently (Figure 8). Oyster accounted for total tonnage from 14% in 2000 to 99% in 2005.

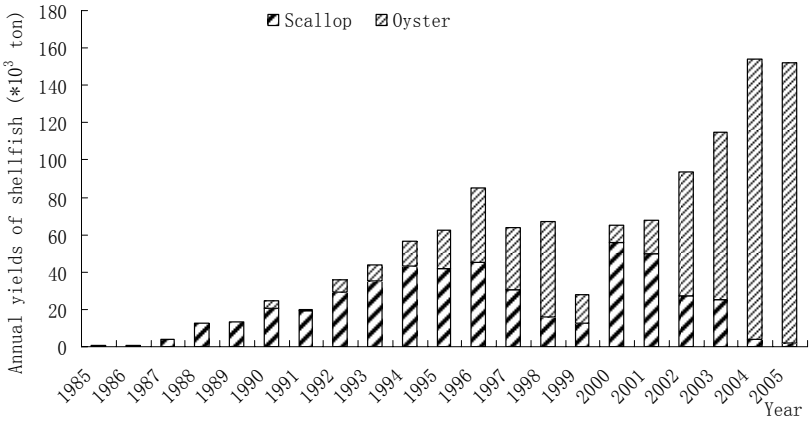

Figure 8: Annual yields of scallop Chlamys farreri and oyster Crassostrea gigas in Sungo Bay.

Totally, the mean nutrient concentrations showed increasing trend in Sungo Bay over the 24 years. The concentrations of TIN had significantly increased, the concentration of DRP showed fluctuated and the concentration of Si increased slowly. The ratios of N and P were below 16:1 before June1989, and then kept fluctuated increase in the period from June 1989 to September 1999 resulted from high concentration of TIN, nearly 50% of the N/P ratios were higher than 16:1. From November 1999 to 2004, N/P atomic ratios reduced to below 16:1 due to high concentration of DRP. But in 2006-2007, N/P ratios increased with the sharply increasing of TIN. Before August 1989 the Si/N ratios were higher than 1:1, from then on the ratios reduced step by step (Figure 9).

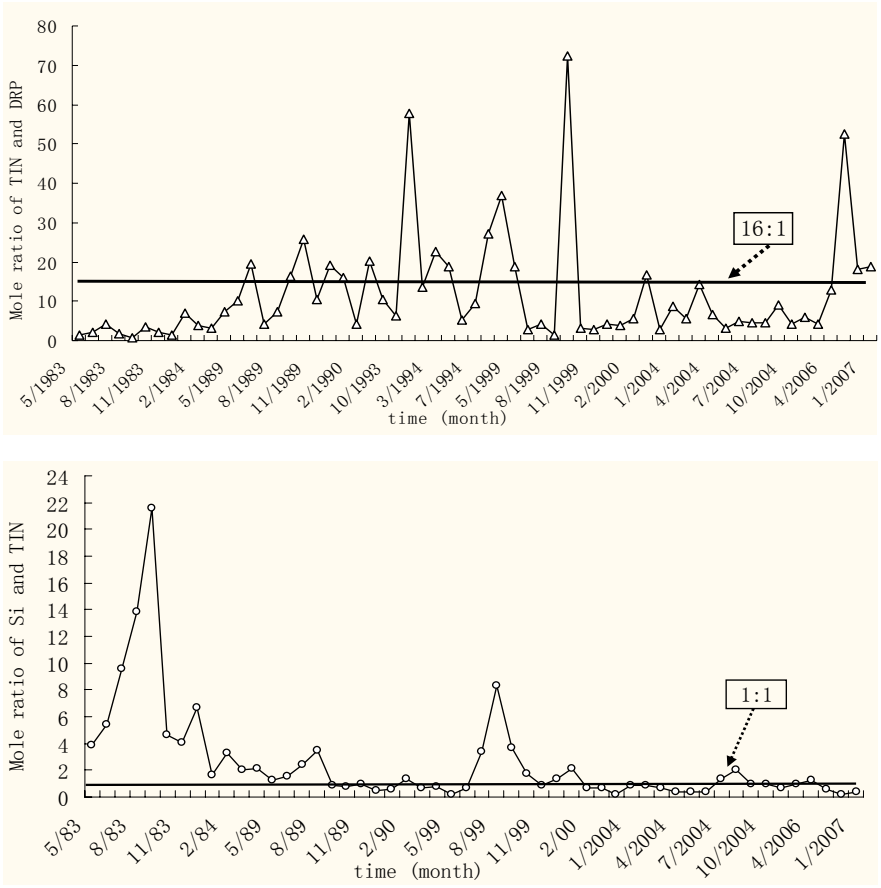

Figure 9: Long-term variation of nutrients atomic ratios (atomic ratios of N/P, Si/N) in Sungo Bay

Therefore, the probability for N-limitation was much higher in 1983-1984, which occurred in 100% of all months. Since 1989, the probability for N-limitation had been lessened, which occurred frequencies were 25%, 42% and 33% in 1989, 1999 and 2004, respectively, and which usually occurred in summer. The probability of Si-limitation increased from the frequency of 0 % in1983.

5.2. Organise a seminar on better management planning for sustainable mariculture

A Seminar with local people and experts undertaken in Sep. 2007 was followed by a series of reports, which introduced the recently results of monitoring in Sungo Bay. About 30 persons joined in the seminar (who came from the Xunshan Fishery group; local government; local farmers; China Ocean University and Yellow Sea Fisheries Research Institute participants; Fishery Technique Extending Station of Rongcheng City). The reports contents: the effect of mariculture animals on the sediment-water hydrodynamics progress of Sungo Bay; the mechanism of particle resuspended and the advection; the hydrodynamics characteristics of nutrients in Sungo Bay; the sustainable development strategic and activity plan; the current environmental status and the dynamic of carrying capacity.

5.3. Organise site visits to demonstration areas with best practices for sustainable mariculture.

Local fishermen visited to three demonstration areas--polyculture of suspended long-line culture of abalone and kelp, scallop and kelp in Xunshan Fishery CO. Ltd. Xunshan Fishery CO. Ltd. Was setup at 1956. The company has total staff 3000. The mariculture areas are about 3200 ha and the annual production of seaweed and bivalves and abalone are 26000 t, 12000t and 100t, respectively. The company takes the lead in polyculture of seaweed and abalone and moving the longline culture from inshore to offshore water.

And the ecological bottom culture of sea cucumber +abalone+scallop+sea grass (Sea weed) in Chudao Company in Oct. 2007. Chudao Company located in south coast of Sungo Bay.

Mr. Bian Yongping (Consultee of Xunshan Fishery Company) was guiding kindly and giving the introduction of the present situation in Xunshan Company to the other fishermen. He introduced the annual yield per unit area and the total benefit. He also gave simple introduce of the new technique of long-line culture of abalone. They discussed about ongoing polyculture in Xunshan culture area.

Mr. Wang Junwei (Manager of Chudao Company) gave a comment on important of protection natural resource. Specially, he introduced the important ecological function of sea grass and sea weed in the polyculture ecosystem.

5.4. Organise a training course for local mariculture practitioners on sustainable maricultrue.

The training course was held in May, 2008. The title is: Sustainable mariculture--polyculture. Prof. Fang Jianguang from Yellow Sea Fisheries Research Institute and Prof. Wang Dajian from Fishery Technique Extending Station of Rongcheng City gave lectures and discussed with participants. Nearly 40 fishermen joined the training course.

Professor Fang introduce the negative impacts of intensive monoculture on marine environment and the development of polyculture in China and the theory of polyculture.

Professor Wang introduced the technique polyculture and the problem of daily management of polyculture. Especially, gave detail introduce on the prevent and clean out of predator in bottom culture.

5.5. Newsletter publication

Twice newsletters in Chinese were printing in December, 2007 and April, 2008, respectively. One newsletter summarized the published research paper on Sungo Bay. 30 papers were included in it. Another newsletter summarized the high benefit mariculture technique and mode (in Chinese: “高效水产生态养殖模式”). More than 50 copies of newsletter were printed and released to local fishermen in Rongcheng.

6. Produced outputs and outcomes

- News letters published two times
- A final report documenting all of processes
- Upgraded understanding and knowledge of the local communities in necessity and management of sustainable mariculture, in particular the polycuture, and appropriate culture density.

- Useful experiences in communicating with local communities on protecting marine environment and sustainable use of marine and coastal resources.

7. Evaluation: Effectiveness of implemented activities

Sharing the information and knowledge of sustainable mariculture is very important. It can give a chance for local fishermen to see what happen in their cultivated area. It can play a role to help them find out what they need to do in the future.

We published the newsletter two times during the projects as planned. The newsletter contained the published research papers and the practice technique on the polyculture, which appears to help local fishermen to deal with the actual problem in their mariculture activities.

Visiting the demonstration areas would help the local fishermen understand more on what was polyculture industry and to enhance they ability to understand the theory of polyculture. The most important was they could see the benefit of polyculture directly which will stimulate their mimic activities in the future.

8. Conclusions and recommendations for future work

We are very happy for the local fishermen shown their great ardor to get the knowledge on the sustainable mariculture. More than 100 local persons joined in our activities, they put forward lots of problem and especially they paid more attention on the practice of polyculture. They did want to know how to do, not why to do it, for the difficult to accept the theory of sustainable mariculture. Therefore, the local fishermen did not show great interesting for the first newsletter (published research paper), whereas for the second newsletter, they were happy to accepted it. It is important to disseminate knowledge in plain language, and also, more training course will needed in the future.

During the activities, the local fishermen asked some questions that we could not answer at that time, which need to be studied in the fellow demonstration project on the polyculture. We could say the small grant project is very successful because it not only enhance the ability of local stakeholder to understand the impact and technical ways of sustainable mariculture in Sungo Bay, but also by intercommunion between local fishermen and the researchers, it was the prelude of next project “Strategic Action Programme Demonstration Activity for Integrated multi-trophic aquaculture”.

9. Contact information

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V. Capacity Building for Local Sea-Water Cultivation Proprietors in the Participation and Management of Marine Protected Areas around Yantai Region

School of Environment and Materials Engineering
Yantai University

Capacity Building for Local Sea-Water Cultivation Proprietors in the Participation and Management of Marine Protected Areas around Yantai Region

School of Environment and Materials Engineering, Yantai University

1. Summary

We have implemented and completed three activities according to the plan since developing the program. In the process of implementing the activity 1, we carried out in situ investigation over north coast and south coast of the Yellow Sea in Yantai. Result shows that survival rate of prawns in breeding ponds affected by the sewage from the sewage treatment plant is low, while survival rate of prawns in the unaffected breeding ponds is over 40%. In the process of implementing the activity 2, we eliminated the barrier for promoting healthy cultivation by providing culture medium prepared by us, formulated concentrate of photosynthetic bacteria and EM bacteria preparation to the culturists for propagation of the preparation demanded. The adoption of microbial remediation and the promotion of healthy mariculture produced intense affinity with the culturists, making many culturists decide to follow. In the process of the activity 3, i.e. capacity building, we received decisive effect by adopting simultaneous implementation of theoretical education and practical education. We have achieved the anticipated objectives of this program. Presently, the influence of the practical propaganda and education implemented by us has been expanded from several adjacent villages in Haiyang and Muping to those in Rushan.

2. Background of activities

The continuous development of Yantai coastal region which is a composition part of Yellow Sea Large Marine Ecosystem faces the serious threat. The geographic area of the project see Figure 10.The contaminated land drainage into the Yellow Sea and the Bohai Sea worsened the water body along Yantai coastal region in addition to local coastal aquaculture areas. The self-pollution of coastal culture areas is very serious because the pollutant from there distributes over shallow waters such as bay and estuary where the exchange of water body is very slow and nitrogen、phosphorus are always accumulated and eutrophication occurs and even causes red tide. In fact, from 14 to 18, September, 2006, in the coastal region around Nanhuang of Changdao county in Yantai red tide happened, the color of sea water was showing brown and the expending area of the red tide was up to 2.37 km2. The main algae in this red tide are Alexandrium tamarence and prorocentum micans. The former could produce Paralytic Shellfish Poison (PSP). Since the red tide occurred in the marine culture areas, the death rate of fishes on culture in floating cage was about 100%, and the death rate of Haliotis discus hannai was about 50%, the direct economic loss was about RMB 403 thousands.

The proposal focuses on capacity building for local sea-water cultivation in the proprietors participation and management of marine protected areas around Yantai region. The purpose is to reduce self-pollution of marine culture along Yantai coastal areas.

3. Objectives of activities

The objects of education are mainly local sea-water cultivation proprietors. We will organize a series of activities and set up the proprietors who have gained economic benefits from aquiculture through special education and help up as an example to universally enhance local proprietors′ consciousness in protecting the marine environment and to make the most of them self-consciously participate in managing marine protected areas around Yantai region.

Figure 10: Diagram of the activities carried out by this Program along the seashore of Yantai

4. Target audiences

The principal recipients of the education that we offer are those seawater culturists breeding prawns and crabs in breeding ponds, for most problems of self contamination exist in this cultivation mode, which is exerting the most severe influence on the marine environment.

5. Activities implemented

5.1. Survey of environmental conditions in coastal bay

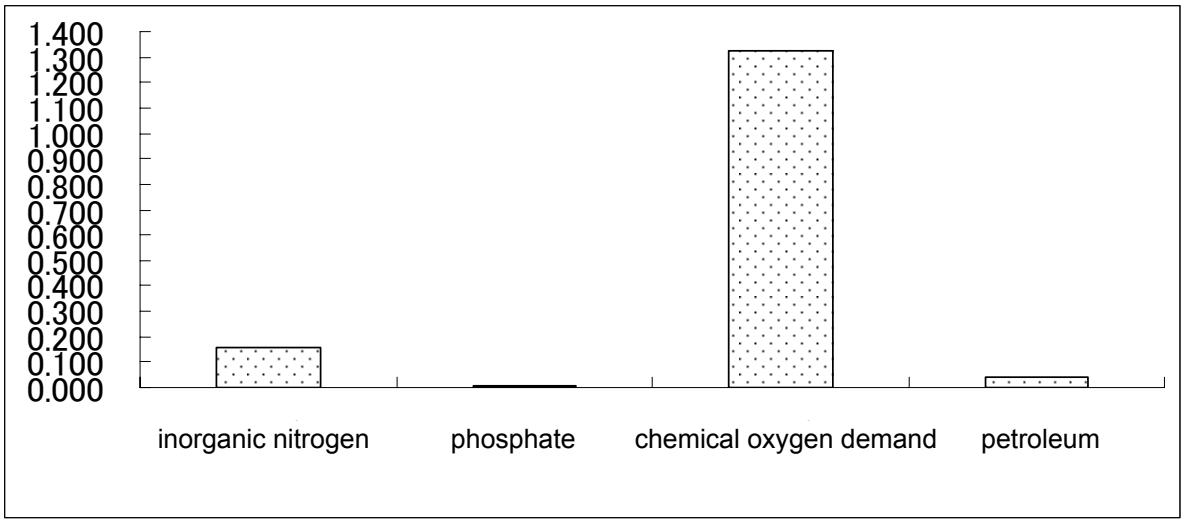
5.1.1. Water quality, sediment and biological quality

Environment quality of seawater
Average conditions for offshore environment quality of seawater is shown as in diagram below (Figure 11; unit: mg L-1).

Quality of marine sediment
Offshore marine sediments are in good condition, with all indexes in compliance with Class 1 marine sediments quality standard.

Marine biological quality
Biological quality of offshore area generally meet the standard for Class 2 marine biological quality and that of “Organic Green Food Limits of Poisonous and Harmful Substance in Aquatic Products” (NY5073-2001).

Environmental status of Haiyang’s inshore area
See Table 2.



Items	Inorganic Nitrogen	Reactive Phosphate	Chemical Oxygen Demand	Petroleum
Average Content(mg L^{-1})	0.160	0.010	1.322	0.044

Figure 11: Offshore environment quality of seawater

Table 2: Status quo of environment quality for Haiyang's inshore area

Chemical factors	Water temperature	Salinity	pH	DO	COD	Inorganic nitrogen	Phosphate	Petroleum
	℃	‰		mg L^{-1}				
Concentration range in surface layer	□1～2.0	33.482～34.136	8.04～8.40	9.84～11.94	1.64～2.35	0.058～0.430	0.004～0.020	0.042～0.962

5.1.2. Culture capacity of Haiyang City's inshore area

Chlorophyll-a and primary productivity
Chlorophyll-a is a good indication of the standing crop of phytoplankton. The average value of chlorophyll-a in this sea area is 1.3446 μg L-1; primary productivity reflects the ability of phytoplankton of certain sea area to covert inorganic carbon into organic carbon with the help of sunshine and nutrient. The average value of primary productivity in this sea area is 32.236 (mg C/m2• d). Culture capacity can thus be estimated per demand of culturing species based on these two indexes.

5.1.3. Advantages of culturing species of Yantai's inshore area

Based on the quality status of Yantai's inshore seawater, especially the specific values of certain marine environment factors, scientific evidences are currently available for the culturing species in Yantai sea area. Yantai's offshore area now mainly cover such culturing species: fish, prawns, crabs, sea-cucumbers, abalones, scallops and beach shellfish.

5.2. Study of Mariculture Activities

This activity covers two stages with March of 2008 as the threshold. The initial stage was between Aug 27, 2007~Feb 29, 2008, with its central task to select and locate the seawater culturists requiring priority support in Muping and Haiyang, whereby we could gain access to their demand, distress as well as culturing experience. Since March of 2008, we have entered the main stage of this activity, with its main objective being: microbial remediation will be utilized and those receiving guidance in healthy seawater culturing have been growing from individual culturists to more culturists; to attract more culturists to follow suit based on the practicability of gaining profit by them so that this favourable seawater culturing mode can be adopted by a great number of individual culturists; and the negative influence of drain contamination from culturing on the marine ecological environment can be minimized objectively. Hereunder is the description on the activities in details.

5.2.1. Activities during initial stage

Yu Weiqi and Yu Tianxue, sea-water culturists at north coast of the Yellow Sea in Yantai, have a 50ha breeding pond each, but their ponds are located at the west side and the east side of the Bridge of Xin'an River respectively, and survival rates of the prawns bred by them are all the difference. Prawn survival rate of the former is quite low while that of the latter is more than 40%. It is learned that, blowdown piping of Xin'an River Sewage Treatment Plant turns to the west via the culvert of the bridge and discharge the sewage into the sea at 1km away from the coast. According to our measurement and analysis, scarce floating algae in the prawn and crab breeding pond at the inner side of the culvert to the west of the bridge is caused by backflow of the sewage discharged to the sea; while thrift floating algae in the fish and prawn breeding pond at the side of the culvert towards the sea to the east of the bridge is due to the fact that backflow of the sewage discharged to the sea does not reach. We suggested that the culturists at west side of the bridge should not put into mass production until implementing the project of extending 1km the offshore distance of blowdown piping of the Sewage Treatment Plant to the off coast.

Activities at Jianggezhuang, Muping District

We paid an investigation and visit to Haojiatuan, Jianggezhuang through the introduction of Qu Xiaoguang. We were received by Hao Fangyi, who has two 3.5ha breeding ponds for prawns and crabs together, and concurrently breeding scallop seedings. According to his introduction, he put more than 400,000 prawn seedings into each pond, and only harvested 70kg spring prawns each pond, almost nothing of a harvest at all due to prawn diseases. Our observation at the spot found that the water in the breeding ponds was darkening, with very poor transparency, stinking bed-mud, oil film floating on the water surface at water inlet channel, and water inlet and water outlet were sharing the same channel. We invited his neighbors into the later discussion, which concluded that the oil film on water surface was caused by oil leakage of water pumps and motor vehicles of the culturists. Pollution and stinking of bed mud were also caused by self pollution in the process of culturing. Therefore, we explained the harm of self pollution in the process of culturing and preventive methods against it for the culturists present. This achieved an instant effect. All the culturists present at the discussion expressed that, they would immediately make their best endeavors to reduce self pollution in the process of culturing and publicize the knowledge to other culturist not present.

We established a relationship with Cui Xiaodong, a culturist at Yantan Village, Muping District. He has seven 2ha prawn breeding ponds for prawns and crabs together. There are totally 40ha prawn breeding ponds for the whole village. His breeding ponds have the

following features: water inlet and water outlet of the ponds are separate. Water assay sampled from the ponds showed that water quality was good. We plan to select some of the breeding ponds from this village to give concrete guidance and conduct an experiment on sustainable culturing.

Activities at Waidao Village of Daxinjia, Liugezhuang, Haiyang at south coast of the Yellow Sea in Yantai

There are approximately 50ha prawn breeding ponds in this village. Most of the proprietors are breeding prawns and crabs together. We selected Sui Fubing as our major object to offer our help, a culturist with a 5ha pond. He has the merits like having the desire for scientific help, good comprehension, and willing to cooperate with us. Aiming at the problems arising in the process of his culturing, we made a number of trips to Haiyang to take water samples, and took surfacial sediment sample for analyzing water quality and surfacial sediment, gave him helps, and made him realize that prevention of self pollution of the culturing was critical for maintaining water quality of the breeding pond and good for both the country and the people.

Sui Fubing now becomes a volunteer propagandist and assistant for our work implementation among the culturists on south coast of the Yellow Sea in Yantai. Therefore, we donated a set of simple tools for monitoring water quality (such as thermometer, densimeter, and pH test paper, etc) to him for encouragement. And we plan to cooperate with him in conducting a pilot healthy culturing experiment in his breeding pond from March 2008.

5.2.2. Activities from March 1 to November 30, 2008

In order to make a practical use of microbial remediation in the healthy mariculture, we first carried out the study over the extraction of photosynthetic bacteria from the sludge in the breeding pond and we realized it. After that, we carried out contrast study over various culture medium of propagated photosynthetic bacteria and several kinds of helpful bacteria, enabling the costs of photosynthetic bacteria preparation and EM bacteria preparation prepared by us to drop by dozens of times compared to those sold at the market. Promotion of healthy mariculture in the numerous individual culturists on a shoestring thus becomes possible and comes true. Because the large quantity and high costs (at the market price) of microbial preparation accumulatively consumed in the breeding pond, most of them cannot afford it.

Guiding the culturists receiving our priority support to take sludge from their breeding pond and extract photosynthetic bacteria using the culture medium we provided. When those green or red photosynthetic bacteria preparations are cultured ready by themselves, they all expressed: it is so magical that useful photosynthetic bacteria could be extracted from the stinking sludge; culturing should be made based on science. After that, we offered to them the formulated concentrate of compound bacteria preparation like photosynthetic bacteria and EM bacteria, and culture medium, asking them to further culture these microorganism preparation per formulation, and use in their own breeding ponds as per instructions.

By the end of April, we had four culturists receiving our priority support, of whom, a breeding pond of 2ha owned by Cui Xiaodong from Yantan Village in Muping District was involved into healthy culturing test; Sui Fubing and Yu Zhoushuai from Waidao Village in Haiyang City joined in the healthy culturing test with their breeding pond of 2ha respectively; Liu Fuyan of Zhangjiazhuang Village in Haiyang City pledged repeatedly to join in healthy culturing test with his breeding pond of nearly 2ha. We offered them guidance and support in different ways. In Muping District, Cui Xiaodong's breeding pond

only used photosynthetic bacteria to clean water and prevent diseases; when diseases were active in summer, his prawns and crabs were in good conditions, instead of catching diseases, ending up with a harvest autumn. In Haiyang City, we provided whole-process follow-up and guidance with our microbial remediation for Liu Fuyan's breeding pond, from cleaning pond in summer, filling water and prawn and crab seedlings up to harvest in autumn.

During the course of his culturing, case by case, we used photosynthetic bacteria preparation, and occasionally EM bacteria preparation and other compound bacteria preparation. When the pond experienced a higher pH value, we added in time EM bacteria preparation to lower it. When prawn diseases broke out in the neighboring breeding pond in summer, his pond unexpectedly survived only by adding double dose of compound microorganism preparation in the breeding pond. In addition, he also achieved success for his mature prawns in autumn. Although Yu Zhoushuai's double-cropping prawn pond where green macroalgae Enteromorpha prolifera break out, he got success with his prawns both in summer and autumn. The reason is to take accept and use photosynthetic bacteria, EM bacteria and compound bacteria preparation after Enteromorpha prolifera dredged up from his cultivating pond and fed on high protein forage. Based on the lesson that the crab seedlings with virus led to the complete loss of his crab seedlings (also causing death of his prawn seedlings) in his breeding pond in spring, Sui Fuqiu adopted healthy prawns and crab seedlings, and the instructed process, recovering certain losses in the end. Summarizing the culturing practice of these 4 culturists, we have realized that such four key factors are of utmost importance during the course of culturing: quality of seedlings, prevention and treatment of diseases, forage and environment of culturing water. Any missing of these factors shall result in unhealthy culturing.

We did not plan to include sea-cucumber culturists into those receiving our priority support. As the pollution to the inshore area in Jiangsu and Zhejiang in 2008 resulted in seawater eutrophication, which caused rampant outbreak of green macroalgae Enteromorpha prolifera in part of its inshore area, which later developed itself into expansion of large area, finally resulting in "green tide". It was spread to the inshore area cross Shandong Province between June and July, and it was much so especially for the mighty and catastrophic "green tide" in the offshore area of Qingdao. The inshore area in Rushan of Shandong suffered from this, causing mass mortality and disastrous loss to its sea-cucumbers. Rushan Minsheng Sea-Treasure Culturing Company (later as "Rushan Minsheng") invited us for help and we were involved. As we learned from Haiyangsuo Town suffering from this: this town has a total of about 400ha of sea-cucumber breeding-ponds along the coast, but 20% of the breeding pond lost 100% of their sea-cucumbers. Through in situ investigation and interview to the sea-cucumber culturing bases of Rushan Minsheng and Oriental Marine Group of this town, we concluded that this catastrophe occurred due to the misleading and misrepresentation of "Harm-free from Enteromorpha Prolifera" and "Enteromorpha prolifera can be used as forage for sea-cucumber", and the lack of prevention measures and improper handling when the "green tide" came with a real attack. 20ha sea-cucumber breeding pond of Minsheng Sea-cucumber Treasure Company is located in intertidal regime. It also suffered massive death of sea-cucumbers in the shallow water area close to the shore due to its neglect of preventive measures, and its loss meant no harvest at all for its breeding pond of 2ha. Loss for this alone came up to no more than RMB one million yuan. However, this oversight caused the death of its more than 30million seedlings out of the 40million seedlings in its sea-cucumber breeding farm. Calculated at 1 yuan per piece, its loss would end up with no more than RMB 30million yuan. To prevent the continuous death of the sea-cucumbers and their seedlings, Rushan Minsheng wished us to provide specific guidance and assistance. We then dispatched special personnel and transport to this company's breeding farm in Rushan City on July 19, collecting the bodies with various death symptom of the dead sea-cucumbers , sea-cucumbers still alive, seedlings of living sea-cucumber and water sampling for special inspection and analysis.

Conclusion of our analysis and studies

Massive death of sea-cucumbers in the breeding pond and seeding pond resulted from the disease-forming and its spread caused by the advantageous growth of harmful bacteria like vibrio. The prevailing pathogenic bacteria from the seeding pond originated from the seawater of offshore area where massive death of sea-cucumbers occurred. Though filtered with sand, its water quality was still not clean. The Enteromorpha prolifera deposited onto the inshore seafloor suffocated to death the microorganism and a small number of sea-cucumbers still in summer sleeping on the seafloor, which later led to vicious circle. This caused the spread of pathogenic bacteria. Its fault lied in the fact that it did not organize personnel in the night to continue its efforts to dredge up the Enteromorpha prolifera from sea in the daytime so that they deposited onto the floor during the night to end up with disaster. We fed back out results and conclusion to this company. Its manager told us that it's a pity that they did not invite us earlier. Our recommendation to them:

- continue using clean-water microorganism photosynthetic bacteria and compound bacteria preparation in the seeding pond of sea-cucumbers,
- prevent diseases and maintain micro-ecological balance for its water, and
- move the sea-cucumbers still alive and healthy in the shallow water of inshore to deep water area, and make thorough cleaning of the polluted floor of inshore shallow water area.

We were later informed of their adoption of our recommendations and sea-cucumbers never die again in their breeding ponds. Everything resumes as normal.

5.3. Capacity building

5.3.1. Discussing with local culturists

Contents of discussion: Discussing from the culture dimensions, variety, and density; water inlet and outlet of breeding ponds, economic efficiency ratio between investment and output, and influence of the climate and environmental pollution on the mariculture, to the four key technological loops including seedling quality of bred living beings, disease control, forage and cultivation water environment. In order to enhance the local culturists' environmental protection consciousness and their capacity in participating in environmental protection initiatively, the content of education on them were extracted from these discussions. Through the discussion, we discovered that they merely knew about the influence of land-sourced pollutants on cultivation environment, but knew nothing about their "self-pollution" caused by drainage of cultivation. We took development of the culturists' capacity as the breakthrough point.

5.3.2. Symposium on offshore area pollution and seawater cultivation

Our task force team delivered a thematic speech at the symposium first, and then discussed the relationship between self pollution of cultivation and the culturists' interests, and the culturists' responsibilities emphatically.

Main contents of thematic speech: A. conditions of offshore area pollution. B. Sources of offshore area pollutants: b1. land-sourced pollution; b2. marine pollution; b3. seawater cultivation pollution. C. Influence of sea area pollution on seawater cultivation: c1. detriment of red tide; c2. worsening of water quality, living beings unable to survive; c3. causing contamination of living beings cultured, which in turn brought influence on

cultivation benefit and human's health. D. Relationship between self pollution of seawater cultivation and the culturists.

5.3.3. Information exchange

Information exchange is realized through explaining, teaching, on-the-spot guidance, family visit, and discussion. Centering at healthy cultivation practice, we helped the culturists especially those key culturists overcome their difficulties.

5.3.4. Convening special workshop on the following themes with the natives and the experts

Theme 1 Healthy cultivation.
Theme 2 Microbial remediation and its application in healthy cultivation of aquatic products.
Theme 3 Detailed instructions for seawater cultivation.
Theme 4 Healthy cultivation of Marsupenaeus japonicus and swimming crab.

6. Produced outputs and outcomes

6.1. Produced outputs

- Culturists having received the education realized the importance of rational arrangement of cultivation and effective control over the dimensions.
- Numerous culturists realized that the degree of self pollution of seawater cultivation is closely bound up with the revenue and economic efficiency of the culturists.
- Our guidance on healthy cultivation to the key culturists attracted many culturists, who also attempted to imitate.
- We edited two booklets for publicity and teaching: "Environmental Pollution and Healthy Cultivation" and "Healthy Cultivation of Shrimps and Crabs". We copied and distributed 100 copies each.
- We purchased 40 densimeters, 40 thermometers and 40 boxes of pH test paper, 40 copies of cross reference list for the relationship among specific density, temperature and salinity to the culturists participating in the activity actively and warmly.
- 38 photos taken on the site of the activity.
- On the basis of culture medium formulated by us, we cultivated 30 barrels of compound bacteria, 30 barrels of photosynthetic bacteria preparation, and 15 barrels of EM bacteria preparation, 5000ml each barrel, and provided to 4 key culturists who were receiving our help.

6.2. Produced outcomes

Through propagandizing for and disclosing the truth of self pollution of seawater cultivation, make the culturists having received the education understand why the disease caught by the cultivated living beings in the breeding ponds of several culturists in a bay would harm the surrounding and even all the breeding ponds in the bay very quickly.

What struck the key culturists who are receiving our help most through promotion of microbial remediation and guidance on healthy cultivation practice is the realization of cultivation pattern of improving water quality before breeding, improving soil quality before improving water quality, controlling the harmful bacteria with helpful bacteria, and giving priority in prevention from diseases on the basis of microbial remediation and healthy

cultivation. In such a way, we have made some culturists soberly realize the supreme importance of the health of seedling quality of the bred living beings.

The statement that can exactly express the thinking of various culturists having received education: “It’s the duty of every culturist to try to reduce or eliminate self pollution of seawater cultivation, for it will benefit both the country and the people.” It shows the great improvement of their environmental protection consciousness and their enthusiasm and determination on participating regional management team of environmental protection in Yantai offshore area.

The influence of practical propaganda education that we have carried out has been expanded from the adjacent villages in Haiyang and Muping to Rushan.

7. Evaluation: Effectiveness of implemented activities

Mariculture pattern applied currently is a non-rational pattern trying to pursue the maximum economic output, which is also main reason of the worsening of cultivation water environment. Guiding the mariculturists from the applied old cultivation pattern to the healthy cultivation pattern indicates that they are participating in the development of marine environmental management ability. This effectiveness of the activities executed by this program is embodied in the following:

- Adopting microbial remediation in order to promote healthy cultivation. Because it is a new ecotechnology with low investment, high efficiency, easy application, and great development potential. In fact, its affinity with the mariculturists participating in this program is the clear proof.
- Providing culture medium prepared by us, formulated concentrate of photosynthetic bacteria and EM bacteria preparation to the culturists for propagation of the preparation demanded and elimination of the barrier for carrying out the activity.
- Adopting proper and effective education mode for building of the culturists’ capacity.

8. Conclusions and recommendation for future work

8.1. Conclusions

The culturists’ activeness in protecting the marine environment is enhanced through analyzing water quality and sediments and explaining the harm of self pollution of cultivation and the preventive methods.

We eliminated the barrier for promoting healthy cultivation by providing culture medium prepared by us, formulated concentrate of photosynthetic bacteria and EM bacteria preparation to the culturists for propagation of the preparation demanded.

The adoption of microbial remediation and the promotion of healthy cultivation produced intense affinity with the culturists participating in the activity. The culturists said that they would continue doing so later.

The culturists participating in the activity experienced and realized that problem would arise in the process of cultivation if there is any deficiency in any of the four key loops (seedling quality, disease prevention, forage and cultivation water environment).

Simultaneous implementation of theoretical education and practical education adopted for the building of culturists’ capacity is appropriate and effective.

We have achieved the anticipated objectives of this program. The influence of the educational activities has been expanded from several villages in Haiyang and Muping to those in Rushan.

8.2. Recommendations for future work

We know from our own experience in the implementation of this program that it is necessary and important to set up this kind of small grants program. We suggest continuing to set up this kind of program in the future, and supporting those practical programs developing the theory and the practice simultaneously.

9. Contact information

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