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Special Issue

eas Congress 2009

Partnerships At Work: Local Implementation And Good Practices

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Good Practices in Water Management and Climate Change

- Saving the Global Commons, Charting Our Future
- Steering the Course towards Safer Shipping and Cleaner Seas
- The Nexus of Water, Energy, Food and Environment: Creating a Ripple Effect
- Weaving through the Pollution Conundrum: Getting it Right

The quest for blue gold

Three centuries ago, Samuel Taylor Coleridge published *The Rime of the Ancient Mariner* (1798). The line, "Water, water, everywhere, nor any drop to drink" from the poem captures the predicament that the world finds itself, particularly with respect to issues such as water supply and management, water pollution and the impacts of climate change/variation such as flooding and droughts.

The most indispensable commodity for human survival — water — is rapidly being recognized as a scarce resource around the world. For example, in the Asia and Pacific region where more than 60 percent of the world's population live, only about 36 percent of the world's water resource is available (Asia Society's Leadership Group on Water Security, 2009). Limited access to water is predicted to be a source of increasing tensions in different regions, providing various environmental and socioeconomic challenges to the respective governments at the national and local levels. The implications of water shortages or limited access to available water have earned water the ominous label of "blue gold".

This issue of *Tropical Coasts* expounds on the challenges and good practices in water supply and management. It features the discussions held during the International Conference on Sustainable Coastal and Ocean Development that were held during the East Asian Seas Congress in Manila, Philippines, on 23-27 November 2009. The third triennial EAS Congress, hosted by the Government of the Philippines and co-organized by the Philippines Department of Environment and Natural Resources, attracted 1,480 participants, 100 exhibitors, 51 co-conveners and supporting organizations, and 12 sponsors.

Good practices covering three water-related issues were explored during the course of the International Conference, namely: (a) prevention of marine pollution from sea-based activities; (b) water use and management for food supply, energy production and ecosystem services; and (c) innovative approaches and practices in freshwater/marine water management, including pollution reduction.

The article entitled, **Steering the Course towards Safer Shipping and Cleaner Seas** (page 4), highlights international efforts in oil spill preparedness and response, marine biosafety and environment-friendly port development and management. Sources and causes of hazards associated with maritime activities, as well as case studies and best practices that can be replicated and scaled up, are detailed. While a combination of efforts by international organizations, governments, the private sector, scientific community and other stakeholders are gaining ground, countries are being encouraged to ratify relevant international conventions, including MARPOL, OPRC, CLC, IOPC Funds, the Ballast Water Convention, Anti-Fouling System Convention, etc., and to adopt corresponding national laws and regulations that will allow for their implementation. NOWPAP and PEMSEA are identified as working examples of regional mechanisms that can be replicated in other regions where advocacy, technical cooperation and promotion of regional oil spill preparedness, response and cooperation need to be enhanced.

Insights into climate change impacts and responses, as well as disaster management systems at the international, national and local levels, are featured in **Saving the Global Commons, Charting Our Future** (page 25). The effects of climate change are discussed as they relate to sustainable development in Monsoon Asia, fisheries production, and shipping. The article further examines available options to address climate change in the East Asian context, through: mitigation measures to further reduce emissions and rehabilitate ecosystems; adaptation measures, including scaling up the application of integrated coastal management (ICM) as a process for systematically reducing risk and increasing resiliency in the face of related hazardous events; and geoengineering or climate engineering measures aimed at reversing negative environmental trends associated with global warming. In sum, the article concludes that longer-term mitigation efforts and adaptation responses to climate variability need to be coupled with shorter-term disaster risk reduction responses to extreme events in order to ensure a comprehensive risk management approach, as well as to guarantee food and water security, biodiversity and ecosystem integrity, and community resiliency.

The Nexus of Water, Energy, Food and Environment: Creating a Ripple Effect (page 46) delves into the issue of improvements in water resource management. The article emphasizes the point that current management practices tend to be fragmented, compartmentalizing each activity and water use. Water for drinking, irrigation, energy, industrial use, sanitation, waste management, navigation, and protecting ecosystems have been treated separately, with distinct management, political and economic structures. Case studies on integrated coastal and river basin management (ICARM) are presented to highlight experiences and good practices in different regions of the world. In addition, the article describes the state of innovative strategies and technologies that are being demonstrated to harness the ocean energy and alternative water-based energy systems for small-scale applications, as part of sustainable development policies and programs in various countries.

Weaving through the Pollution Conundrum: Getting it Right (page 78), focuses on best practices from the Northwest Pacific, East Asia, Europe and North America. Lessons learned in the Danube River, Amur and Tumen Rivers, Selangor and Klang River systems, Chesapeake Bay, Singapore River and Pasig River provide invaluable case studies of pollution management through strategic partnerships, including the applications of strategic integrated planning, regulatory/policy/institutional framework, innovative approaches and technologies, and financing mechanisms for water supply, sanitation and pollution reduction. In addition, the importance of public-private partnerships in addressing pollution and other issues is emphasized. The situation of Manila Bay is presented, where the business sector has confirmed its commitments, set specific targets, and taken an active role in initiating programs to support the rehabilitation of the Bay and surrounding watershed areas.

From the discussions, conclusions and recommendations among the various workshops during the EAS Congress 2009, a general agreement was that water supply and management issues transcend administrative boundaries, necessitating the need for an integrated river basin and coastal area management approach, founded on concerted action involving various stakeholders, from government leaders at the national and local levels, to the business sector, to industry, and to local communities. Water supply and management is no longer considered to be a sectoral concern, but an essential component of sustainable development.

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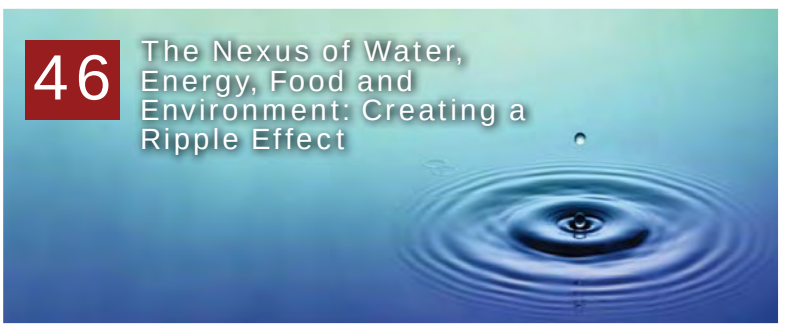

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Raphael P.M. Lotilla
Executive Editor

S. Adrian Ross
Editor

Anna Rita Cano
Assistant Editor

Jonel Dulay
Ray Nonnato Leyesa
Design/Illustration/DTP

Rosemarie B. Razon
Cover photo

Vanessa Bautista
John Eric Dylan Saet
Research

Contributors
Carlos L. Agustin
Danilo Bonga
Patricia Charlebois
Choi Sang-Ki
Edward Clarence-Smith
Maria Corazon Ebarvia
Diane Factuar
Fredrik Haag
Shigeko Haruyama
Anatoly Kachur
Ki Dai Kim
Bjorn Kjerfve
Chul-Hwan Koh
Gunnar Kullenberg
Magda Lovei
Jose Matheickal
Hector E. Miole
Cristine Ingrid Narcise
David Nemazie
Daisy Padayao
Rainier Requinala
Alex S. W. Retraubun
S. Adrian Ross
Raul C. Sabularse
Richard Sykes
Vicente Tuddao
Won-Tae Shin
Alexander Tkalin
Cherdsak Virapat
Kazumi Wakita
Rudolf Wu
Zhou Qiulin

Editorial by
Anna Rita Cano.

The next issue will cover the Thematic Workshops on Ocean and Coastal Governance; Habitat Protection, Restoration and Management; and Food Security and Livelihood Management.

The Partnerships in Environmental Management for the Seas of East Asia (PEMSEA), Global Environment Facility (GEF), United Nations Development Programme (UNDP), United Nations Office for Project Services (UNOPS) publish Tropical Coasts Magazine biannually. This issue of Tropical Coasts is co-financed by the United Nations Environment Programme - Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (UNEP/GPA) and the Swedish International Environmental Secretariat for Asia (SENSA). The publication is geared towards stimulating an exchange of information and sharing of experiences and ideas with respect to environmental protection and the management of coastal and marine areas. Readers are strongly encouraged to send their contributions to:

Executive Editor
P.O. Box 2502,
Quezon City 1165,
Metro Manila, Philippines

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www.pemsea.org

By Ms. Patricia Charlebois, Head, Pollution Response Section, Sub-division for Pollution Response and TC Coordination, Marine Environment Division, International Maritime Organization (IMO);
Mr. Richard Sykes, Executive Secretary, International Petroleum Industry Environmental Conservation Association;
Dr. Jose Matheickal, Chief Technical Adviser, Globallast Partnership Programme, IMO;
Mr. Fredrik Haag, Technical Adviser, Globallast Partnerships, IMO;
Commo. Carlos L. Agustin, President, National Defense College of the Philippines and Maritime League – Philippines;
Mr. Hector E. Miole, Port District Manager - Southern Luzon, Philippine Ports Authority
Dr. Shigeko Haruyama, International Geographical Union (IGU);
Dr. Cherdsak Virapat, Executive Director, International Ocean Institute (IOI);
Ms. Diane Factuar, Training Specialist, PEMSEA;
Ms. Kazumi Wakita, Programme Officer - Partnership Programs, PEMSEA; and
Ms. Maria Corazon Ebarvia, Consultant, PEMSEA

STEERING THE COURSE TOWARDS SAFER SHIPPING AND CLEANER SEAS

Ships that pass in the night, and speak each other in passing, only a signal shown, and a distant voice in the darkness; So on the ocean of life, we pass and speak one another, only a look and a voice, then darkness again and a silence.

- Henry Wadsworth Longfellow

Sending out an S.O.S.

Eutrophication and dead zones, marine debris and oil spills, toxic and radioactive wastes, invasive species and anti-biofouling, degraded habitats and extinction of endangered marine species, increasing temperatures and acidity... the list goes on. Some of these issues have been around for awhile, others are now just emerging. But the implications of these hazards and their associated risks to sustainable development of the region's seas and coasts are becoming more apparent.

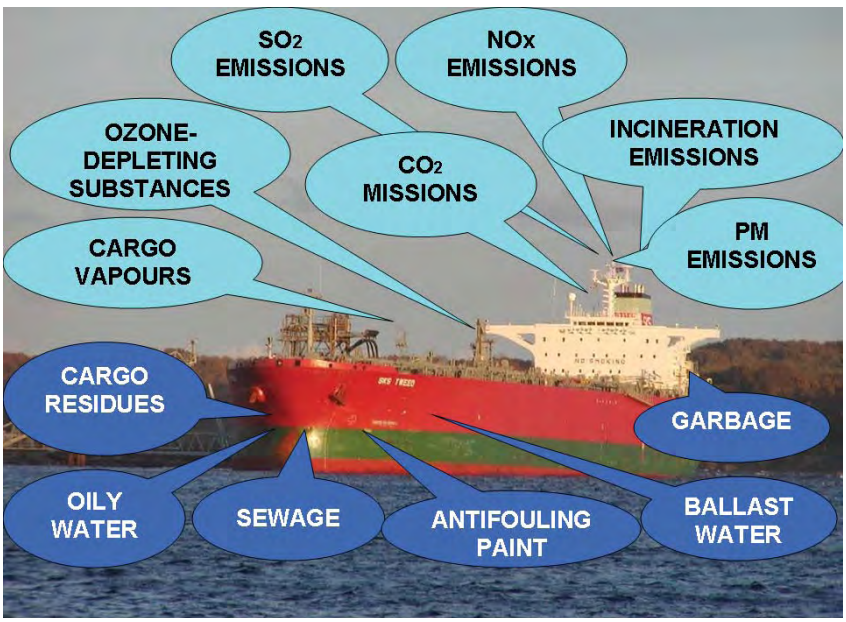
While the majority of pollutant loadings to the marine environment are land based, ships also pollute waterways and oceans in many ways (**Figure 1**). For example, oil spills – from either operational or accidental causes – can have devastating effects. Offshore oil production can produce oil pollution — from spills, accidents and operational discharges. The recent catastrophe in the Gulf of Mexico gives ample evidence of the devastation that can occur as a consequence of sea-based accidents.

The East Asian Seas Congress 2009 tackled these and other issues during the series of workshops and seminars of the International Conference on Sustainable Coastal and Ocean Development. The presentations and ensuing discussions resulted in various recommendations, aimed at further strengthening global, regional, national and local actions towards safer shipping and cleaner seas.

Oil and water don't mix!

When it comes to mixing oil and water, oceans suffer from far more than an occasional devastating oil spill. Disasters make headlines, but hundreds of millions of liters of oil quietly end up in the seas every year, mostly from non-accidental and operational sources, both land-based and sea-based. Operationally, every year, bilge cleaning and other ship and port operations result in the release of millions of liters of oil into coastal waters. While only a small percentage of oil pollution in oceans is due to major tanker accidents, one large spill can disrupt sea and shore life for hundreds of kilometers, affecting livelihoods, human health

Figure 1: Types of Ship Wastes.



Source: Uwe Breitling. Sustainable Port Development in the ASEAN Region.

Table 1. Costs of Oil Spills.

Incident	Year	Oil Spilt (tons)	Total Cost (US$)	Cost US$/ tonne
Hebei Spirit (Korea)	2007	112,000	650,000,000(?)	55,000
Prestige (Spain)	2002	63,000	1,443,000,000	22,904
Erika (France)	1999	19,800	247,500,000	12,500
Sea Empress (UK)	1996	73,000	55,200,000	756
Braer (UK)	1993	84,000	78,000,000	928
Exxon Valdez (USA)	1989	37,000	1,950,000,000	52,702
Amoco Cadiz (France)	1978	223,000	225,000,000	1,009

Source: ITOPF

and ecosystems. However, major oil spills from ships and oil tankers create images of oiled birds and marine mammals, damaged mangroves and beaches, affected fisherfolk — and huge environmental and economic impacts.

Table 1 shows some of the large oil spill incidents and the corresponding cost of damages. Aside from being toxic to marine life, polycyclic aromatic hydrocarbons (PAHs) found in crude oil are very difficult to clean up, and can last for many years in the sediment and marine environment. Mangroves, seagrass beds and coral reefs are sensitive to oil. In addition, the thick oil sticks to the bodies of marine mammals, sea turtles and birds, incapacitating and eventually killing them.

Treaties treat pollution problems

The International Convention for the Prevention of Pollution from Ships (MARPOL) is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. It is a combination of two treaties adopted in 1973 and 1978, respectively, and updated by amendments through the years. The MARPOL Convention was adopted on 2 November 1973 at the International Maritime Organization (IMO) and covered pollution by oil, chemicals, harmful substances in packaged form, sewage and garbage. The Protocol of 1978 relating to the 1973 International Convention for the Prevention of Pollution from Ships (1978 MARPOL Protocol) was adopted at a Conference on Tanker Safety and Pollution Prevention in February 1978 held in response to a spate of tanker accidents in 1976-1977.

The operational and construction regulations introduced by MARPOL, which entered into force in 1983, have been a success, with statistics from reputable industry and independent bodies showing that these regulations, along with other safety-related regulations, such as the introduction of mandatory traffic separation schemes and international standards for seafarer training, have been instrumental in the continuous decline of accidental oil pollution that has taken place over the last 30 years (IMO, 2009).

In spite of best efforts, and the technical, operational and preventive measures set in place, some spills continue to occur. When this happens, it is necessary to ensure that effective and coordinated response mechanisms are in place and an adequate liability and compensation regime is available to compensate those affected. Effective and efficient spill response starts with preparation, long before any incident. IMO's International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC Convention) was adopted in 1990 to minimize the environmental and economic consequences of major oil pollution incidents. Bilateral and multilateral cooperation and promotion of regional arrangements to prepare for and combat oil pollution incidents were emphasized in the articles of the Convention.

In 2000, the Protocol on Preparedness, Response and Co-operation to

Pollution Incidents by Hazardous and Noxious Substances (OPRC-HNS Protocol 2000) was adopted in recognition of the increasing threat of pollution incidents involving chemicals, and it entered into force on 14 June 2007. Twenty-five countries have ratified the HNS Protocol 2000.

Parties to the OPRC Convention are required to establish a national system for responding to incidents of oil and HNS pollution. The national system should include: (a) a national contingency plan; (b) designated national authorities; and (c) an identified national operation focal point (or focal points). Contracting parties are also mandated to enhance pollution preparedness and response capacity, either individually or through bilateral/multilateral cooperation, through: (a) setting up of pre-positioned equipment; (b) implementation of a program of exercises and training of personnel; (c) development and implementation of plans and communication capabilities; and (d) establishment of a mechanism for coordinating the response. Rules and provisions for international assistance are also dealt with, emphasizing agreements among countries to provide international assistance to other State parties, and; responsibility of requesting Parties to facilitate the receipt of such assistance in-country and to reimburse the costs incurred by the assisting Party.

Advancing Cooperation between Industry and Government

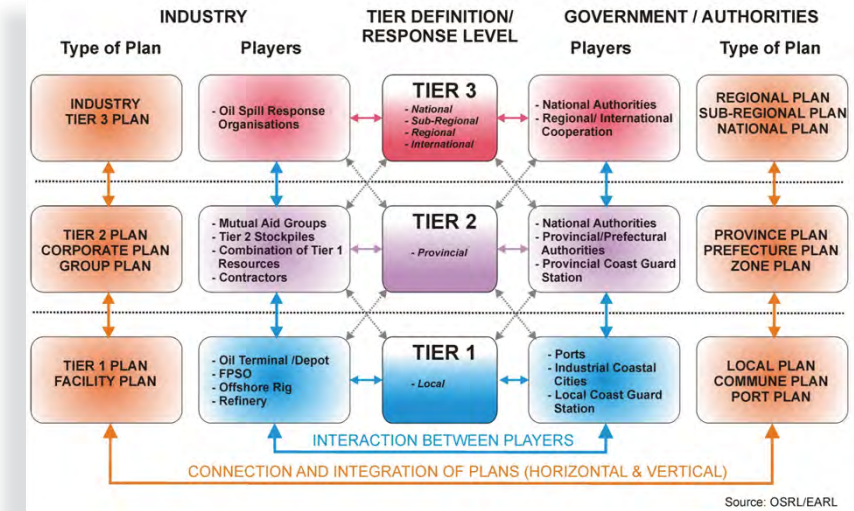
The 'working together' approach has been the basic principle in promoting cooperation involving government, industry and other stakeholders, thus increasing capacities for oil spill preparedness and response. The OPRC Convention 1990 provided the effective framework for the significant advances in oil spill preparedness and response around the world and remains to be an important instrument for strengthening government and industry partnerships. Major oil spill incidents provide evidence that response resources are more effectively used and deployed when these are operationally integrated.

The Global Initiative (GI) is one example of a joint programme between industry and government at the global level. In 1996, the Global Initiative — a joint programme between the International Petroleum Industry Environmental Conservation Association (IPIECA) and the International Maritime Organization (IMO) — was formally launched in South Africa. The Global Initiative was organized on a regional basis with focal points established for West and Central Africa, the Mediterranean, Caspian and Black Sea, and the Caribbean. The programme aims to improve and sustain the capacity of developing countries to protect their marine and coastal resources at risk from an oil spill incident. Specifically, it encourages and facilitates the development and implementation of oil pollution response capacity and support activities to assist countries in ratifying and implementing the provisions of related international conventions. A number of brochures/profiles have been produced over the years to provide an introduction to the IMO/IPIECA Global Initiative partnership and the various regional GI groups that promote its aims.

The IPIECA Oil Spill Working Group (OSWG), established in 1987, serves as a key international oil industry forum, which aims to improve the state of oil spill contingency planning and response around the world. IPIECA operates globally and seeks to achieve its vision through the following strategies: (a) developing, sharing and promoting sound practices and solutions; (b) enhancing knowledge management and information exchange; (c) engaging members and others in the industry and working in partnership with key stakeholders; (d) supporting joint industry-government cooperation at all levels; (e) encouraging ratification of relevant international conventions; and (f) promoting the principle of 'Net Environmental Benefit Analysis' and the tiered response concept when

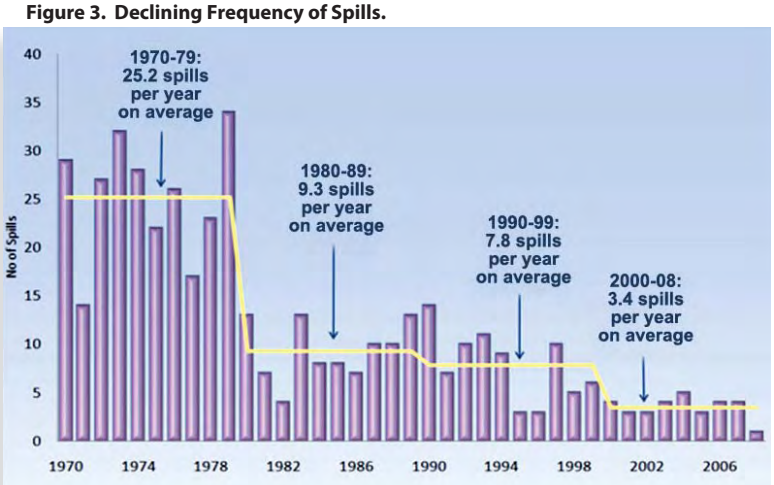
Oil tanker Hebei Spirit *Photo: Whittington/ITOPF*

Figure 2. Response Integration.



The figure above presents response integration based on a tiered preparedness and response concept. It shows the entry points for industry and government integration and highlights the need for consistency of plans, both horizontally (industry and government) and vertically (regional and local level).

Figure 3. Declining Frequency of Spills.



Source: IOPCF, 2008

designing response strategies (IPIECA, 2009). One of the popular works of IPIECA is the publication of technical reports — the IPIECA Oil Spill Report Series, which provides a practical and accessible overview of issues relevant to the preparation for and response to oil spills at sea.

At the regional level, Oil Spill Response Limited, an oil industry tier 3 response organization with a global scope, operates a regional base in Singapore for the Asia-Pacific region, and has been an active partner of government entities in the region.

For the past eight years, Oil Spill Response has implemented a pro-active advocacy program, assisting relevant government agencies in building oil spill response capacities. Oil Spill Response operates on a tiered preparedness and response concept, which is considered as the most efficient and effective way to sustainably meet operational challenges for oil spill response (**Figure 2**). Oil Spill Response is part of the Global Response Network, a collaboration of seven major oil industry-funded spill response organizations whose mission is to harness cooperation and maximize the effectiveness of oil spill response services worldwide.

Based on studies (IMO, 2009), it was evident that the frequency of major spills has declined due to prevention efforts by government and industry (**Figure 3**). However, the costs of oil spills have increased — not only in terms of the response and cleanup costs, but also in terms of the economic losses and damages to ecosystems, which are already vulnerable due to other human activities and climate change (**Table 1**).

Reinforcing Regional/ Sub-regional Arrangements in Oil Spill Preparedness and Response

Underscoring the need for cooperation, the OPRC Convention and OPRC-HNS Protocol specifically call for State parties to endeavour to adopt bilateral or multilateral agreements for oil pollution preparedness and response. The establishment of regional oil spill centers was cited as an effective tool for strengthening and backstopping national and regional capabilities. Such centers also facilitate cooperation and mutual assistance, promote information exchange, and serve as coordinating centers for the mobilization of regional and international resources and for regional capacity-building activities.

The Marine Environmental Emergency Preparedness and Response Regional Activity Centre (MERRAC) is one of four Regional Activities Centers of the Northwest Pacific Action Plan (NOWPAP). MERRAC was established in 2000 for the development of effective measures for regional cooperation in marine pollution prevention and response in the NOWPAP Region. MERRAC was originally designated to deal with oil spill preparedness and response. However, the scope of MERRAC activities was expanded

in 2005 to include HNS spills, marine litter, ballast water, MARPOL, and Compensation and Liability (CLC, Fund, Bunker and HNS conventions).

The NOWPAP Regional Oil Spill Contingency Plan was adopted in 2003, providing technical and operational guidelines for regional cooperation in case of an oil spill incident in the NOWPAP Region. The Plan provides a framework under which NOWPAP Members (China, Japan, RO Korea and Russia) can cooperate at the operational level in responding to oil spill incidents. It is also referred to as an operational mechanism for mutual assistance. HNS has been recently added to the existing Plan and a corresponding Resolution (guidelines) was adopted in 2008. With this arrangement, the four member states are in a better state of preparedness to respond to oil and HNS spills, as each of them may request assistance from other NOWPAP members in cases of major oil and HNS spill incidents.

Some of the major oil spill incidents in the NOWPAP region were the Sea Prince incident in 1995, the Nakhodka incident in 1997 and the Hebei Spirit incident in 2007. These incidents resulted in damages to the marine environment and huge economic losses, necessitating the need to strengthen regional cooperation.

The Regional Oil Spill Contingency Plan was tested during the Hebei Spirit incident, and the importance of regional cooperation was thereby recognized. Lessons from this incident highlighted the necessity of regularly conducting communication and table-top exercises and organizing joint operational exercises with neighboring countries at least every two years. The importance of improving the regional contingency plan and making it a living document was also stressed, particularly on the need to share information on equipment that can be used for external assistance, national performance standards on the application of non-mechanical methods for managing oil spills and information relating to compensation and liability. MERRAC also recognized the need to further enhance its capability for marine pollution prevention, preparedness and response.

Another sub-regional agreement, the Joint Statement on Partnerships in Oil Spill Preparedness and Response in the Gulf of Thailand (GOT), which was signed by the countries of Cambodia, Thailand and Vietnam in January 2006, provided an example of intergovernmental cooperation that is not covered by a regional convention. The joint statement and framework programme provides a common cooperative platform for enhancing capacities and implementing an effective response system for oil spills in the respective countries. It also promotes mutual assistance and international cooperation in oil spill-related programmes and activities, particularly in training, research and exchange of information, among others. The GOT cooperation resulted in increased oil spill preparedness and response capability of the participating countries and a better understanding of the system of response in each country. Some of the lessons learned from the sub-regional cooperation are: (a) integration of government and non-government stakeholders into the overall system of preparedness and response is imperative; (b) the need to recognize the role of local governments in increasing the level of national preparedness and response; (c) the need to strengthen interconnectivity of oil spill preparedness and response from regional, national to provincial levels; and (d) partnership with the industry increases oil spill response capability within the region.

Enhancing National and Local Capacities in Oil Spill Contingency Planning

Petroleum exploration and production activities are increasing in the region. Vietnam, in particular, ranks third in terms of crude oil production after Indonesia and Malaysia in Southeast Asia. The estimated oil production in Vietnam in 2009 was 23.8 million tonnes. This has made the country vulnerable to oil spill incidents. In view of this, a national plan to cope with oil spill incidents was approved by the Prime Minister in 2001. Specifically, the plan established three regional centers in the country for Oil Spill Response (Northern, Central, Southern), and classified oil spill response into three levels: Grassroots or local level, regional level and national level. Vietnam implemented a comprehensive capacity development

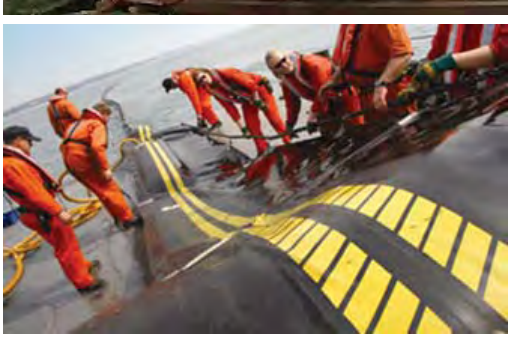


Photo: Oil Spill Response

Photos: Whittington/ITOPF

Part of the response for the shoreline contamination from the Hebei Spirit oil spill incident included rock and pebble wiping.

program for oil spill preparedness and response, including: (a) setting up a comprehensive legal framework; (b) building oil spill response teams; (c) investment in vessels, oil spill response bases and equipment; and (d) setting up a mechanism for oil spill compensation. In addition, Vietnam has initiated the development of oil spill contingency plans in the coastal provinces of southern Vietnam.

In PR China in 2008, there were about 134 cases of marine disasters due to storms, ocean waves, sea ice, red tide and other causes, and these disasters resulted in direct economic losses of about 20.6 billion Yuan and led to 152 deaths (Li). To establish and improve their marine disaster warning system and emergency management, the Chinese government emphasized the importance of: (a) setting up the strategic concept of natural disaster reduction through science and technology; (b) reinforcing marine disasters monitoring; (c) strengthening marine hazard forecasting and warning; (d) strengthening the studies on science and technology; (e) enhancing investigation, evaluation and analysis of marine disasters; and (f) developing disaster-reduction technologies and equipment.

When Disaster Strikes: Oil Spill Response

In December 2007, the fully laden tanker Hebei Spirit was involved in a collision off the coast of Taean, Republic of Korea. The incident resulted in the largest oil spill in Korean history, during which approximately 10,800 tonnes of crude oil contaminated significant proportions of the country's western coastline and caused wide-scale economic losses, particularly affecting the fisheries and aquaculture industry. The oil spill response was undertaken on a huge scale and involved cleanup contractors, local people, the Korean military and thousands of volunteers.

The Hebei Spirit incident challenged both the national system for oil spill preparedness and response in RO Korea and the effectiveness of the NOWPAP Regional Oil Spill Contingency Plan. Some of the issues identified during the incident included the following: (a) failure of initial emergency actions; (b) lack of policies and guidelines for the selection of response technologies; (c) command and control was not unified; (d) lack of a plan for the management of huge numbers of volunteers; (e) lack of understanding of the international compensation and liability regime; and (f) poor mass media relations.

To address the problems faced during the incident, the Korean government carried out a series of comprehensive post-spill follow-up measures, including the revision of the national response function and capability, through the establishment of three national strike teams under the Korean Coast Guard, an overhaul of oil spill training programs and the construction of a specialized oil spill training facility amounting to US$ 15 million for practical training, in conformance to the requirements of the OPRC Convention and OPRC-HNS Protocol. In addition, a restoration program for affected areas, based on outcomes of post-oil spill research (i.e., oil pollution; ecology monitoring; and ecology restoration), is being implemented, which covers the shorelines and island areas of 12 cities in 2 provinces, covering a total area of 6,473 km^2.

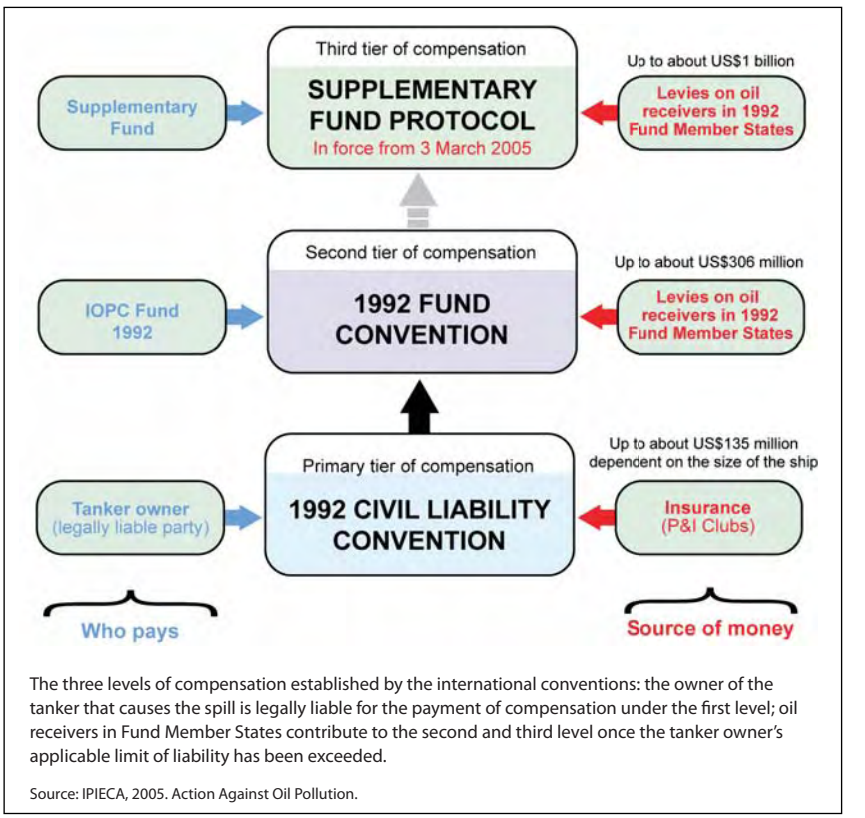
In the Philippines, the oil tanker M/T Solar I, carrying more than two million liters of bunker fuel, sank on 11 August 2006 in the Guimaras Strait, off the coast of the Guimaras and Negros Occidental provinces. The sinking resulted in some 500,000

L of oil discharging into the strait, affecting mangroves, beaches and the fishing industry. The Solar 1 incident presented various concerns relating to the Philippine government's system for oil spill preparedness and response, specifically those relating to organizational arrangements, appropriateness of the National Oil Spill Contingency Plan (NOSCP), preparedness of local governments to handle oil spill incidents, and the response capability of the Philippine Coast Guard (PCG).

Post-spill measures were carried out by the PCG, using their experience with the SOLAR 1 incident, involving: (a) revision of the NOSCP; (b) establishment of additional oil spill response centers; (c) empowerment of local governments; (d) upgrading of oil spill response capability of the PCG; and (e) formulation/revision of pertinent pollution prevention regulations.

On the part of the scientific community, an experimental research on the development of inorganic coagulant for the removal of oil from the surface of rocks, wood and sand was conducted in Guimaras, following the Solar 1 oil spill incident. The experiment examined the removal effects of inorganic coagulant on attached oil and the effects of bio-stimulation method in combination with the coagulant. The cleanup effects of biostimulation on heavy oil after solidification showed that Total Petroleum Hydrocarbons (TPH) were decomposed up to 80 percent during the first three weeks, demonstrating that solidified heavy oil decomposes as much as ordinary heavy oil. Solidification reduces the initial TPH level by more than half. Therefore, the TPH level in solidified heavy oil goes below 1,000 mg/kg a week earlier than in unsolidified heavy oil, thereby shortening the cleanup periods and lowering the cost. The coagulant

Figure 4: Three Tiers of Compensation.



The three levels of compensation established by the international conventions: the owner of the tanker that causes the spill is legally liable for the payment of compensation under the first level; oil receivers in Fund Member States contribute to the second and third level once the tanker owner's applicable limit of liability has been exceeded.

Source: IPIECA, 2005. Action Against Oil Pollution.

was effective in removing spilled oil, although the coagulant is not yet available commercially (Hotta).

Payback time: Compensation and claims recovery

The oil and shipping companies believe that those who have to conduct clean up operations or suffer damage as a result of an oil spill need to be assured that they will receive prompt and adequate compensation. There is a complex interlocking scheme of liability insurance (obtained by ship owners through mutual insurers called Protection and Indemnity Clubs) and levies (financed by oil companies) administered through various national and intergovernmental regimes and administrations. Insurance by ship owners against oil pollution is compulsory (IPIECA, 2005).

Over the years, the IMO has put in place a comprehensive set of regulations covering liability and compensation for damage caused by oil transported by ship, through which the shipping industry (in conjunction with oil importers) provides automatic cover of up to US$ 1 billion for any single incident, regardless of fault. There are two international conventions, which made compensation available to those who incurred clean up costs or suffered pollution damage as a result of a spill of persistent oil from a tanker. These are the 1969 Civil Liability Convention and the 1971 Fund Convention, which are funded by the shipping and oil industries, respectively. Following the Prestige incident, a Protocol was adopted at the IMO creating the International Oil Pollution Compensation Supplementary Fund or 'Supplementary Fund' in May 2003. As with the 1992 Fund, the Supplementary Fund is financed by the oil industry. **Figure 4** shows the three levels of compensation established by the international conventions. **Table 2** shows the types of claims filed, the claims that were processed and the amount of settlement in the cases of Solar 1 and Hebei Spirit, under the

international regime for compensation for oil pollution damage.

Rowing towards safety: Places of refuge

In November 2003, the International Maritime Organization (IMO) Assembly adopted two resolutions (guidelines) addressing the issue of places of refuge for ships in distress – an important step in assisting those involved in incidents that may lead to the need for a place of refuge to make the right decisions at the right time. The guidelines recognize that, when a ship has suffered an incident, the best way of preventing damage or pollution from its progressive deterioration is to transfer its cargo and bunkers, and to repair the ship. Such an operation is best carried out in a place of refuge. However, to bring such a ship into a place of refuge near a coast may endanger the coastal State, both economically and from the environmental point of view, and local authorities and populations may strongly object to the operation.

In order to make a decision-making process as efficient as possible, a GIS-based decision support system (DSS) has been developed. In Croatia, such DSS contains all relevant data necessary for environmentally- and socially-sound risk assessment. Multi-criteria analysis, with GIS-generated input data, would be used to establish worthiness of a place of refuge for each ship, taking into account the type of accidents. Matrices of available intervention resources would be made, as well as analysis of their availability with respect to response time as well as quantitative and qualitative sufficiency. Integrated GIS support, with data about both coastal and sea characteristics (including 3D model of the coast and 3D bathymetry), enables pre-identification of places of refuge that greatly enhances the saving of lives at sea and pollution prevention. Croatia is the first country to have an integrated system (Nenad).

Table 2. Claims Recovery for Solar 1 and Hebei Spirit Oil Spill Incidents.

Solar 1 (Philippines) – as of October 2009	Hebei Spirit (RO Korea)
• **Mariculture damage claims** o 770 mariculture claims (seaweed farms/ fishpond operators) assessed at total of PHP 3.6 million (£45 728) o 200 paid a total of PHP 3.3 million (£41 907) o 462 claims rejected o 10 offers by Club/Fund; remain pending	• **Fisheries and mariculture** o 1 244 claims for a total of Won 685 billion (£351 million) o 139 assessed at a total of Won 9.1 billion (£4.7 million); 131 paid at a total of Won 8.4 billion (£4.3 million); 43 rejected
• **Subsistence fisheries claims** o 27 800 (subsistence) fishery claims assessed at total of PHP 206 million (£2.62 million) o 26 000 paid a total of PHP 191 million (£2.43 million) o 598 rejected	• **Tourism and other economic damages** o 5,796 claims for a total of Won 159 billion (£81.6 million) o 626 assessed at a total of Won 6 billion (£ 3.08 million); 441 paid at a total of Won 4.5 billion (£ 2.3 million); 906 rejected
• **Property damage**: 3.260 claims assessed at total of PHP 5.3 million (£67 305); 670 paid a total of PHP 4.96 million (£62 988); 2 465 rejected • **Clean up & preventive measures**: 27 claims assessed at total of PHP 790 million (£10 million); 14 paid a total of PHP 776 million (£9.85 million); 11 rejected • **Tourism**: 415 claims assessed at total of PHP 5.5 million (£69 845); 75 paid a total of PHP 5.4 million (£68 575); 329 rejected • **Miscellaneous**: 160 claims assessed at total of PHP 3.7 million (£46 987); 3 paid a total of PHP 3.6 million (£45 717); 80 rejected	• **Clean-up and preventive measures** o 251 claims for a total of Won 193 billion (£ 99 million) o 155 assessed at a total of Won 60.6 billion (£31 million) o 117 paid at a total of Won 50.9 billion (£26 million) o 13 rejected • **Property damage; environmental damage and studies; miscellaneous** o 19 claims for a total of Won 5 billion (£2.6 million) o 7 assessed at a total of Won 350 million (£179 645); 5 paid at a total of Won 300 million (£153981); 1 rejected

Source: Oosterveen. International Oil Pollution Compensation Funds.

Nobody's Cargo, Everyone's Headache

Marine bio-invasions (see **Box 1**) and anti-biofouling agents cause adverse environmental impacts on marine biodiversity, public health and certain marine economic sectors, among others, as well as potential transboundary and long-term impacts. International instruments on ballast water management and antifouling systems have been ratified by several IMO-member States, but there is a need to build capacity, enact compatible legislation and apply technology in order to implement the provisions of such instruments at national levels. **Box 2** shows the current problems that need to be addressed to mitigate the potential damages that can be brought about by invasive alien species (IAS). Effective marine biosecurity is the science-based protection of native marine biodiversity and marine ecosystems that provide environmental, economic, social, and cultural values to society through effective management and control of non-native species (Kaur).

Dealing with unwanted stowaways

The IMO's Ballast Water Management (BWM) Convention (2004) regulates the introduction of invasive species via the ballast water and sediments from ships. The objective is to prevent, minimize, and eventually eliminate the risk to the environment, property, resources and human health. To date, the convention has been ratified by 25 countries representing around 24.2 percent of the world tonnage. Relevant articles of the convention are shown in **Box 3**.

Box 1. Invasive Marine Species.

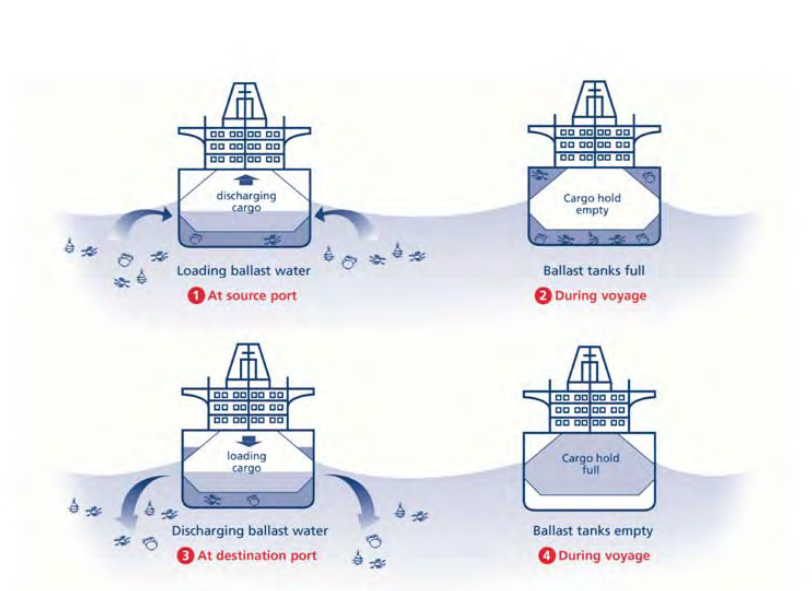
Translocation of marine invasive aquatic species by ships can occur through ballast water transfer and biofouling of ship hulls, as well as trading of exotic species (marine and estuarine).

All ships need to carry ballast water to keep them stable in the water. Taking on ballast water and discharging it must be carefully controlled to ensure the safety of the vessel and the seafarers on board. But there is another challenge – ballast water taken up in one area and released in another is a major source of harmful algae, microscopic planktons, invasive and pathogenic species, and other alien and unwanted exotic organisms (**Figure 5**). Invasive alien species (IAS) can overrun natural local species and cause extremely severe environmental, economic and public health impacts.

Several regions, such as the Great Lakes, Caspian Sea and Black Sea, have been affected by invasive species causing havoc to native aquatic species and its environs as well as economic losses to the local fishing industry and coastal tourism. It has been estimated that the economic impact of marine invasive species may well exceed US$ 100 billion per year (McNeely, et al., 2001).

The seas of East Asia are one of the main sources of translocated species like the mitten crab, Corbula (Asian clam) and Codium (seaweed). At the same time, this region – a centre of biological diversity (terrestrial and marine) – is also under threat from bio-invasions due to increased trade and shipping activities. At present, marine biosafety is an emerging concern in the region, particularly with respect to ballast water management for international shipping. The harmful algal blooms – which could be due to nutrient discharges or to translocation, are also a cause for concern (Kaur).

Figure 5. Cross section of a ship showing ballast tanks and ballast water cycle.



Source: GloBallast, International Maritime Organization

The Convention emphasized obligations of Flag States as follows:

- Enact domestic laws, including penalties and sanctions;
- Ensure that all vessels under their jurisdiction have a Ballast Water Management Plan in place, and that they carry a Ballast Water Management Record of BWM requirements and availability of reception facilities;
- Assign a designated officer on each vessel for ensuring compliance with the BWM Plan and for reporting to port authorities;
- Ensure that the crew members are adequately trained in implementing the BWM Plan; and
- Establish appropriate procedures for the issuing of the International Ballast Water Management Certificate.

On the other hand, obligations of Port and Coastal States include the following:

- Enact domestic laws;
- Establish a compliance monitoring and enforcement (CME) system, including procedures for the inspection of vessels; and
- Put in place adequate facilities for sediment reception in ports and terminals where ballast tanks are cleaned or repaired.

The BWM Convention provides the critically needed set of management tools through which the maritime industry can be regulated in a manner that is predictable, transparent and responsive with regard to environmental benefits, technological achievability and international consistency. The Convention includes three sets of management measures: (a) Option 1 – mid-ocean ballast water exchange; (b) Option 2 – ballast water treatment using onboard treatment technologies; and (c) any alternative management options that will provide

Box 2. Main Obstacles to Addressing Invasive Alien Species (IAS).

- Inadequate policy and legal frameworks, at national, regional and global levels. While current trends in development of policies and enactment of laws at national and international levels are good, a lot remains to be done including in relation to further development of strategic frameworks that incorporate all aspects of IAS as well as mainstreaming at the national level;
- Limitations in implementation and enforcement of existing policies and laws for reducing IAS. Implementation effectiveness of many international agreements varies, and national policies are not always adhered to fully;
- Insufficient institutional coordination at national, regional and international levels. IAS is a problem with national, regional and global dimensions and prevention and management need coherent approaches;
- Lack of understanding of the severity of the threat posed by IAS at political as well as technical levels, which is in part causative of policy and legal shortcomings;
- Insufficient human, technical, institutional and logistical capacity for addressing IAS;
- Limited public awareness of IAS, their threats and potential impact;
- Insufficient financial support to programmes addressing IAS, whether through policy development, supporting enforcement and building compliance, or building capacity and awareness.

Source: Global Invasive Species Programme, Millennium Ecosystem Assessment.

Box 3. Highlights of the BWM Convention.

- Article 5 – Sediment Reception Facilities where cleaning and repair of BW tanks occurs, provides for the safe disposal of sediments (should not damage the environment)
- Article 6 – Scientific and Technical Research Parties shall promote, facilitate and monitor research on BW Management (BWM)
- Article 7 – Survey and Certification – Each party shall survey and certify its ships
- Article 9 – Inspections of Ships – Includes inspection of BW record book, validity of Certificate and BW sampling; no undue delay; ships without valid certificate; detailed inspection and no BW discharge until proven harmless
- Article 13 – Technical Assistance, Co-operation and Regional Co-operation- Train personnel, availability of technology, equipment and facilities, joint research, implementation of BWMC
- Article 14 – Communication of Information – Each Party shall report to IMO on BWM to ensure vessels flying their flag are in general compliance with the Convention.

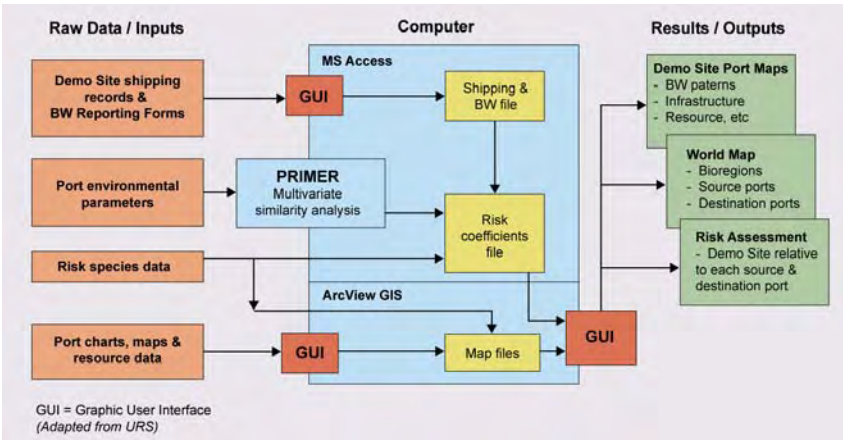
the same level of protection as given by Options 1 and 2.

It is widely recognized that Option 1 – ballast water exchange – is only a temporary management option due to the safety issues involved and the constraints related to biological effectiveness of such a process. The Convention therefore requires that the ships will eventually have to meet performance standards, which are basically ballast water discharge quality standards. This also means that ships would need to be equipped with ballast water treatment technologies to meet these discharge standards. According to the BWM Convention, all international vessels would need to be fitted with a treatment technology by 2016, the year when the ballast water exchange option will be phased out. Thus, it is essential that the current technology hurdles are overcome, and effective management solutions have been scale tested and installed.

The technology developers and shipping industry have been rising to this challenge and some steady progress has been achieved over the last few years. It is crystal clear that global environmental problems like marine bio-invasions will be solved only if the private sector, with its vast technical, managerial and financial resources and expertise, is actively involved. There are currently over 100 research-and-development (R&D) projects around the world focusing on development of cost-effective treatment technologies for shipboard applications, and control of sediments in ballast tanks. Several of these treatment systems have received IMO approvals and also approvals by national administrations, and are therefore available in the market. Several ship owners are currently fitting these treatment systems on board the ships.

IMO, together with the Global Environment Facility (GEF), United Nations Development Programme (UNDP), member countries and the shipping industry, is implementing the project on Building Partnerships to Assist Developing Countries to Reduce the Transfer of Harmful Aquatic Organisms in Ships' Ballast Water, simply known as the GloBallast Partnerships (GBP). The overall goal of the GBP is to assist the developing countries to reduce the risks and impacts of marine bio-invasions caused by international shipping. GloBallast Partnerships focus

Figure 6. Schematic diagram of Ballast Water Risk Assessment.



Source: Fredrik Haag/GloBallast

on the legal, policy and institutional reform process at the national level. The project aims to spur global efforts to design and test technology solutions, and enhance knowledge management and marine electronic communications to address the issue. The implementation strategy for GBP uses a multi-component, multi-tiered approach:

- A *global* component, managed through IMO London, providing international coordination and information dissemination, including the development of toolkits and guidelines, and establishing a strong cooperation with industry and NGOs.
- A *regional* component, providing regional coordination and harmonization, information sharing, training, and capacity building in the application of ballast water management tools and guidelines. The regional component and activities will be coordinated with the support of Regional Coordinating Organizations (RCOs).
- A *country* component, that establishes a fast track (Lead Partner Country or LPC) and partner track (Partner Country or PC) process for GEF-eligible countries in the priority regions. LPCs are the countries who have committed to develop and implement a National Ballast Water Management Strategy (NBWMS), and to adopt legal, policy and institutional reforms (LPIR).

A series of tools and guidelines have been developed in collaboration with partners:

- *Risk Assessment Tool for Ports* — The GloBallast Risk Assessment methodology is supported by a GIS interface. The database consists of port environmental data from approximately 400 ports. **Figure 6** shows the ballast water risk assessment methodology.
- *GloBallast Guidelines for National Ballast Water Status Assessments* (with IOI) — It provides a structured approach and templates for rapid status assessments and serves as a tool in the development of a national ballast water management.
- *Guidelines for Ballast Water Economic Assessments* (with IUCN) — It illustrates the economic benefits of implementing the BWM Convention and provides an approach (with templates) to estimate the costs associated with ratifying and implementing the BWM Convention, as well as the potential cost of dealing with a marine invasion. It will also serve as useful tool in the development of policies, strategies and implementation/ratification of the BWM Convention.
- *Guidelines for development of a National BWM Strategy* (with IUCN) — The National Ballast Water Management Strategy (NBWMS) is an integral part of the national regulatory framework, along with relevant policies, legislation and institutional arrangements, as well as more specific work programmes and action plans.
- *GloBallast Toolkit for Legal Reform* (by the Global Task Team) — It consists of: (a) Guideline document and road map with an expanded legal review as background

Box 4. Biofouling.

Biofouling is the undesirable growth of organisms on man-made structures. Marine biofouling occurs on ships, port infrastructure, navigational instruments, oil platforms, seawater intake pipes (e.g., heat exchangers; cooling systems; desalination plants), etc. Algae and molluscs attaching to the hulls of ships could slow down the ships and increase fuel consumption (e.g., slime alone can cause a 4 percent drop in speed). Thus, anti-fouling paints are used to coat the bottoms of ships to prevent such marine organisms from attaching. These paints contain compounds that slowly "leach" into the sea water, killing barnacles and other marine life that have attached to the ship. However, studies have shown that these compounds persist in the water, killing marine life, harming the environment and possibly entering the food chain. One of the most effective anti-fouling paints developed in the 1960s contains organotins, in particular, tributyltin (TBT), which has been proven to cause deformations in oysters and sex changes in whelks.

document; (b) Model Ballast Water Management Act; and (c) a two-day training course for maritime lawyers.

The GBP has also established a pioneering public-private sector partnership called Global Industry Alliance for Marine Biosecurity (GIA). The current GIA members include shipping giants, such as BP Shipping, Vela Marine International, Daewoo Ship Building and Marine Engineering Services, and APL. A GIA Fund, established through annual membership contribution by the GIA industry partners, will provide the necessary financial resources for the GIA to implement selected projects (Globallast). This innovative public-private sector partnership model is expected to assist in creating solutions for addressing the ballast water issues, including new technologies, along with training and capacity-building activities.

To be or not to be: Handling the marine biofouling issue

Marine biofouling (**Box 4**) has direct economic cost for shipping as well as biodiversity and ecological impacts. Direct economic costs include cost of anti-fouling application (US$150,000 – US$400,000); cleaning and maintenance costs (hull cleaning, approximately US$35,000) – average about 10 percent total cost of vessel, and fuel costs which account for 50 percent of operational cost of a ship (Teo). In terms of biodiversity and ecological impacts, the real cost is a large annual budget for pest management. For example, cost of eradication of *Mytilopsis sallei* from Darwin Harbour amounted to US$ 1.6 million excluding manpower costs, and the management of zebra mussels in the Great Lakes costs US$ 100 million per year. The risks from hull-fouling may exceed the threats from ballast water (Teo; Drake and Lodge, 2007).

Box 5. Air pollution from ships and ports.

With the unprecedented economic growth in the East Asian region, there is increased shipping and trade activities. The Straits of Malacca and South China Sea are among the busiest shipping lanes in the world (**Figure 7**). Port and shipping security is critical to guarantee safety of the ships and their cargo, crew and passengers, as well as ensure that the coastal and marine habitats and resources are not unduly affected by shipping activities and accidents. Ports therefore need to comply with relevant international safety, health and environmental codes, standards and conventions and improve their safety, health and environmental management systems.

Toxic emissions from ships and port operations represent a danger to public health and a long-term threat to the economy. While millions of people in the region live and work in close proximity to port facilities, the direct exposure to harmful levels of shipping and port-related emissions is causing increased concern for health impacts. Air pollution from ships and ports causes a cumulative effect that contributes to the overall air quality problems encountered by populations in many coastal areas, and also affects the natural environment. **Figure 8** shows the mortality cases of cardiopulmonary diseases due to emissions of PM2.5 (particulate matter, 2.5μ) from ports and ships (Corbett, et al., 2007).

Climate change is also a matter of concern in the shipping sector. According to the Second IMO Greenhouse Gas (GHG) Study 2009, exhaust gases are the primary source of emissions from ships (IMO, 2009). Carbon dioxide is the most important GHG emitted by ships, both in terms of quantity and of global warming potential. Although the GHG emissions by ships and ports are lower compared to other sectors*, the increased shipping and world trade activities will not lead to a reduction of GHG emissions by this sector, unless technical and operational measures are implemented, and technologies that would allow for fuel and energy efficiency are adopted.

* International shipping was estimated to have emitted 870 million tonnes, or about 2.7 percent of the global emissions of CO_2 in 2007 (IMO, 2009).

However, dealing with these unwanted pests may cause more harm than good. Anti-fouling paints that contain harmful organotins have adverse effects on marine organisms, and could enter the food chain, consequently affecting humans as well. Therefore, it was recommended that the focus of marine biofouling prevention should be directed at: (a) anti-fouling coatings and treatment systems; (b) environmental impacts from the use of toxic antifouling substances; and (c) management practices to reduce fouling on ships. Existing marine anti-fouling coatings were invented to improve ship performance, i.e., reduce fouling so there is less drag and better fuel economy and engine performance. They do not specifically address biosecurity concerns.

The IMO's International Convention on the Control of Harmful Anti-fouling Systems on Ships was adopted in October 2001 to prohibit the use of harmful organotins in anti-fouling paints used on ships, and establish a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems (IMO, 2009). Under the terms of the new Convention, Parties to the Convention are required to prohibit and/or restrict the use of harmful anti-fouling systems on ships flying their flag, as well as ships not entitled to fly their flag, but

which operate under their authority, and all ships that enter a port, shipyard or offshore terminal of a Party.

Current challenges range from information and technology gaps to capacity gaps:

- Shortage of trained personnel for monitoring programs: being able to identify species correctly is important for bio-invasion detection.
- Poor knowledge leads to the use of excessively heavy-handed methods which are invariably detrimental to the environment.
- National water quality guidelines and standards (in some countries) do not include the TBT parameter.
- Research and development initiatives in the future may focus on a combination of methods with synergistic properties that will deliver good performance at a lower environmental cost.
- Alternatives to TBT are not efficient. For example, switching from TBT to copper paints has increased incidence of biofouling and the frequency of dry docking (Teo).
- R&D on antifouling coatings is conservative as development costs are very high.
- The lack of international coating performance standards makes it difficult for new technologies to enter a marketplace dominated by a few large players.
- New R&D is needed to tackle ship fouling:
  - Better ship design to reduce fouling in niche areas;
  - Better design to facilitate maintenance activities; and
  - Better coatings and tools that allow regular maintenance.

In China, the anti-fouling system (AFS) issue is addressed through legal, technical, scientific, and institutional means. A national legislation adopting the AFS Convention is being developed. Technical interventions include promotion of alternatives, such as the use of copper-based anti-fouling paints, tin-free anti-fouling paints, and non-stick coatings; developing national standards; and identification of manufacturers. Other initiatives include the conduct of scientific research, establishment of national task force and prohibition of sale of TBT in the market.

En route to safe and green ports

Ports are gateways that link goods transported by sea to markets. They provide significant benefits to the host port cities as well as contribute billions of dollars to the local and national economies. Ports are places where various economic activities are performed, either by port authorities, stevedores or industries located within the port jurisdiction.

Maritime ports are situated at an interface between land and sea. Some of them are directly on the shore; some are set up on reclaimed land and on the surrounding seabed; others are located along the banks of estuaries or mouths of rivers. All of these sites are in one way or another connected to rich habitats (e.g., seabed; estuarine waters; mud flats; wetlands; mangroves; seagrass beds; coral reefs). These habitats are at risk from port operations as well as from accidental oil and chemical spills. Numerous problems, such as soil contamination, water and air pollution (**Box 5**), solid waste, safety of port operation and storage of goods, safety of industrial processes, ballast water and marine biosafety, must be addressed.

The port industry in general has been faced with sustainability issues — compliance with international and national regulations vis-à-vis demands for bigger port capacity and increased productivity without compromising environmental quality. While each port has developed knowledge on environmental issues and initiated measures specific to its setting, cooperation and collaboration on environmental protection, reduction of greenhouse gas and other emissions, and protection of coastal and ocean resources around ports will deliver significant incremental benefits to the entire region. 'Green' initiatives have been taken by the ports sector on a voluntary basis and/or as a result of local/national policies and regulations and international conventions (**Table 3**). A combination of regulatory framework, enforcement, incentives and voluntary proactive approaches is an effective mechanism for advancing port sustainability and environmental stewardship.

Always on the safe side: Sustainable ports

The United States Environmental Protection Agency (US-EPA) emphasized that the critical element to sustainability is environmental stewardship — where all parts of society actively take

Table 3. Green Initiatives.

Voluntary Initiatives	Local/National Regulations (current and proposed)	International Conventions
• LNG and ULSD at ports • Hybrid vehicles • Electrical port equipment • Slower traffic • Emergency efficiency at ports • Retrofitting ships • Local tugboats: shoreside power	• Fuel switch • Ferries • Shoreside power • Parked vessels • Modal shift	• IMO: MARPOL Annex VI • North America ECA • GHG post-2012

Source: Booth

Box 6. Port Safety, Health and Environmental Management System (PSHEMS) Development and Implementation.

- Phase 1: Initial Status Review
- Phase 2: Strategic Planning
- Phase 3: System Development
- Phase 4: Implementation and Monitoring
- Phase 5: PSHEMS Auditing
- Phase 6: Continual Improvement

responsibility to improve environmental quality and achieve sustainable results. Such principle of environmental stewardship has been recognized by the American Association of Port Authorities (AAPA), including its stakeholders. AAPA has gained significant achievements towards this goal. In the same way, the International Association of Ports and Harbours (IAPH) has demonstrated its commitment to port sustainability by placing high priority on environmental considerations in managing its business. The environmental management system (EMS) as a tool for improving environmental performance and advancing port sustainability was initiated by US-EPA in partnership with the American Association of Port Authorities (AAPA).

An *EMS Primer for Ports* was developed in order to provide a general introduction to environmental management systems and help ports develop these systems and understand how they can also advance port efficiency, security, and other aspects of sustainability through the use of the Plan-Do-Check-Act (PDCA) framework. An EMS is a formal system for proactively managing the environmental footprint of a port.

To address air quality issues, *Current Methodologies in Preparing Mobile Source Port-related Emission Inventories* was developed as a result of the study conducted by US-EPA. In response to increasing focus on climate change, a technical paper entitled "Planning for Climate Change Impacts at US Ports" was also developed.

A major initiative in the East Asian Seas region is the Port Safety, Health and Environmental Management System (PSHEMS), which was developed by Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) to provide the ports with a methodology to improve ports' operational performance through a comprehensive and coordinated approach to safety in port operations, protection of human life, property and the environment. Two ports in the region have successfully implemented the system: Bangkok Port of Thailand and Port of Tanjung Pelepas of Malaysia. PEMSEA is providing technical support to ports implementing the PSHEMS by way of training port personnel on the six phases of PSHEMS development (**Box 6**); reviewing the ports documented safety, health and environmental (SHE) management system; as well as assessing its SHE performance in accordance to the requirements of the PSHEM Code. This is the standard developed by PEMSEA that enables an organization (port authority/port operator) to measure the performance of its operation with regard to quality, safety and health of port workers and the protection of the environment.

The Sustainable Port Development in the ASEAN Region, a project of the German Technical Cooperation (GTZ) in collaboration with the ASEAN Ports Association (APA), is aimed to assist selected ports to comply with relevant international SHE codes, standards and conventions and improve their SHE management systems. The project will cover the following components: capacity development through application of proven tools, systems and best available practices; development of modular training program on Port SHE management; adapting national legislation to international regulations, codes of practice and standards; and cooperation with other organizations and programs. Activities lined up for 2010 include development of model port SHE regulations, conduct of air emission inventory, conduct of study on access control/traffic management and implementation of the PSHEMS in collaboration with PEMSEA.

Specific activities of ports towards environmental stewardship include environmental management for existing and new facilities, measuring and reporting on continuous improvement in environmental performance, addressing community concerns, such as human health, environment and quality of life, and responding to climate change.

Reducing emissions to ensure public health and contribute to climate change mitigation

In October 2008, IMO adopted the revised MARPOL Annex VI and the nitrogen oxide ($NO_{x)}$ Technical Code 2008, with an entry-into-force date of 1 July 2010. The main changes are a progressive reduction in emissions of sulfur oxide (SO_x), NO_x and particulate matter (pm), and the introduction of emission control areas (ECAs) where the emission of NO_x as well as SO_x and particulate matter are further restricted. Similar to measures being taken to prevent marine pollution and oil spills, it is also evident that governments and maritime industries are developing interventions to protect public health (**Box 6**) in and around ports by way of regulations, incentive programmes, award and recognition schemes, comprehensive plans and policies, research and cross-interest collaborations.

Based on a study conducted in Hong Kong, ships and ports are taking steps to reduce emissions, including sulphur dioxide (SO_2), NO_x and PM, from their operations. Hong Kong and other

ports in the Pearl River Delta region have begun to implement initiatives to reduce their impact on air pollution in the region.

In a study conducted by Civic Exchange-Hongkong entitled "Green Harbours: Hongkong and Shenzen — Reducing Marine and Port-Related Emissions," it was revealed that regulations that demand cleaner operations are needed for industries to implement green practices. Without a clear regulatory framework, it is difficult to implement greener practices, as these may put operators at a competitive disadvantage. In addition, complementary measures are needed to ensure compliance with the regulations. These include: availability of incentives to encourage green practices, cost and availability of clean fuel, the need to do more research on green technologies, use of shoreside (tidal/wave) power, and designating emission control areas.

In response to the issues raised, recommendations were put forward, such as: (1) developing a comprehensive strategy for reducing emissions from marine and port-related activities; (2) developing clean fuels initiatives supported by energy policy offering clean fuel incentives and improved distribution networks for clean fuel; (3) implementing training programmes for industry; and (4) conducting research focusing on emissions inventory and health effects of pollutants.

The U.S.-coordinated regulatory strategy for vessel emissions applies the new international emission standards based on amendments to MARPOL Annex VI. More stringent limits for engines, fuel sulphur for vessels that operate within the emission control area (ECA) are applied. The US-EPA Sector Strategies Program works with representatives of the ports sector and other stakeholders to assess opportunities to improve environmental performance while reducing the regulatory burden. The program's work focuses on four priority areas:

At sea response during the Hebei Spirit oil spill incident *Photo: Whittington/ITOPF*

1. Implementing the "Strategy for Sustainable Ports";
2. Planning for climate change impacts at U.S. ports;
3. Documenting and imparting information on best practices for developing port emissions inventories; and
4. Developing emission reduction incentives, and to promote environmental management systems (EMS).

The World Ports Climate Initiative (WPCI), initiated by the International Association of Ports and Harbours (IAPH), is supported by 55 major ports in the world with the objective of reducing GHG emissions through developing a GHG emissions inventory and developing a collaborative approach toward collecting information, estimating emissions and developing plans to reduce the footprint of port operations. The mission of the WPCI is to:

- Raise awareness in the port and maritime community of need for action;
- Initiate studies, strategies and actions to reduce GHG emissions and improve air quality;
- Provide a platform for the maritime port sector for the exchange of information thereon; and
- Make available information on the effects of climate change on the maritime port environment and measures for its mitigation.

In support of this mission, the WPCI has developed a website and formed subgroups focusing on "Themes" that will provide guidance to ports looking to monitor and reduce their GHG emissions. These themes currently include:

- Carbon Footprinting and Modeling Tools
- On-shore Power Supply
- Environmental Shipping Index
- Cargo-handling Equipment
- Intermodal Transport
- Lease Agreement Template

Clean Ports USA, an incentive-based, innovative program is designed to reduce emissions from existing diesel engines and non-road equipment at ports. The engines and equipment used at ports, including cargo handling equipment, trucks, locomotives, tugboats, ferries and ships, can contribute significantly to the levels of fine particulates (PM 2.5), SO_x and ozone-forming NO_x in the air. Because

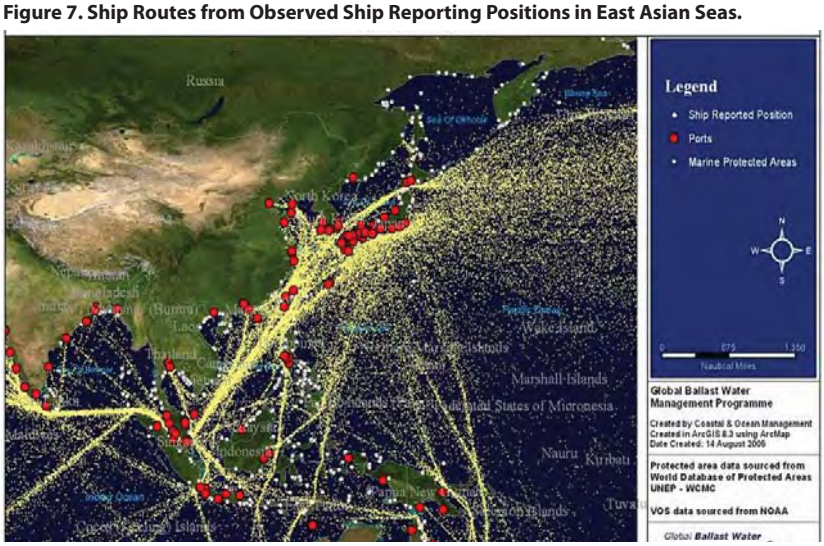
EPA's regulations only apply to newly manufactured diesel engines, the Clean Ports USA program was developed to help ports and fleet owners reduce emissions from the older engines that are currently in port operation. Different emissions reduction strategies include: switching to cleaner fuels; retrofitting; replacement; rebuilding; repowering; and operational strategies. The significant progress made toward this goal is attributed to strategies, such as promoting partnerships, fostering innovative technologies and providing funding assistance to accelerate the introduction of clean diesel technologies.

SmartWay[SM] Transport is an innovative collaboration between US-EPA and the freight transport industry. It is designed to improve energy efficiency, reduce greenhouse gas and air pollutant emissions, and improve energy security. The SmartWay program provides information or tools that quantify costs/benefits of operational and technology options, identifies clean and efficient vehicles/equipment, provide financial programs for deployment of fuel-saving technologies and offers freight transport performance evaluation, tracking and recognition.

Setting the agenda to task

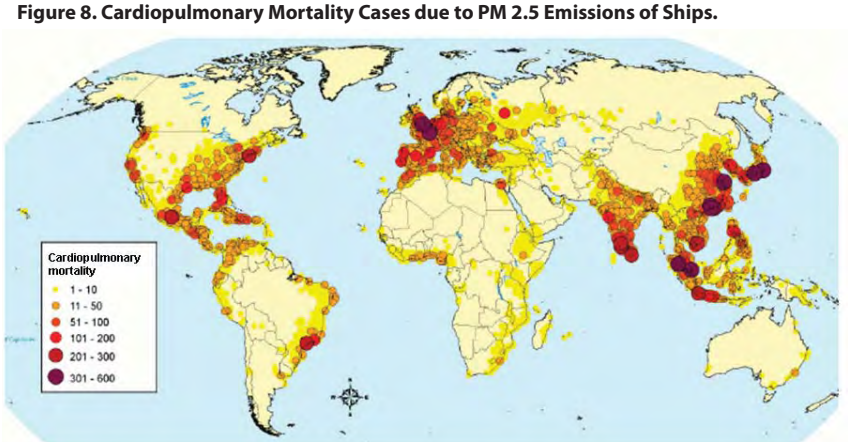
Marine pollution is a diversified term. Several factors have created the present dilapidated condition of the sea. Sources and causes of the current situation of the marine environment are many, but the solutions are few. However, there are current initiatives and best practices that can be replicated and scaled up. A combination of efforts of international organizations, governments, the private sector, scientific community and other stakeholders is gaining ground. The following are the recommendations arising from the stakeholder dialogue during the EAS Congress 2009.

Figure 7. Ship Routes from Observed Ship Reporting Positions in East Asian Seas.



Source: GloBallast

Figure 8. Cardiopulmonary Mortality Cases due to PM 2.5 Emissions of Ships.



Source: Corbett, et al., 2007.

Oil spill contingency plan and response mechanism

Over the years the amount of oil produced and transported has greatly increased as the world's economy has expanded. Actions need to be taken by the oil and shipping industry, in cooperation with the governments and international community, to reduce the risk of oil entering the marine environment, ensure safe carriage of oil by sea, and enhance the capacity to respond in case an oil spill occurs. Supporting policies, laws and guidelines also have to be set in place, and proper lines of communication and delineation of roles and responsibilities are essential.

1. National actions:

a. Countries that have not yet developed national oil spill contingency plans should consider developing their plans, with clearly defined institutional arrangements, roles and responsibilities, and backed by proper funding and skilled personnel. Such plans should also be tested through tabletop and field exercises with various concerned agencies and sectors;

b. Countries are encouraged to ratify relevant international conventions, such as MARPOL, OPRC, CLC, IOPC Funds, etc., and legislate corresponding national

East Asian Countries Ratification of IMO Conventions and Protoco's Relating to the Coastal and Marine Environment.

Convention	MARPOL					London Convention		COL-REG Conv	Intervention		CLC		FUND			SUA	
COUNTRY		Annex				Conv	Prot		Conv	Prot	Conv	Prot	Conv	Prot	Prot	Conv	Prot
	73/78 Annex I/II	III	IV	V	VI	72	96	72	69	73	69	92	71	92	03	88	05
Brunei Darussalam	86							87			D	02	D	02		03	
Cambodia	94	94	94	94				94			94	01		01		06	
China	83	94	06	88	06	85	06	80	90	90	D	99	D	99*		91	
DPR Korea	85	85	85	85				85									
Indonesia	86							79A			78	99	D				
Japan	83	83	83	83	05	80	07	77	71		D	94	D	94	04	98	
Lao PDR																	
Malaysia	97			97				80			D	04	95	04			
Myanmar	88															03	
Philippines	01	01	01	01		73		77A				97		97		04	
Rep. of Korea	84	96	03	96	06	93	09	77			D	97	D	97	10	03	
Singapore	90	94	05	99	00			79			D	97		97		04	
Thailand	07																
Timor-Leste																	
Vietnam	91							90				03				00	

Numbers represent year of ratification/accession
D - Denounced; Conv - Convention; Prot - Protocol
*For application in Hongkong SAR only.

Sources: International Maritime Organization (IMO).
http://www.imo.org/includes/blastDataOnly.asp/data_id%3D28080/Status-2010.pdf
https://imo.amsa.gov.au/public/parties/solas88protocol.html
https://imo.amsa.gov.au/public/parties/solas78protocol.html
https://imo.amsa.gov.au/public/parties/ll88protocol.html

laws and regulations that would allow for their implementation (Table 4);

c. There is a need to recognize and adddress constraints currently faced by some countries, e.g., lack equipment, training and capability to effectively respond to marine pollution incidents;

d. Appropriate mechanisms should be established by countries in the region to facilitate, as a priority, the transport and movement of response equipment and personnel across international borders (address customs issues).

e. There is a need to educate the public and raise awareness of the actual reality of oil spill threats, which could be introduced at school level, as well as through national campaigns that could be extended region-wide;

f. Political will of national governments is essential to paving the way for regional cooperation.

2. International actions:

a. International organizations need to catalyze OPRC activities/ systems at national and regional levels;

b. The revitalization of ASEAN-OSRAP will require a legal statement from ASEAN (through the Maritime Transport Working Group) as a policy framework to operate and hold its first official meeting;

c. Identify organizations, such as industry, funding and development agencies (The World Bank, Asian Development Bank, UNDP, GEF, donors), which can provide technical assistance and support to countries at each level (national, regional, international);

d. Different elements needed locally, nationally and regionally should be identified for oil spill preparedness, response and cooperation, to ensure effective communication and operational

SOLAS			LL	Salvage	OPRC	HNS	OPRC-HNS	Bunker Oil	Anti-Fouling	Ballast Water
Conv	Prot	Prot	Prot							
74	78	88	88	89	90	96	00	01	01	04
87	87									
95	95	01	01							
80	83	00app	00	94	98		09	08		
85	85	01	01					09		
81	88									
80	81	00	00		95		07		03	
84	84				97			08		
88	88									
82										
81	83	00	00		99		08	09	08	09
81	84	00	00		99		03	06	09	
85					00					
91	93	02	02							

response integration;

e. NOWPAP can serve as an excellent working model, which can be adapted by other sub-regions of East Asia;

f. PEMSEA's important role in advocacy, technical cooperation, promoting and assisting in regional oil spill preparedness, response and cooperation needs to be stressed.

Marine biosafety

International efforts to address the translocation of invasive species and use of toxic anti-fouling substances as well as to mitigate the environmental impacts through the promulgation of environmental instruments, adoption and application of standards, research, technology and the promotion of public awareness and capacity building are critical.

1. Ballast water and invasive alien species management

a. It is imperative to recognize and address the economic and societal costs of marine bio-invasions in the EAS region, due to the potential impact on biodiversity and the intensity of shipping activities.

b. Countries are encouraged to ratify the International BWM Convention on an urgent basis. Implementation of the Convention should be supported through regional cooperation efforts and regional agreements.

c. To remove barriers for early and effective implementation of existing instruments, capacity building will be of outmost importance. This should also include Compliance Monitoring and Enforcement related capacity-building aspects.

d. The regional efforts to address biosafety issues should be assisted by the development of a (regional) database on invasive species, distribution and prior invasion history, environmental and ecological requirements.

e. Countries and key stakeholders are encouraged to make use of existing tools and guidelines developed by programmes such as GEF-UNDP-IMO GloBallast.

f. It is strongly recommended to re-establish the Regional Task Force which was initiated during the first phase of GloBallast.

2. Anti-fouling system

a. There is an urgent need for governments to ratify the AFS Convention, in order to drive technology development to address fouling in non-hull areas of vessels. New R&D is needed to prevent fouling under low flow/static conditions (e.g. when vessels are moored, at berth or at anchor).

b. There is a need for coating standards (e.g., ISO standard), which would be useful to enhance development and business competition on antifouling technology and

products, including market entry into an otherwise very conservative market.

c. Biofouling should be addressed from a perspective of biosafety, and countries should be encouraged to contribute to the ongoing discussion on the development of a global framework for biofouling.

3. Scientific support

a. Regional and port-specific risk assessment (qualitative) should be carried out, using existing information on shipping patterns and port environmental conditions.

b. Regional and national efforts should be supported with the establishment of a regional network (correspondence group) of biosafety experts, from the various organizations active in the biosafety field.

4. Stakeholder awareness and support

a. It is critical to raise public awareness on the biosafety issues in the region.

5. International support

a. Regional financial institutions (e.g., ADB) and NGOs are encouraged to participate in and support capacity building efforts, to ensure long-term sustainability of the management efforts.

b. Existing regional networks (e.g. PEMSEA, COBSEA, ASEAN) are encouraged to actively address the biosafety issues.

Greener and sustainable ports

The port industry has been faced with government regulations to achieve regulatory compliance on safety, security and environmental protection. While many perceive that these requirements are added costs and hamper port productivity and competitiveness, some have considered "green" and "sustainability" issues as business attributes that enhance port competitiveness. Today, the pressure is mounting for every potential polluter, every user of energy and every conspicuous contributor to climate change and global warming to clean up their act and adopt greener practices (IMO, 2009). The port and shipping sector is definitely not exempted.

1. Considering that East Asia is a market place for shipping, it is recognized that ports provide a significant economic contribution to national GDP. Therefore, the need for sustainable port planning, development and operation is imperative.

2. Encourage the port sector to be pro-active and engage in voluntary approaches to greener ports.

3. There are existing models, practices, guidelines and programs that can be accessed within and outside the region to promote port sustainability and environmental stewardship.

4. There is a need to develop green policies supported by incentives to encourage ports to implement green practices.

5. Green practices in the marine and port sector would need collaboration with other sectors (e.g., air quality concerns, etc.).

Summing up

A critical facet of an efficient and sustainable shipping and port system is good governance, which preserves public assets and ensures adequate social and environmental safeguards. Governance is not just about what governments do, but how they involve private sector, civil society and other stakeholders in what they should do. Public awareness is crucial to increase their understanding of the causes and effects of marine pollution, oil spills, GHG emissions, bio-invasions and biosafety. While IMO adopts international regulations, providing a single, universal framework governing maritime operations, it is National Governments that must implement these rules by incorporating them into their own, national laws.

Moreover, experience shows that the best environment for pollution prevention comes from good legislation and enforcement coupled with good and responsible industry performance (IPIECA). Market-based mechanisms should also be considered, and would serve two main purposes: off-setting of growing ship emissions and providing a fiscal incentive for the maritime industry to invest in more fuel-efficient ships and technologies and to operate ships in a low-carbon and more energy efficient manner. R&D to make alternative technologies available and accessible is also critical to allow switching to environmentally-sound practices.

The solutions we will opt for need to be realistic, pragmatic, doable, cost-effective and should be implemented through mechanisms that are clear, practical, transparent, and easy to administer. There are difficult and complex issues involved, not just from the technical viewpoint, but from a political perspective as well. We need to make some tough decisions and we need to act on them. We have to consider our priorities and accept that there are costs involved and we have to make certain sacrifices. We all have a responsibility to take bold, comprehensive and coordinated action. Finally, we need to start putting *life* ahead of *lifestyle*.

Conclusions and Recommendations for workshops under Theme 2: Natural and Man-made Hazard Prevention and Management

Presented by Theme Chair: Dr. Cherdsak Virapat

Workshop 1 - Government/Industry Partnership for Effective and Consistent Preparedness and Response to Marine Pollution in East Asia

The workshop reviewed major issues on preparedness, response and co-operation for combating pollution from oil spills with a particular emphasis on regional arrangement, cooperation, partnerships and stakeholder involvement in oil spill preparedness and response including lessons learned from past incidents.

Conclusions and Recommendations

- Ensure essential elements in oil spill preparedness and response are present in national oil spill contingency plan;
- Encourage countries to ratify relevant international conventions;
- International Maritime Organization: should play a catalytic role in Oil Spill Preparedness Response and Cooperation activities/ systems at national and regional levels;
- Establish a legal basis for operating a regional arrangement and establish a mechanism for extending assistance to other countries;
- Recognize the important role of international and regional organizations in providing advocacy, technical cooperation, promoting and assisting in development of regional OPRC; and
- Implement a twin track approach for identifying gaps and developing action plans for improving oil spill preparedness and response.

Workshop 4 - Development and Advances on Marine Bio-safety in the Context of the Conventions on Biodiversity

The Workshop focused on translocation of invasive species arising from ballast water and biofouling associated with shipping, highlighting the adverse environmental impacts on marine biodiversity, public health and certain marine economic sectors, the potential transboundary and long-term impacts. It also highlighted international efforts to address the translocation of invasive species as well as to mitigate the environmental impacts.

Conclusions and Recommendations

- There is an urgent need to recognize and address the economic and societal costs of marine bio-invasions in the EAS region;
- Regional financial institutions and NGOs should be encouraged to participate in and support capacity building efforts;
- Countries should be encouraged to ratify relevant conventions;
- Capacity building should be increased on compliance monitoring and enforcement;
- Countries and key stakeholders should be encouraged to make use of existing tools and guidelines developed by relevant programs;
- Existing regional networks should be encouraged to actively address the biosafety issues;
- Development of a database on invasive species, distribution and prior invasion history, environmental and ecological requirements should be undertaken;
- Regional and port-specific risk assessment should be carried out; and
- A regional network of biosafety experts should be established.

Seminar on Greener Ports

The seminar focused on various efforts and examples of policies, strategies, good practices and initiatives relating to green and sustainable port planning, development and operation. Port management systems relating to safety, health and environment were also reviewed including the drivers for investments in environmental initiatives.

Conclusions and Recommendations

- Considering that East Asia is the market place for shipping, it is recognized that ports provide significant economic contribution to national GDP. Therefore, the need for sustainable port planning, development and operation is imperative.
- There are existing models, practices, guidelines and programs that can be accessed to promote sustainable port planning and operation.
- There is a need to develop green policies supported by incentives for ports implementing green initiatives.
- Encourage the port sector to be pro-active and engage in voluntary approaches to greener ports.

Acknowledgements:

Co-convenors:
Theme 2 Workshop 1: International Maritime Organization; International Petroleum Industry Environmental Conservation Association; and Oil Spill Response

Theme 2 Workshop 4: International Maritime Organization

Special Session on Disaster Management: International Geographical Union

Presentations:

Theme 2 Workshop 1 - Workshop on Government/Industry Partnerships for Effective and Consistent, Preparedness and Response to Marine Pollution in East Asia

Charlebois, P. "Implementation of the OPRC Convention and the OPRC-HNS Protocol through Regional Agreements."

Factuar, D. and P. Prasertwong. "Partnerships in Oil Spill Preparedness and Response in the Gulf of Thailand: Achievements and Challenges."

Oh, J.-H. "Lessons Learned and Challenges in Implementing a Regional Oil Spill Contingency Plan: NOWPAP-MERRAC Experience."

Olavario, A.P. "Philippine Coast Guard. National Disaster Coordinating Council (NDCC) Philippines. Case Study: Working in the Aftermath of the SOLAR 1 Incident in the Philippines."

Oosterveen, W. "Claims Handling and Settlement: SOLAR 1 and HEBEI SPIRIT."

Smith, A.*, D. O' Driscoll and D. Chan. "Benefits and Challenges in Government-Industry Partnership in Oil Spill Preparedness and Response: Perspective of the International Response Organization."

Suh, W.-R. "Post-Oil Spill Response of the Government of RO Korea: Implementation of a Comprehensive Restoration Programme and Lessons Learned."

Sykes, R. "Update on IPIECA Oil Spill Working Group Activities and the Global Initiative."

Trong, N.H. "Enhancing Local Capacities in Oil Spill Preparedness and Response: Vietnam Experience."

Whittington, M. Case Study – The Hebei Spirit Incident."

Theme 2 Workshop 4 - Workshop on the Development and Advances on Marine Bio-safety in the Context of the Convention on Biodiversity

Awad, A. "Overview on Marine Biosafety and Related International Instruments."

Haag, F. "The GEF/UNDP/IMO GloBallast Partnership Programme."

Kaur, C. R. "Marine Biosafety in Domestic Shipping in Coastal and Insular East Asia."

Matheickal, J. "The International Convention for the Control and Management of Ship's Ballast Water and Sediments."

Teo, S. L.-M. "Prospects for Research and Technology Development in Marine Biofouling Prevention."

Xu, X. "Marine Biofouling and Its Impact on Marine Biodiversity with Special Reference to China."

Seminar on Greener Ports

Bailey, K. "Case study: EMS as a Tool for Improving Environmental Performance in US Ports."

Bailey, K. "The Business Case for Sustainable Port Communities."

Booth, V. "Green Harbours: Ports, Ships and Public Health."

Breitling, U. "Sustainable Development in the ASEAN Region."

Cardinal, R. and S.A. Ross. "Implementation of the Port Safety Health and Environmental Management System in Selected Ports."

Special Session on Disaster Management

Hotta, K. "Experimental Research on the Development of Inorganic Coagulant for the Removal of Wreck Oil by Oil Spill Accident: Oil Removal Examination at the Philippines' Guimaras Island."

Li, J. "Present Situation of China for Prevention and Management against Marine Disasters."

Nenad, M. "Development of DSS for Environment Protection in Cases of Marine Incidents."

Suppiah, R. "Designating the Straits of Malacca as a PSSA."

References:

Biosecurity Council. 2003. Tiakina Aotearia – Protect New Zealand: The Biosecurity Strategy for New Zealand. Ministry of Agriculture and Forestry, Wellington, New Zealand.

Corbett, J., J.J. Winebrake, E.H. Green, P. Kasibhatla, V. Eyring and A. Lauer. 2007. "Mortality from Ship Emissions: A Global Assessment." Environmental Science and Technology. 41: (24) 8512-8518.

Drake, J.M. and D.M. Lodge. 2007. Hull fouling is a risk factor for intercontinental species exchange in aquatic ecosystems. Aquatic Invasions (2007) Volume 2, Issue 2: 121-131. DOI 10.3391/ai.2007.2.2.7. Regional Euro-Asian Biological Invasions Centre (REABIC). Available at http://www.reabic.net)

McNeely, J.A., H.A. Mooney, L.E. Neville, P. Schei, and J.K.Waage (eds.) 2001. A Global Strategy on Invasive Alien Species. IUCN Gland, Switzerland, and Cambridge, UK, on behalf of the Global Invasive Species Programme (GISP), x + 50 pp.

GloBallast Partnerships. 2000-2010. http://globallast.imo.org.

IMO. 2009. IMO and the Environment. International Maritime Organization. 6 pp.

International Petroleum Industry Environmental Conservation Association (IPIECA). www.ipieca.org

IPIECA. 2005. Action Against Oil Pollution - A guide to the intergovernmental and industry organizations involved in the prevention and mitigation of oil pollution in the marine environment. International Petroleum Industry Environmental Conservation Association (IPIECA).

Millennium Ecosystem Assessment 2005. Ecosystems and human well-being: synthesis. Island Press, Washington, D.C.

NOWPAP - The Action Plan for the Protection, Management and Development of the Marine and Coastal Environment of the Northwest Pacific Region. Downloaded from: http://www.nowpap.org/RACs.php and http://www.nowpap.org/data/ACTION%20PLAN.pdf

By Dr. Björn Kjerfve, President, World Maritime University, Sweden;
Prof. Chul-Hwan Koh, Seoul National University, RO Korea;
Dr. Gunnar Kullenberg, Professor Emeritus, University of Copenhagen, Denmark; Senior Fellow, United Nations Institute for Training and Research (UNITAR);
Dr. Shigeko Haruyama, Professor, Graduate School of Bio-Resource, Mie University, and International Geographical Union (IGU);
Dr. Cherdsak Virapat, Executive Director, International Ocean Institute (IOI);
Ms. Cristine Ingrid Narcise, Country Programme Manager, PEMSEA;
Mr. Danilo Bonga, Country Programme Assistant, PEMSEA;
Ms. Kazumi Wakita, Programme Officer - Partnership Programs, PEMSEA; and
Ms. Maria Corazon Ebarvia, Consultant, PEMSEA

Saving the Global Commons, CHARTING OUR FUTURE

"There is still time to avoid the worst impacts of climate change, if we take strong action now."
Sir Nicholas Stern

Setting the Context: Climate Change and the Global Commons

We have, from time to time, been reminded of the 'tragedy of the commons,' a conflict in public resource exploitation between individual benefit and group benefit. In his seminal paper, Garrett Hardin argued in 1968 that users of a commons (e.g., pastures, fishing grounds) are caught in a predictable process that leads to the destruction of the resources on which they depend. The 'tragedy of the commons' arises when a collectively-owned sustainable resource is wasted through individual overuse and failure to limit their consumption. While no single act of consumption contributes much to the problem, the consequence of all these individual actions is a situation where the commons can no longer sustain overall consumption.

Extending the premise, our *global commons* includes the entire biosphere. In the case of global warming, the sustainable resource is an atmosphere actually capable of absorbing the infrared radiation of the sun without too much warming of the lower atmosphere and oceans. The consumption involves the release of greenhouse gases (carbon dioxide, methane, nitrous oxide, chlorofluorocarbons, etc.), especially through the burning of fossil fuels, and also the destruction of carbon 'sinks' — forests, coastal habitats and vegetation. Collective action will require using less fossil fuels or using them more efficiently as well as maintaining or even expanding the total area of forest cover and other ecosystems.

The pasture is already over-grazed, with well-recognized cases of continued deforestation and depleted world fisheries. In coastal regions, the evidence of environmental change attributable to the growth of human populations and their consumption and production patterns is demonstrated in terms of reduced water quality; destruction and degradation of such critical habitats as estuaries, coastal wetlands, mangroves, coral reefs, and beds of macrophytes and seagrass; the collapse of stocks of important fish and shellfish; deforestation; land subsidence; seawater intrusion into groundwater aquifers; erosion of topsoil; ocean acidification; and even the spread

of the dead zones (Chen). These threats will grow in the future due to population growth and migration to coastal areas, rapid urbanization, and uncontrolled development and resource use.

The problem is that this is no longer a tragedy of the commons in a certain locality. The tragedy is now global in scope. We are facing a warming of the global climate system and there is a clear linkage to human activities (IPCC, 2007). Climate changes are not new — cycles of tremendous climatic changes have happened throughout Earth's history; but in those times, the contributions from humans were nil or very insignificant. During the last 100 years, human activities related to the burning of fossil fuels, clearing of forests and agriculture have resulted in a 35 percent increase in carbon dioxide (CO_2) levels in the atmosphere, causing increased trapping of heat and warming of the earth's atmosphere.

In addition to greenhouse gas (GHG) emissions, destruction of important habitats contributes to global warming and climate change. Deforestation and poor land use, which have reduced the absorptive capacity of plants, forests, and soils for CO_2, have made things worse. Degradation and loss of marine habitats also contribute directly to increasing CO_2 levels in the atmosphere and ocean. The carbon stocks in coastal habitats, such as mangroves, seagrass meadows, kelp forests and tidal salt marshes, are similar to many terrestrial ecosystems (forests). Not yet accounted for is the carbon sequestration in sediments by coastal habitats.

Understanding the debate

Until recently, climate change has been given relatively low priority on the policy agendas of most developing countries, partly due to more pressing economic development and poverty reduction priorities. Not all developing countries, however, view climate change in the same way. Countries with vast floodplains (like Bangladesh) and low-lying, small island states view their situation from the perspective of a potential victim of sea level rise. Other developing countries with large populations are under international pressure to curb their total GHG emissions, as they are making a major contribution to global emissions, despite relatively low per capita emissions. Most countries fall in between these scenarios. Some developed and developing countries are looking at climate change mitigation and adaptation as an opportunity. With the melting of the Himalayan glaciers, Bhutan is making plans to climate-proof infrastructure and, at the same time, harness potential water supply and hydropower energy (as an alternative energy source and as a climate change mitigation measure) and be a major provider of energy in South Asia. Opportunities for shipping and trade are also being studied. With the melting of the polar cap, states along the Arctic Ocean are viewing cheaper or shorter shipping routes and new energy sources (Kitagawa).

If there is such diversity in how countries view the global phenomenon of climate change, then there is equal or greater diversity among different stakeholders within each country, ranging from ignorance or scepticism to significant concern and voluntary action. Different interest groups structure their outlook on climate change according to their own perceived costs and benefits of action or inaction. Some policymakers and decisionmakers want more research, more data and definitive proof before taking any action, especially when actions call for changes in lifestyles. Others suggest that because we are not certain about how bad global warming will be, we should do little or nothing. The prospect of curbing fossil fuel consumption has already sparked intense policy conflicts within major carbon dioxide-emitting nations. Significant reduction of GHG emissions and arresting rainforest conversion may not be currently achievable given that some national leaders insist upon protecting only national economic interests instead of considering the long-term environmental and economic interests of the planet as a whole. Countries might mean no harm to disappearing island states, but the effects of their GHG emissions are just as devastating as a war. We need to ensure that climate change continues to be a priority in the global policy agenda, integrated into sustainable development and poverty alleviation goals, and both global and local solutions are found and implemented. One part of the research needed is to get evidence of physical and social impacts, including climate-sensitive health risks, effects on food and water security, livelihood and infrastructure, and psychosocial concerns due to displacement. The other part entails finding innovative solutions and effective policy interventions in order to make reluctant groups more aware of the real costs and benefits, especially if they are operating under flawed assumptions, and/or change their assessment of the respective costs and benefits.

However, time is of the essence. A degree of urgency in efforts to research and implement potential solutions is based on the historic failure to control emissions, and the possibility that *tipping points* in the Earth's climate system are just around the corner. If we wait for every single study to be done, and fail to do something now, we will leave the future generations with an irreversibly changed environment and a permanently altered earth. To avoid the worst predicted impacts of climate

change, institutions and individuals around the world must act now. Uncertainty should make us act more resolutely today, not less. Applying the precautionary principle would allow policymakers to make discretionary decisions in situations where there is high risk and evidence of potential harm, and there is a social responsibility to protect the public from exposure to harm, even in the absence of complete scientific proof.

The bad news and why it matters

Several new climate stressors are being heralded: (1) the rate of decline of Arctic summer sea ice extent was 40 percent greater than what was forecasted, which alerted scientists to revise their estimates upwards (Allison, 2009); (2) sea level rise is more likely between 100 to 144 cm, way above the forecasts made by IPCC of between 18 and 59 cm by year 2100 (Hamilton, 2009); and (3) the oceans capacity to absorb CO_2 has started to diminish as much as 10 percent since 2000 which implies that more emissions will remain in the atmosphere (Khatiwala, et al., 2009). The summer sea ice extent in the Arctic reached its minimum in 2007 indicating that global warming and sea level rise is indeed happening (*Kitagawa*). Complex and dynamic social, economic and environmental processes influence the vulnerability of coastal nations to global environmental change, and the ability of those affected to cope, recover and adapt (*Goh*). The Stern report (Stern, 2007) estimated the economic costs and highlighted that sea level rise and climate change will affect agriculture, water resources, forest and other ecosystems, human health and infrastructure of megacities (**Figure 1**). Developing countries will require substantially increased financial resources and technical support for measures to ensure their continued economic growth in the face of climate change.

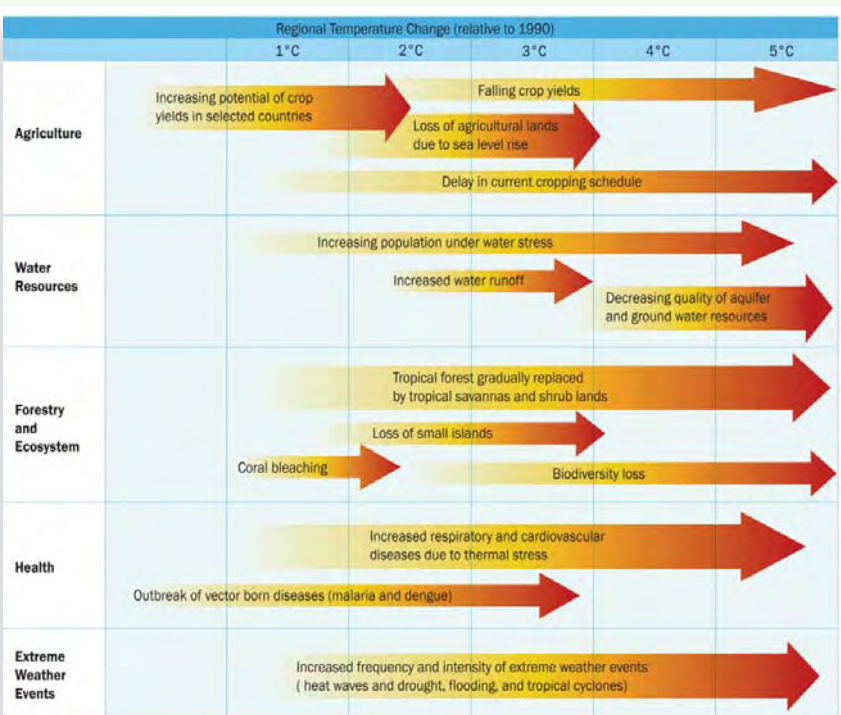


Figure 1. Potential Impacts of Climate Change on Key Sectors.

Source: ADB. 2009. The Economics of Climate Change in Southeast Asia: A Regional Review; modified from Stern (2007)

Coastal areas are at the frontlines of climate change, and will suffer most the full force of climate change. The coasts, oceans and islands (and their inhabitants) are particularly affected by phenomena linked to climate change, which include: the warming of ocean surface water, rising sea level (average rate of 1.8 mm per year from 1961 to 2003), and oceans becoming acidic (IPCC, 2007). In turn, ecosystems and their capacity to deliver goods and services, including carbon sequestration, are threatened. Coral reefs are destroyed by bleaching whereas the slowly decreasing pH of the oceans affects the basic structure of calcium-dependent organisms; the implications of which are detrimental to coral reefs and associated coral reef productivity. Changing wind patterns and sea temperatures affect various oceanographic processes, including upwellings and surface currents, resulting in changes in population abundance and distribution for many marine species, further affecting ocean productivity. Destructive typhoons, which disrupt fishing patterns and seasons, formation of fish schools, and primary and secondary productions, and damage fishing vessels and aquaculture facilities, affect the livelihoods and food security of millions of people dependent on subsistence and artisanal fisheries (Kim and Low).

Moreover, destruction of coastal habitats makes communities more vulnerable to natural hazards. Studies have also shown that coral reefs, seagrasses and mangroves, provide protection as they naturally buffer against high energy waves, even under scenario of sea level rise (David, et al; see **Figure 2**). This functional service has been reduced due to coastal habitat degradation and compounded by climate change effects. For instance, the destruction of the mangrove forests in Myanmar left coastal areas exposed to the devastating force of Tropical

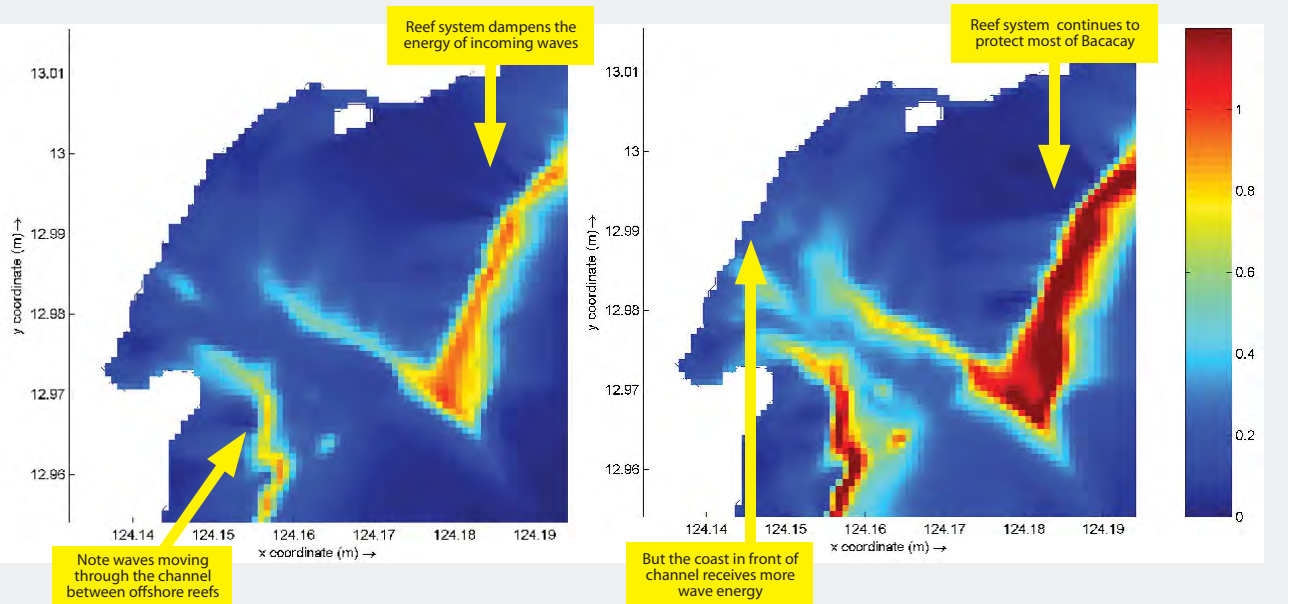


Figure 2. Natural Shoreline Protection Provided by Coastal Habitats.

Under a sea-level rise scenario

Even if sea level was increased by 1 m and wind velocity raised by several orders of magnitude, healthy coral reefs were found to be still effective in dissipating the energy of storm-generated waves.

Source: David, et al.

Cyclone *Nargis* in 2008. The final death toll was at least 146,000, and some 2.4 million people were severely affected by the cyclone (Maung Maung Aye).

Climate change and unsustainable development are adversely impacting marine and coastal ecosystems and biodiversity, affecting their ability to provide critical services such as food, energy, medicines, natural shoreline protection against storms and floods, water quality maintenance, carbon sequestration, etc. The seas of East Asia sustain 30 percent of the world's coral reefs and mangroves; produce about 40 percent of the world's fish catch and 84 percent of world aquaculture; and represent one of the world's centers for tropical marine biodiversity. The countries of Asia and the Pacific are home to over half the world's population, and about two thirds of the world's poor. East Asia's coastal cities also host an estimated 77 percent of the total population, contributing significantly to consumption and international trade of products. Clustered around these coastal cities are traditional resource-based activities, such as coastal fisheries, aquaculture, forestry and agriculture, side-by-side with industry, shipping and tourism.

The Southeast Asian region is the most vulnerable to climate. Keeping "business-as-usual" could leave the region to suffer damages equivalent to more than six percent of GDP by 2100, more than two times higher than the global average (ADB, 2009). Vulnerability mapping covering 530 subnational areas in Cambodia, Indonesia, Lao PDR, Malaysia, Philippines, Thailand and Vietnam showed that the hotspots or most vulnerable areas in Southeast Asia include all the regions of the Philippines, the Mekong River Delta in Vietnam, almost all the regions of Cambodia, North and East Lao PDR, the Bangkok region of Thailand, and West Sumatra, South Sumatra, Western Java and Eastern Java in Indonesia (EEPSEA, 2009). The assessment defined vulnerability as a function of exposure to five climate hazards (tropical cyclones, floods, landslides, droughts, and sea level rise), sensitivity, and adaptive capacity. Population density and extent of protected areas were used as proxies for human sensitivity and ecological sensitivity, respectively; and adaptive capacity was measured based on selected socioeconomic variables, technology, and infrastructure. Indices of vulnerability to climate change were then generated and illustrated through maps (**Figure 3**).

As the Stern report points out, as usual, the poor are the most vulnerable. The IPCC suggests that by 2080, sea level rise could convert as much as 33 percent of the world's coastal wetlands to open water (IPCC, 2007). A third of

Bangladesh will be underwater by the end of this century while the Maldives and a host of Pacific Island states will disappear: our 21st century Atlantis. While it is conceivable that entire populations of small islands in the Pacific might be relocated, there will be no easy international response to the human misery in poor countries that will be reduced to even greater poverty by more violent storms, coastal flooding, droughts, poor harvests and disrupted fishing activities. The poor — with limited adaptive capacity due to low income and poor access to infrastructure, basic services, and education — are often most vulnerable to climate change. They generally live in geographically vulnerable areas that are prone to natural hazards. They are often dependent on climate-sensitive sectors, particularly agriculture, forestry, and fisheries, with practically no chance of moving towards alternative sources of income. In extreme cases, climate change may cause people to abandon their homelands and migrate within countries or across international borders for their survival.

Water, food and seafood security for the region is in question with ever-changing weather patterns. Thus, there is mounting pressure to expand our understanding of how to better manage the socioeconomic risks associated with climate change. Adequate attention to the needs and participation of women, children, the poor, indigenous groups, cultural minorities and other at-risk populations will be important.

Lost in the discussion are the direct impacts on human health and emerging climate change-related health risks. Climate change is expected to increase endemic morbidity and mortality from communicable diseases in Asia. Increases in coastal air and water temperature, and increased flooding and resulting contaminated water supplies will lead to increased occurrence of heat stress, water-, food- and vector-borne diseases, and more virulent strains of cholera, malaria, and dengue fever; aeroallergens; respiratory diseases due to air pollution; malnutrition, food and water security issues; and psycho-sociological concerns due to damages to housing and/or forced migration and displacement (WHO, 2009).

These climate change impacts and socioeconomic losses erode the efforts spent in alleviating poverty and improving the quality of life of the people in the region. Gains made in achieving the MDGs may come to naught.

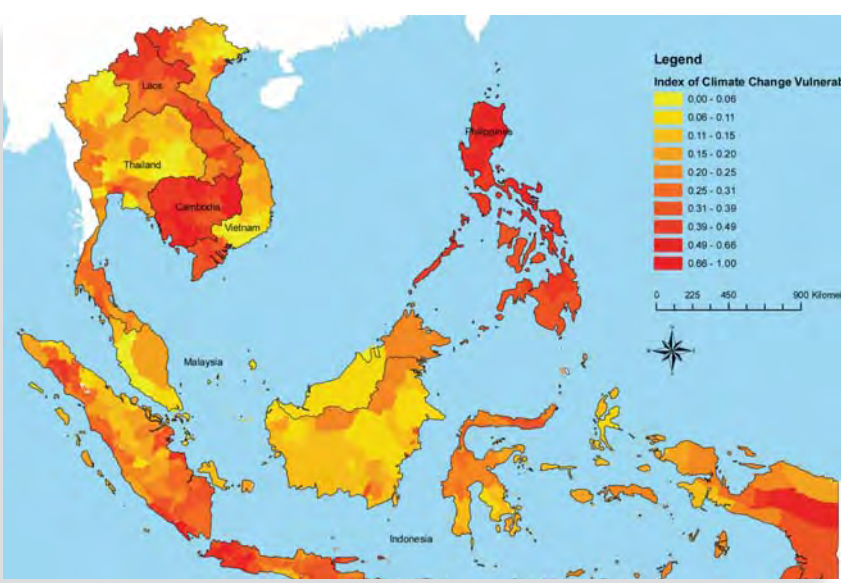


Figure 3. Climate Change Vulnerability Assessment for Southeast Asia.

Source: EEPSEA, 2009.

The good news: Unlocking solutions

Higher benefits compared to cost

Rapidly decreasing forests, constant threats to the world water supply and higher CO_2 levels are reversible trends, but only if we act NOW. Some politicians, economists, scientists and other concerned stakeholders see solutions in climate change mitigation and adaptation policies and actions integrated into the sustainable development framework, combined with public awareness, research, technological innovation, and financing schemes. Such efforts involve significant amount of resources and changes in policies, institutional arrangements, and consumption and production patterns. This would indeed cost a lot, however, it would cost more not to do anything. It is estimated that adaptation for the agriculture and coastal zones of the four countries in Southeast Asia (Indonesia, Philippines, Thailand and Vietnam) would cost about US$ 5 billion per year on average, but that benefits would exceed the cost by 2060, and by 2100, the benefits could be 1.9 percent of GDP compared to the cost at 0.2 percent of the GDP (ADB, 2009). Thus, disaster risk reduction and adaptation measures should be seen as an investment (with future returns), not a cost.

National strategies in place

Practically every country has prepared a national strategy or plan

for addressing climate change in an effort both to arrest further increases in GHG emissions and to cope with already inevitable adverse impacts of climate change (**Table 1**). Supporting institutional and policy reforms include mainstreaming adaptation into sustainable development; integrating shorter term disaster risk reduction and longer term climate risk management; and utilizing climate change models and vulnerability assessments in formulating mitigation and adaptation measures. Actions on climate change adaptation complemented by mitigation efforts take into account GHG emission reduction through reforestation and coastal habitat restoration, reducing deforestation rates, applying clean technologies and energy conservation measures, using alternative energy sources, exploring mitigation potentials of agriculture, and climate-proofing of investments and infrastructure.

For example, RO Korea announced a comprehensive plan for adaptation to climate change in 2008 and a five-year green growth plan in 2009, and has come up with a list of short- and long-term actions that include prediction of and response to the marine impact of climate change and climate-friendly ocean management. RO Korea will also create adaptation guidelines for local governments. In the Philippines, the Climate Change Act 2009 was signed into law last October 2009. It mainstreams climate change into a broader government policy through a National Framework Strategy and Programme on Climate Change; sets up a Commission that will coordinate the country's climate change initiatives; and emphasizes the very important role of local governments.

In PR China, the central government issued the Framework for Adaptation to Climate Change in June 2007. It aims to eliminate management gaps and focus on reducing vulnerability and increasing adaptability of marine ecosystems to climate change using ecosystem-based approaches. Primary implementation measures in the coastal areas include: (1) enhancing legislation and establishing integrated management demonstration sites; (2) developing technologies on ecosystem restoration, biodiversity conservation and vulnerability reduction and transferring these to local communities; (3) capacity building for marine environmental monitoring and early warning; (4) enhancing adaptive measures to sea level rise including engineering and biological strategies, such as shelter belt; and (5) undertaking mangrove and coral transplantation activities in various areas in order to reduce the vulnerability of coastal areas from impacts of natural disasters and sea level rise.

Inundation and flooding in Danang (top). After the Xangsane typhoon (bottom). Photos: Danang Department of Natural Resources and Environment

Available indigenous knowledge and practices

Development of national policy frameworks for adaptation is imperative, but there is considerable opportunity to build on existing institutional frameworks. A good reservoir of indigenous knowledge and local coping strategies to deal with climate change exist in Asian developing countries. In Bacacay, a poor fishing area in Albay, Philippines, the communities have developed several autonomous (self-organizing) adaptation practices in the face of recurring threats and infrequent but extreme events. These include diversification into supplementary and alternative activities, which have helped to spread the risk across more than one income source (Uy). There is a broad scope for integrating such knowledge in local adaptation plans; however, capacity development covering new and innovative approaches to adaptation in local areas must also be considered. Technical, financial, infrastructure, and other measures and forms of support from national government and other organizations are needed.

Initiatives of local governments and communities

While local governments implementing coastal resource management (CRM) and integrated coastal management (ICM) programs have undertaken coastal habitat restoration activities, alternative/supplemental livelihood projects and the establishment of protected areas, these have been previously carried out without direct linkage to disaster management and climate change response. However, such activities have actually increased

local communities' resiliency, and contributed to climate change mitigation and adaptation efforts.

At the local level, projects that involve vulnerable communities in participatory impact assessments and risk management are among the most successful in adaptation capacity-building efforts. These initiatives identify specific "downscaled" climate impacts and associated sectors or ecosystem risks, help reduce vulnerability to localized impacts, and increase the adaptive resilience of vulnerable populations exposed to climate hazards. In Demak, Indonesia, using a participatory approach, key issues were identified (extensive conversion of mangroves to shrimp and fish ponds and coastal infrastructure, saltwater intrusion, coastal erosion, sea level rise), and a corresponding village management plan and adaptation strategy were developed. Short-term and long-term countermeasures were subsequently implemented (e.g., community awareness raising, mangrove planting, use of bamboo as a breakwater, retrofitting of houses by placing them on stilts, and rehabilitation of village infrastructure, such as roads and schools. Harmonization with district and national programs was also undertaken. Other communities have expressed interest to replicate the climate change adaptation efforts in Demak (Diposaptono).

Research and interdisciplinary scientific and technical expertise

At the same time as practical adaptation measures are being implemented at the local level in collaboration with various stakeholders, research and technical analysis in support of longer-term adaptation efforts are also being undertaken. Initiatives planned and conducted by the Asia-Pacific Network for Global Change Research or APN, an intergovernmental network of scientists and policymakers include research in global change issues and providing scientific information for the formulation of on-the-ground strategies and actions (Peñafiel; Perez, et al.).

Developments in science and technology — modelling and forecasting tools, which can now generate climate scenarios at finer resolutions, including subnational levels; environmental and meteorological monitoring; GIS mapping; and nuclear and isotopic techniques, which can be used to understand natural processes and impacts of storm surges and tsunamis — can provide useful inputs in assessing the impacts of future climate change and setting up adaptation and mitigation measures. Decision-support systems also provide options and information for planning and strategy formulation. Early warning systems enhance disaster preparedness and response.

As an example, the Pilot Project on Monsoon Onset Monitoring and its Social and Ecosystem Impact (MOMSEI) aims to improve the understanding and forecasting of the Asian Monsoon by strengthening the monsoon monitoring capability in the Andaman Sea. The pilot project supports the existing efforts of the Indian Ocean Observing System (IndGOOS). This IOC WESTPAC project is also aimed at demonstrating the value of ocean observation in ecosystem conservation by analyzing the possible link between the Monsoon onset and coral reef bleaching in the Andaman Sea (Yu).

Bridging science, policy and actions to address climate change

The available options to address climate change are: ***mitigation*** to reduce further emissions and rehabilitate ecosystems; ***adaptation*** to reduce the damage caused by warming and increase resiliency in the face of

Table 1: Selected Climate Change Policies and Related Sector Plans in Southeast Asia.

Country	Policies/Plans/Strategies
Cambodia[a]	• National Adaptation Programme of Action 2006 • Strategic National Action Plan for Disaster Risk Reduction 2009
Indonesia[b]	• National Climate Change Action Plan 2007 • Decree No. 206/2005 Afforestation and Reforestation (A/R) CDM projects • Decree No. 14/2004 Afforestation and Reforestation (A/R) CDM projects • National Energy Law/Presidential Decree No. 5/2006 (Perpes) • Law 27/2007 on Coastal Zone and Small Island Management Conduct • Coral Reef Rehabilitation and Management Programme
Philippines[b]	• Philippine Disaster Risk Reduction and Management Act of 2010* • Climate Change Act of 2009 • National Framework Strategy and Programme on Climate Change • Philippines Energy Plan 2004–2014 • Biofuels Act of 2006 • Clean Water Act of 2004 • Clean Air Act of 1999
Singapore[b]	• National Climate Change Strategy 2008, part of Singapore Green Plan 2012
Thailand[b]	• National Strategic Plan on Climate Change, 2008–2012 • National Climate Change Committee (NCCC), chaired by the Prime Minister
Vietnam[b]	• National Target Program in Response to Climate Change • National Steering Committee for implementing the UNFCCC and the Kyoto Protocol

Sources: [a]SIDA, 2009.
[b]ADB, 2009.
*Signed into law on 27 May 2010. (www.philstar.com)




Top: Coral reef rehabilitation in Bali.
Bottom Right: Seagrass planting in Chonburi, Thailand. Photo: Kanchanopas-Barnette
Bottom left: Mangrove planting in Bataan, Philippines. Photo: Bataan ICM Program

related hazardous events; and, more recently, ***geoengineering*** or ***climate engineering*** to reverse global warming (e.g., ocean iron fertilization). Within these options are tools ranging from science-based (modelling, monitoring, vulnerability mapping, comprehensive risk assessment, economic valuation, etc.) to community-based (information, education, communication or IEC campaign, participatory planning, risk communication, livelihood programs, etc.). Capacity development, knowledge management, technology exchange, and financing are also necessary to equip coastal communities to implement adaptation measures and implement and monitor appropriate mitigation measures.

Reversing the tide: Climate change mitigation

Mitigation measures are needed to prevent GHG concentrations in the atmosphere from reaching dangerous levels, as well as to stabilize their atmospheric concentration within a range of 450–550 parts per million (ppm) (IPCC, 2007). There is a need to promote policies for low-carbon, climate resilient growth, and undertake reforms in the water, energy and transport sectors and changes in agricultural and urban development strategies.

Carbon capture and storage (through restoration of 'carbon sinks'), promotion of clean technology and low carbon technology, methane capture in waste management, and ocean-based alternative energy development (e.g., wind power, currents, tides, and ocean thermal energy conversion) are considered the most promising. To make these happen, technology transfer, capacity development, innovative financing mechanisms and private sector participation are essential.

Recognizing the necessity: Climate change adaptation

Adaptation refers to the policies and actions designed and implemented to make adjustments in natural or human systems in response to actual or expected climatic changes and their effects and impacts in order to reduce harm and/or take advantage of beneficial opportunities (IPCC). Climate change adaptation should receive as much attention as mitigation because several countries in the region are already facing the impacts of climate change. Perez and Lee, et al., noted that the focus of interventions must now shift to adaptation measures — to complement mitigation — because of a prediction that global mean temperature and sea level will continue to rise even if we succeed in stabilizing atmospheric GHG concentrations at present levels. A combination of both top-down support and bottom-up engagement approaches is crucial to advance the adaptation agenda in the region. Different approaches to climate adaptation have been suggested, including risk-based, resiliency-focused, ecosystem-based, and no-regrets approaches, as well as integrated management frameworks, such as integrated coastal management (ICM), integrated water resource management (IWRM), integrated river basin management (IRBM) and large marine ecosystem (LME) management to deal with transboundary issues, bridge science, policy and action, improve governance, build functional integration across sectors and enhance partnership synergies.

The key features of risk-based approaches to climate adaptation include: (a) assessment of baseline conditions; the likelihood of climate events based on historic trends and predictions of climate variability and extremes; and potential consequences of climate events for physical, social, and natural systems; (b) hazard risk assessment and management processes; (c) risk-based land- and sea-use planning; (d) cost-benefit analysis of climate adaptation options in terms of reducing unacceptable risks; and (e) development of polices and action plans to reduce risks. The following are some of the monitoring and vulnerability assessment projects, which provide adaptation options:

- A modelling tool — the DINAS-

COAST DIVA (Dynamic Interactive Vulnerability Assessment) Model was used to assess the vulnerability of coastal areas in Southeast Asia to sea level rise (Goh). The DIVA model also showed that adaptation to impacts of sea level rise requires engineering measures to limit damage to human population and coastal resources. Full nourishment (incorporating coastal cover rehabilitation) was the most cost-effective option for minimizing loss of wetland areas, sand and land (with consequent reduction in migration of populations). Dike protection was a better option to mitigate the number of people flooded, land loss due to submergence, and other damages due to flooding from the sea. Results from the DIVA model were combined with a geospatial clustering tool, LOICZ-DISCO (Deluxe Integrated System for Clustering) to highlight similarities and disparities between countries. Beach nourishment effectively mitigated land and wetland losses in Vietnam, Malaysia, Thailand, the Philippines and Cambodia, while dike protection was recommended for Singapore.

- At the local level, a vulnerability and adaptation assessment to climate change was done in Koh Kong Province, Cambodia, using CCSR and CSIRO GCM (CCSR, 2009) models and emission scenarios. Results showed that there would be a 1.35-2.5°C increase in temperature in 2100, and 3–35 percent increase in annual rainfall. The rainfall in four main river basins is predicted to increase between 2 and 15 percent, thereby increasing water flow by 2-10 m^3/s, and a 1-m rise in sea level would put 44 km^2 of the province (0.4 percent of total provincial area) permanently under water and about 56 percent of the settlement areas flooded. In addition to the profound damage to the coastal ecosystem and economies, potential economic loss from damage of infrastructure has been estimated at US$ 21 million.

Resiliency-focused adaptation approaches include: (a) identification of the resilience capacities of physical, social, economic, and environmental systems and their interdependencies; (b) identification and implementation of processes to assess and track community capability to withstand climate variability and extremes; and (c) community-based resilience assessment processes to facilitate coordination and cooperation among different sectors (public, private, and nonprofit/non-State), and across numerous disciplines and tools, such as land use planning, economic development, natural resource management, integrated environmental impact assessment, sustainable livelihood analysis, education, and emergency management. Fisheries management plans must be made or revised to consider both changes in climate and in social systems since lower ocean productivity and more frequent super-typhoons and heavy rains will have significant impacts on capture fisheries and aquaculture production (Kim and Low).

In Bacacay, Albay, Philippines, a sustainable livelihood analysis (SLA) framework, which took into account nearly 50-year regional climate trends (temperature, rainfall, and tracks and frequency of cyclones), typhoon disaster events as well as existing livelihood assets and alternative/supplemental livelihood activities, was applied to determine how the fishing communities have responded to and coped with the disaster events and climate disturbances through the years (Uy).

At the national level, a proposed strategy for prioritizing sites for protection and enhancing resiliency of coastal communities in the Philippines was developed using various remote sensing and numerical model simulations, which considered: the presence/absence of reefs and related habitats; entrainment; connectivity features; variability of environmental exposure; and perceived threats and vulnerability (**Figure 4**). The

Many Pacific Islands now experience flooding of coastal areas due to sea level rise. Photos: Jennifer Henman, The Nature Conservancy

recommendations include prioritizing coastal habitats that have withstood climate fluctuations through decades; prioritizing series of reef areas to ensure sustainability of connectivity corridors; and elimination of specific anthropogenic activities that further exacerbates the vulnerability of the coast to climate change impacts.

Ecosystem-based approaches involve: (a) protection and restoration of natural ecosystems that can provide cost-effective protection against the effects of climate change (e.g., forests, wetlands, mangroves, coral reefs, beaches) in addition to many other environmental services, including carbon sequestration; (b) preservation of biodiversity and making ecosystems more resilient to climate change; (c) protection of populations and infrastructure from the threats of climate change through climate-proofing of infrastructure and implementing ICM programs, including comprehensive risk assessment and management, risk-based integrated land- and sea-use plan, coastal habitat rehabilitation, pollution reduction and water resource management. Some of the key actions taken in the region are the following:

- Bali (Indonesia), Bataan and Batangas (Philippines), Chonburi (Thailand) and Danang (Vietnam) have institutionalized the integrated coastal management (ICM) program, which includes the establishment of an interagency and multi-sector coordinating mechanism, conduct of public awareness, and mobilization of different stakeholders in carrying out various habitat and resource protection projects (e.g., mangrove planting, coral and seagrass transplantation, sea turtle and wildbird sanctuaries, beach restoration, greening and reforestation, fishery reserves, etc.).
- A network of marine protected areas (MPAs) under an ICM governance framework is expected to increase ecological resiliency, protect biodiversity and decrease social vulnerabilities. In addition, an MPA network is a strategy for accelerated and synergistic effects, and in the long run is more cost-effective (David, et al.). The existing functional networks that have been established in the Philippines, such as the MPAs Support Network (MSN) and inter-local government unit alliances showed that the cost of enforcement has been reduced by 50 percent as well as increased the area of effective enforcement by 100 percent.
- Conservation of wetlands is critical in Amur River, an international river that crosses China, Mongolia and Russia. Remote sensing data and numerical analysis of precipitation, river flows, flooding and wetland area showed correlation between precipitation and wetland area, and estimated the distribution and probability of maximum monthly precipitation (Murooka, et al.). A regional plan among the concerned countries was deemed essential since the wetlands on the floodplain serve as a buffer zone and as a flood control basin.

The no-regrets approach involves climate-related decisions or actions that make sense in development terms, whether or not a specific future climate change threat actually materializes. While operating under conditions of uncertainty regarding future climate impacts and trends, near-term development outcomes are maximized. In Hawaii, USA, government responses focused primarily on beach erosion and the conventional designation of hazard zones. Current adaptation efforts include: beach nourishment; setting of shoreline setback to at least 40 ft (12.9 m); designation of special coastal zone management area extending to a minimum of 300 ft (91.44 m) landward from the shoreline and where land use requires county permits subject to coastal management policies and conditions; mandated designation of tsunami zones, flood hazard zones and more rigorous building codes; and flood insurance in designated flood zones.

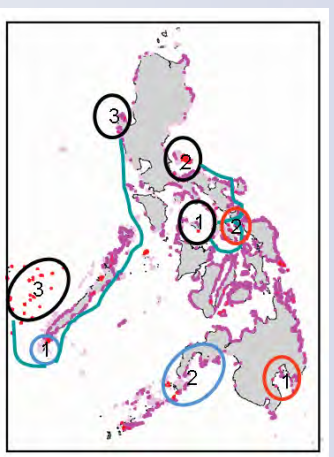
Countering a 'culture' of disasters

An increase in global temperature will also change the amount and pattern of precipitation (**Box 1**). A drastic change in the occurrence of natural hazards in the Asia-Pacific region will render

Figure 4. Priority Sites for Protection Based on Reef Features.

Recommendations:

- **offshore reefs that are less vulnerable to thermal stress and storms**
- **reefs that have withstood thermal fluctuations through decades**
- **food security**
- **prioritizing series of reef areas to ensure a sustainable exchange of larval supply through connectivity corridors**

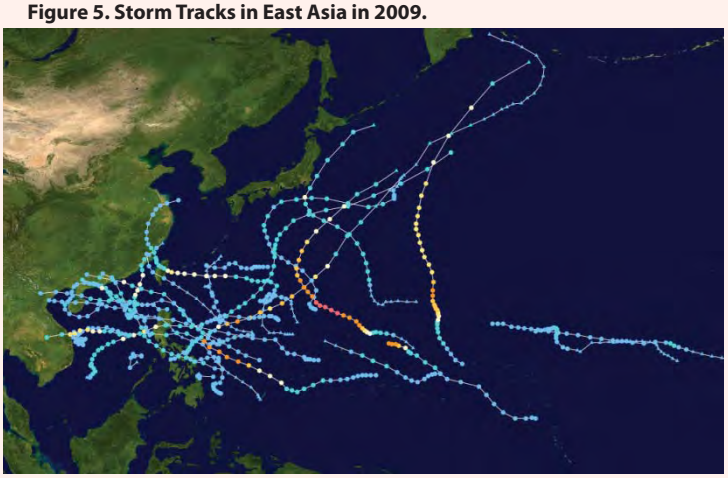


Source: David, et al

Box 1. Changes in Precipitation Volume and Patterns.

A drastic change in the occurrence of natural hazards has been observed, rendering coastal areas and islands prone to destructive storm surges, erosion, riverine flooding and inundation, resulting in huge economic losses. In the eastern Asian region, 20 storms were recorded entering the Philippine area of responsibility during the 2009 typhoon season; 10 of which were typhoons and three were considered super typhoons (**Figure 5**). More than 2,000 people died and losses of about USD 5.6 billion were estimated.Some experts considered these numbers to be severe under-estimates (*Kim and Low*).

Figure 5. Storm Tracks in East Asia in 2009.



In Taiwan, although the average amount of precipitation has shown no real change in trends over time, the number of raining hours is decreasing but the events with significantly heavy rains are increasing, e.g., in three days, 3 m of rain was estimated in Xiaolin Village, causing extreme flooding (*Chen*). In the Philippines, in September 2009, Typhoon *Ondoy* (or *Ketsana*) dumped 341 mm of rain in only six hours — almost equal to the average monthly rainfall in Metro Manila of 392 mm (*Perez*).

coastal areas and islands prone to destructive typhoons/cyclones, storm surges, erosion, landslides, riverine flooding and inundation; and cycles of drought and frequent heavy rains, resulting in destruction of natural resources, disruption of agriculture, damages to vital infrastructure, settlements, and facilities that support the livelihood of coastal communities, and loss of human life. Some countries have technological solutions like barrages to deal with such events as super typhoons, heavy precipitation and flooding, but most poor countries do not have these capacities (Chen).

Disaster management is becoming more important in light of the recent natural disasters that resulted in damages in the region. Importance of knowing how to prepare and respond to disasters has also led to the evolution of disaster management from an almost ad-hoc response to nature's disturbances to a holistic system of adaptation and preventing and mitigating risks. Disaster risk management and disaster risk reduction approaches are areas for immediate adaptation intervention to ensure resilience against extreme weather events and anticipated climate impacts.

Although international, national and local efforts to mitigate the effects of natural hazards, including infrastructure, were set up before, these seemed inadequate given the increasing frequency and severity of disaster events in recent years. Countries are facing several major challenges to address disasters in the immediate and short terms, while combating climate change in the long run: lack of institutional capacity to prepare and implement disaster preparedness, response and recovery plans; weak collaboration among key agencies/sectors and communication gaps between governments and communities for effective early warning, mitigation and preparedness; inadequate resources and equipment to prevent disasters from occurring as well as to effectively deal with the hazards and disasters at hand; and lack of common understanding of preparedness and prevention arrangements and respective roles and responsibilities. The threat of climate change and its consequences also put a global perspective on an otherwise local concern.

In order to address the priorities of the *Hyogo Framework for Action 2005-2015*, many countries have undertaken wide-ranging institutional and policy changes to strengthen disaster risk reduction (DRR) and to develop national early warning systems to tsunamis and other coastal hazards. New ways of addressing disasters have taken advantage of the advances in computer models and information and communication technology, involve the integration of various disciplines, and highlight the importance of stakeholder awareness and participation, scientific inputs, coordination, governance and policy reforms at the local and national levels. Focus has been made on developing a comprehensive climate policy within the sustainable development framework, which includes: (a) science-to-action strategies; and (b) a major rethink in governance for local government development and continued economic growth

notwithstanding the impacts of natural disasters and climate change. The challenge is for local governments to localize the Hyogo Framework for Action, change mindsets from disaster response to disaster risk reduction and preparedness, and bring disaster risk reduction to a higher level of significance.

Disaster management and climate change response within the sustainable development framework

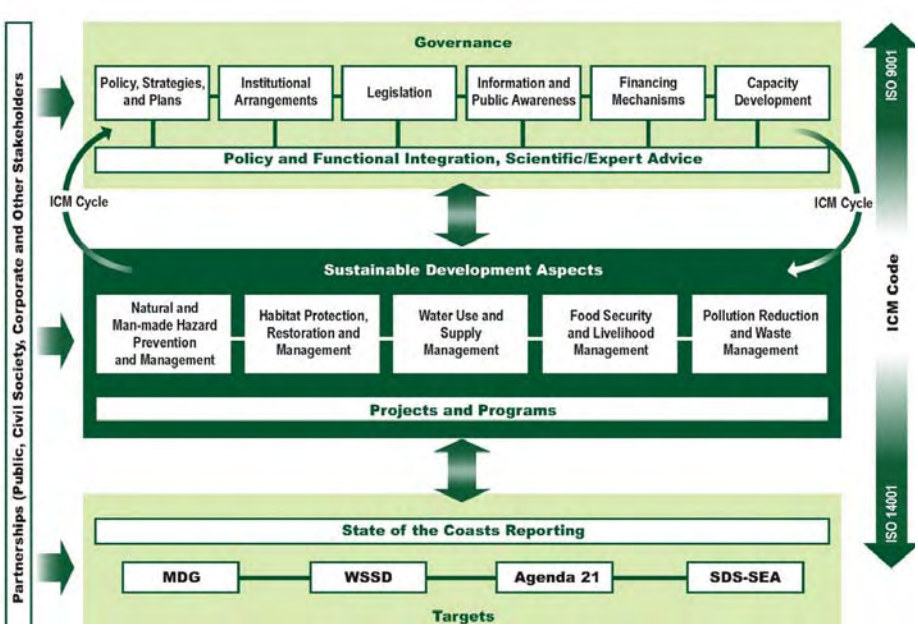
Sustainable development can reduce vulnerability to natural hazards and climate change by enhancing mitigation and adaptive capacity and increasing resilience (IPCC, 2007). The practical experience in the application of ICM in the East Asian region over the past 15 years has led to the development of a common framework for sustainable development of coastal areas (**Figure 6**), which covers a system of governance as well as several issue-specific management systems critical to achieving the overall goals of sustainable development, including climate change adaptation. ICM is an accepted framework in the coastal area, with demonstrated ability to generate and support development. The ICM approach can also meet the requirements to address climate change adaptation and disaster risk reduction, including mainstreaming these into local government development plans. It is the local government that is the first responder, and the one responsible for community development and sustainable disaster risk reduction. ICM tools and methodologies can be enhanced further to improve local governments' ability to support climate change adaptation and disaster risk reduction. **Figures 7a** and **7b** provide examples of how ICM can be utilized by local governments to optimize responses to climate change at the local level.

- Within the National ICM Demonstration Project in Danang City, Vietnam, many activities relating to disaster prevention and mitigation were implemented, including public awareness programs on disaster prevention and mitigation, identification of areas vulnerable to erosion and flooding and relocation of settlers to safer areas, intensifying urban greening and reforestation efforts, enhancing meteorological capacity for typhoon, water level and flood forecasting, improving communication systems for fishing boats, strengthening and developing infrastructures such as dykes, shelter houses and shelters for boats, promoting energy conservation and use of alternative energy, and passing priority policies on waste recycling and reuse and cleaner production. Climate change concerns have also been integrated into the other programs of the city including those on population, food security and poverty alleviation.

- In Bali, Indonesia, key actions have been implemented to manage the coastal area, address risks from natural hazards and climate change, and ensure sustainable tourism development: a shared vision and long-term coastal management strategy based on ICM principles were adopted, an integrated land- and sea-use plan was developed and integrated into the Regional Land Use Plan, a Strategic Plan for Coastal Disaster Impact Mitigation was developed, and a Disaster Management Board was created.

- In Bataan, Philippines, private-public partnership (PPP) is an integral and significant aspect of ICM implementation. The various stakeholders have adopted a sustainable development strategy and integrated land- and sea-use plan. The Bataan Coastal Care Foundation, Inc. (BCCFI), composed

Figure 6. Framework for Sustainable Development of Coastal Areas through ICM Implementation (PEMSEA).



Source: PEMSEA

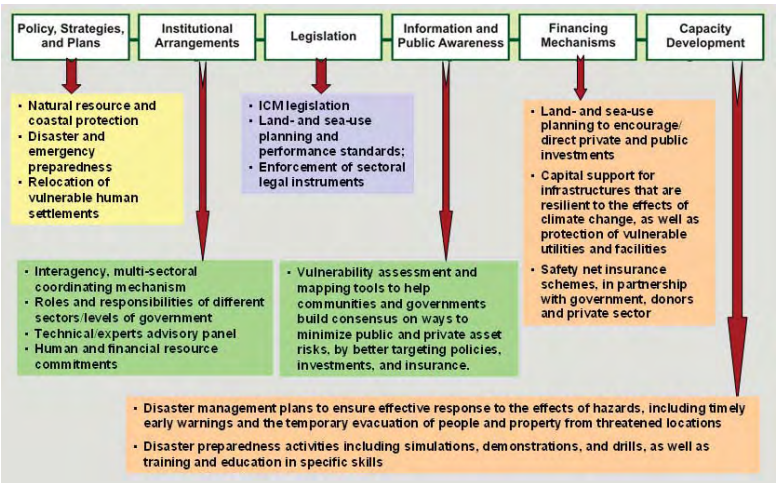
of 17 companies, provides technical support, management expertise and counterpart funding to the Bataan ICM Program to build better coastal governance, increase awareness and promote community participation in coastal and marine environmental and resource management. As part of its corporate social responsibility (CSR) objective, BCCFI and its member companies also are implementing various programs on: habitat restoration, emission and effluent reduction, solid waste reduction and recycling, water management, energy efficiency and environmental compliance.

- In Batangas, Philippines, the management interventions initiated to improve the sustainability and strengthen coastal resilience to the impacts of climate change include: (1) declaration and establishment of marine protected areas (coral reef/mangrove); (2) water quality monitoring (surface and groundwater); (3) advocacy for the prohibition of use of plastic bags on dry goods and regulation of their utilization on wet goods, and prohibition on the use of Styrofoam; and (4) enforcement of fishery and environmental laws.

- Chonburi, Thailand, is strengthening the implementation of its coastal strategy, particularly the action plans related to control of flooding, disaster preparedness and response and other specific actions that tackle climate change-related issues.

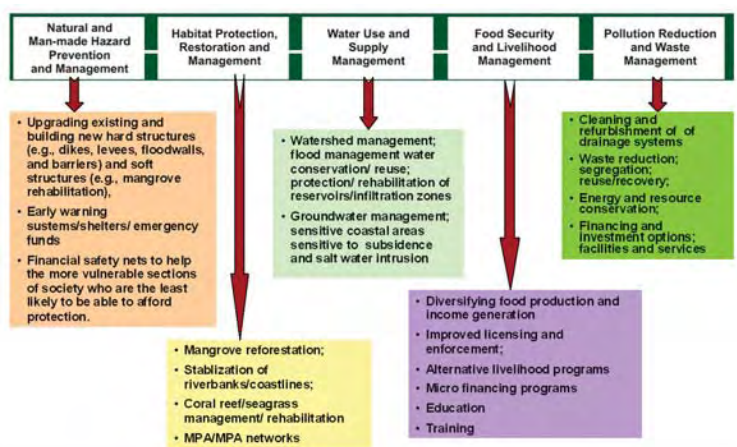
Disaster risk reduction at the local level depends on good local governance, particularly in the formulation of policy, political decisionmaking and enforcement relating to land- and sea-use planning, regulatory controls, zoning, construction standards and environmental standards. A number of tools, frameworks, guidelines, templates and other useful resources already exists and only needs to be adapted or updated for specific use by local government authorities and local communities. In some cases, there are information from and practices by communities and indigenous groups that can be tapped to contribute to policies and plans and can be replicated and scaled up.

Figure 7a. Governance: Some Key Considerations.



Source: PEMSEA.

Figure 7b. Sustainable Aspects.



Source: PEMSEA.

Utilizing forecasting and simulation modelling of climate change

Global and regional climate models are being used to simulate and forecast changes in temperature and precipitation and occurrence of tropical cyclones and storm surges. Downscaling of these models has been applied in various countries to provide more realistic climate simulations as shown in the following examples:

- To simulate future climate change under various emission scenarios, coupled atmosphere-ocean global climate models (GCMs) are usually used (MacGregor, et al.). However, the grid resolution of the GCMs is typically around 200 km, which is too coarse for most islands, or regions with steep orography or complex land use. For the last ten years, downscaling at the CSIRO has been performed with a variable

global atmospheric model, the Conformal-Cubic Atmospheric Model (CCAM). A 60-km simulation can provide guidance on tropical cyclones and be used to drive other models (e.g., storm surge, hydrological, etc.). The 60-km simulations of present-day rainfall in Indonesia and changes predicted in 2080-2100 showed the tendency to become drier over Java and wetter over Sumatra. The University of Hanoi has also started using CCAM for regional climate simulations. It is likely that PAGASA in the Philippines will soon use CCAM for regional climate simulation.

- Future changes in temperature and precipitation in the Philippines were simulated using the global climate model developed by the United Kingdom Meteorological Office - Hadley Climate Centre for Climate Prediction and Research known as HadCM3. PRECIS, a regional climate modelling system was used to downscale the HadCM3 for 1971-2000 as baseline and for future climate change responses (Hilario, et al.). The model results indicate that significant warming will occur in the middle of the next century in the Philippines, with the largest warming occurring in June-July-August and March-April-May over Mindanao. For the annual rainfall, the model projections showed large seasonal variation. Climate change projections of rainfall over the country indicate that June-July-August and September-October-November seasonal rainfall in 2020 and 2050 will exhibit increasing trends.

Integrating disaster risk reduction (DRR) and climate risk management and adaptation

In a comprehensive risk assessment, climate is just one factor in a multiple-stress environment (Perez). Because interconnections between socioeconomic, environmental and climatic stresses exist, it is essential to mainstream disaster management and climate change adaptation and mitigation measures in development processes. Moreover, it is critical to increase scientific understanding and develop the tools and methodologies (e.g., modelling and forecasting climate change impacts, monitoring, vulnerability assessment, remote sensing, GIS mapping, nuclear and isotopic techniques, etc.) necessary for incorporating climate change into risk assessments and risk mitigation decisions. Efforts are being made at the national, city and village levels.

In the Philippines, GIS-based maps, which integrated several layers of information, have been developed (Perez). The maps illustrate risks to projected rainfall change, typhoons, El Niño, projected temperature increase and floods, and show areas where climate-related risks are most pronounced. Local governments can utilize such maps for their economic development plans and strategies on disaster risk reduction and preparedness and climate change adaptation.

To assess vulnerability of coastal cities, data on socioeconomic factors, physical and geological environmental factors, and policies were combined with climate change scenarios (Lee, et al.). The pre-screening of Mokpo City in southern RO Korea served as a test case to highlight the city's exposure and its sensitivity to sea level rise.

In the municipality of Gubat in Sorsogon Province, Philippines, a scientific study on vulnerability of specific sites to impacts of climate change was adopted as a guide to designing and implementing programs and activities on disaster risk reduction and climate change adaptation by the concerned *barangay* (village) councils. Targeted public awareness campaigns facilitated greater appreciation for the economic and ecological importance of coastal ecosystems by the people. Local government involvement in physical assessment and site selection, training on the importance and strengthening of disaster preparedness, appropriate planning and legislations, and coastal environment protection and fisheries management in relation to climate change adaptation were critical in obtaining support for the study and its recommendations.

Adopting risk-based integrated land- and sea-use plan

Various management interventions in the form of action programs, projects, and contingency plans have been developed and undertaken by various national and local governments in response to their priority concerns with respect to natural and manmade hazards. These need to be strengthened given predictions of severe events. For example, comprehensive land use plans of local governments in the Philippines have to be updated, incorporating water- and coastal/sea-use plans. Moreover, an overall disaster response plan can be incorporated within an integrated land- and sea-use plan (**Figure 8**). Such plans provide direction for future developments, reduce multiple use conflicts, enhance conservation of critical habitats, and provide guidance for disaster risk reduction and climate change adaptation measures. To be more effective, these should be combined with market-based incentives (e.g., user fees, tax incentives, etc.) and enforcement of zoning and other regulations.

Applying the integrated environmental impact assessment

An **integrated environmental impact assessment** (IEIA) is also

now more relevant, given that knowledge of cumulative impacts of development and proper land- and coastal use planning contribute to risk reduction. *Natural hazard thinking*, which incorporates geo-hazard, hydro-meteorological and structural engineering evaluation into IEIA for new coastal development projects and human settlements is increasingly gaining importance. This strategy helps in: (1) improving our understanding of vulnerability (and resilience) of existing infrastructure, settlement and ecosystems; and (2) ensuring that new coastal development and infrastructure are not placed in vulnerable areas, and will not result in further damages to ecosystems, which provide important environmental services, including protection from natural hazards.

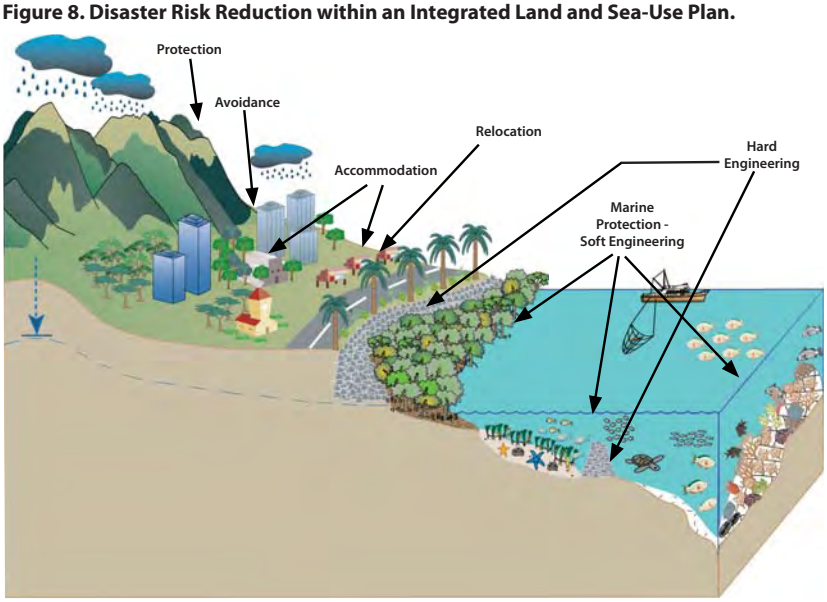
Harnessing the participatory approach and community-based disaster risk management

Most disasters occur due to lack of understanding of the risks, no access to information, failure of communication, weak contingency plans, and lack of capacity and resources for effective response and post-event recovery efforts. Most of the plans have been done at the national level with little participation of the stakeholders at the local level.

To improve disaster risk reduction and response, especially at the local or community level, stakeholders need to cooperatively identify the various risks, understand those risks, and improve the disaster prevention capabilities of their regions by means of their own efforts, so that each region can respond autonomously in case of a major disaster. In 2008, the National Research Institute for Earth Science and Disaster Prevention (NIED) in Japan developed a participatory approach of scenario-based risk communication. This approach allows the integration of hazards and disaster risk data that are scattered in multitudes of regulatory or research institutions. The residents and other stakeholders can: (i) identify and improve their awareness of risk profile and management issues of the disaster risks in terms of risk scenarios; (ii) organize a variety of self-governance and collaborative networks among stakeholders in ordinary times; (iii) build a multi-layered network of disaster prevention systems to make full use of various types of regional resources for disaster governance; and (iv) link these efforts to specific disaster prevention activities tailored to their communities (Tsubokawa, et al.).

As a result of the massive earthquake in Sumatra in 2004 and the tsunami that followed in the Indian Ocean area, it was found that the early warning system was not effective, and disaster prevention and response needed to be strengthened. The Adaptive Learning in Disaster Management for Community Awareness and Resilience Project (ALDC) under UNESCO/IOC was initiated to focus on enhancing people's learning and participation in the planning and coordination of disaster warning, preparedness, response, mitigation, and recovery in order to build up capacity and resilience at the community level. The project has provided strategic integrated models and approaches for interagency coordination and participation of all relevant stakeholders for implementation at the community level in 24 schools/villages in six Andaman coastal provinces affected by the 2004 tsunami. These 24 schools/villages have developed their

Figure 8. Disaster Risk Reduction within an Integrated Land and Sea-Use Plan.



- Protection — of the watershed for freshwater source
- Avoidance — future structures should not be built where the coast is highly varying (intermittent erosion/accretion)
- Relocation — there should be provisions for relocating existing structures in highly hazardous areas
- Accommodation — disaster resistant structures are recommended for essential facilities & habitation
- Soft and Hard Engineering — management of coastal integrity necessitates ensuring existence of healthy coastal habitat that attenuate the incoming wave energy. As necessary, hard engineering structures may also be employed.

Source: David, et al.

The Garbage Bank project in Chonburi, Thailand promotes youth participation in solid waste management.

adaptive community-based disaster management practices which can be expanded to other 490 villages in the tsunami-affected areas of Thailand (Cherdsak).

In Ormoc City, Leyte Province, Philippines, after an extreme rainfall and flashflood event (Tropical Storm Thelma; Philippine name: Uring) in 1991 left 8,000 people dead (20 percent of the city population), a Flood Mitigation Committee, composed of the mayor and representatives from the national government, local government, nongovernmental organizations (NGOs) and communities, was established. Structural measures were put in place, and risk management interventions were introduced with community participation, e.g., a land use plan, which identifies hazard-prone areas; watershed management; river monitoring; solid waste management, etc. (Hipolito).

Mainstreaming informal governance and initiatives

While some national policies and action programs in the region have started with good intentions, the implementation at the local community level has oftentimes been weak or done informally. The following cases show key issues and lessons learned:

a. Importance of integrating formal and informal governance to address underlying hazard vulnerabilities

Despite the radically improved institutions and policies expected to improve the disaster risk reduction (DRR) and early warning system after the 2004 Indian Ocean tsunami, the underlying socioeconomic vulnerabilities to natural hazards still persist. In Thailand's tourism-dependent coastal communities, the most prominent source of post-tsunami resilience of communities has been innovative modes of stakeholder agency or informal governance mechanisms throughout the public, private and civil society sectors. These include tourism bodies, enterprises, family-oriented business groups, NGOs, elite groups, influential families and others. However, such forms of collective action have largely remained informal and are often undermined by the formal governance system. On the other hand, while an informal stakeholder agency can be a positive driving force in building resilience, it can also undermine formal governance systems and cause their collapse at the local level. In this case, a lack of trust and absence of a shared vision of desirable resilience among competing stakeholders from the government, private and civil society sectors weakened the governance mechanism. Lack of monitoring and transparency also created the risk of unethical outcomes and exacerbation of underlying vulnerabilities.

b. Importance of integrating national and local policies, development of local capacity, and mainstreaming informal and local initiatives

The case studies in Tien Hai, Northen Vietnam (Powell, et al.) and Nakhon Si Thammarat, Thailand (Osbeck, et al.) argued that although conservation policies can complement and can have cross-purposes with development policies, implementing them can create conflicts between policy actors (i.e., those recipients of policy interventions, those formulating policies and those implementing them). This observation is particularly shown whenever a policy is transmitted from the national level to the local levels. Powell, et al., cited several reasons why discordance occurs, namely: (1) poor coherence of a national policy prescription with that of guidelines to effect local implementation; (2) the lack of stakeholder participation in the policy development process; and (3) the absence of feedback mechanisms between the policy actors.

Closing the gaps: What the East Asian Seas Region can do

Recognizing the daunting climate change challenge that faces the region, a concerted effort to mainstream climate risk management and adaptation measures into development plans will have to be made internationally, regionally, and at the country and local levels — without losing focus on sustainable development and poverty alleviation goals. A number of recommendations were given at the conclusion of the workshops on climate change and disaster management during the EAS Congress 2009.

a. Policy and enabling environment

Allowing for 'business-as-usual' and 'science-as-usual' are no longer acceptable, as the cost to human societies and ecosystems is too high.

- ICM is a good approach to address rapid environmental change, climate change adaptation, and sustainable development goals.
- Disaster risk reduction and climate change response strategies must simultaneously consider all components of the ecosystems and socioeconomic system rather than specific functions in isolation.
- Local adaptation using ICM tools, such as integrated land- and sea-use planning, setback and hazard zones and permits, should be implemented using climate change science.
- The longer-term mitigation efforts and adaptation responses to climate variability need to be coupled with shorter-term disaster risk reduction responses to extreme events to ensure a comprehensive risk management approach as well as guarantee food and water security, biodiversity and ecosystem integrity, and community resiliency as well as reduce losses and damage costs.
- Institutional arrangements that would allow more effective collaboration and coordination among different government agencies, non-State organizations, academic and scientific community and local stakeholders, and mainstreaming of informal initiatives are essential for early warning, disaster prevention and response, and climate change adaptation.
- In addressing global change issues, including climate change, it is imperative to develop national framework and strategies and to strengthen local implementation and enforcement. Mechanisms for co-management by governments and local communities for disaster risk reduction and climate change adaptation should be explored/ strengthened.
- Poverty alleviation measures contribute to climate change adaptation by reducing vulnerabilities and enhancing resiliency. International and national commitments and efforts to meet the MDGs must be given top priority and continuously pursued.

b. Capacity development and technology transfer

Capacity development for institutions involved in the planning and management of responses in vulnerable sectors and regions is one of the most pressing climate change needs in the region. Integration of climate change impact and adaptation considerations into development planning is a relatively new policy area.

- Capacity-building activities and technology exchange are essential to equip coastal communities with the capacity for adaptation to climate change, for deploying and monitoring appropriate mitigation measures, and to use new technologies.
- Development of capability to generate and interpret computer modelling results, GIS maps and vulnerability assessments is needed for formulation of policies and action programs, and dialogue with users and other stakeholders. Capacities of stakeholders to use information and communication technology (ICT) for disaster risk reduction need to be strengthened.
- In order to strengthen the initiatives at the local, national and regional levels and share good practices and lessons learned, a regional training course on disaster management should be designed and developed, especially for middle-level management.
- Local communities need to be empowered to become responsible stewards of their resources to prevent the

Radio drama (play) recording is used as a participatory disaster risk communication tool in Japan. Photo: National Research Institute for Earth Science and Disaster Prevention

Sihanoukville in Cambodia practices community-based waste management.

marginalization of local people, establish robust local institutions, ensure the sustainability of marine resource conservation for climate adaptation, diversify local economies and livelihoods, and enhance resiliency in the face of disasters and climate change.

c. Financing

A sufficient level of financing needs to be mobilized to meet the climate change adaptation and mitigation requirements. However, an assessment of the current financial instruments available to support adaptation in Asia suggests that the amount of resources flowing through such instruments is inadequate. Nonetheless, existing funding sources can provide initial support and can be used to catalyze additional financing and investments:

- National and local governments and their constituents should work together in planning the allocation of funds and budget specifications.
- Impediments to access to international fund mechanisms, such as the clean development mechanism, climate investment funds, carbon markets, etc., by developing countries and local governments, must be addressed.
- Innovative financing mechanisms are needed by developing countries to: undertake research, climate change modelling, vulnerability assessment, and comprehensive risk assessment; deploy green, environment-friendly and climate-friendly technologies; shift to clean power generation; climate-proof infrastructure; and carry out other mitigation and adaptation measures.

d. Knowledge management

- A regional platform to support adaptation efforts through the creation of a regional clearinghouse for databases and a compendium of good adaptation practices should be explored.
- Scientists need to be trained in communication in order to effectively raise public awareness and work with local governments and communities in formulating local adaptation plans and actions.
- Good practices have been developed and implemented, and need to be shared, replicated and scaled up to cover more communities, and expanded to cover multi-hazard frameworks.
- Information, education and communication (IEC) campaigns will help the public understand how to limit the causes and deal with the consequences of climate change.

e. Partnership synergies

Enhancing mitigation efforts and adaptive capacity of Asian populations and ecosystems will require multiple actions at various levels. Given that climate change is a cross-cutting issue, coordination among international and development agencies and governments, and engagement of different sectors and stakeholders as partners are needed to work towards global and local solutions.

- ***Local governments***: Given the 'front line' status of local governments, they can provide the political leadership, work with local stakeholders, make available data that reflect realities from the ground, and give feedback from a local perspective on how disaster risk reduction, and climate change mitigation and adaptation actions are being integrated in the local sustainable development processes.
- ***Private sector***: Mobilization of and partnership with the private sector to address environmental and climate issues, initiate investments in clean technologies and waste management, and contribute to habitat and resource conservation efforts is essential.
- ***Academe, research and scientific sector***: Engagement of academicians and scientists is increasingly becoming important to predict and explain climate changes and impacts, and provide inputs to disaster risk

Selected Conclusions and Recommendations for some workshops under Theme 2: Natural and Man-made Hazard Prevention and Management

Presented by Theme Chair: Dr. Cherdsak Virapat

Workshop 2 - Meeting Challenges of Climate Change at the Local Level through ICM

Conclusions:

- Adaptation occurs at local to regional scales. Improved scientific information is needed at the local level.
- Adaptation requires anticipation, investment in information, data, equipment, and warning systems, through international, regional cooperation and networking.
- Adaptation measures need to be included in national economic development and strategic plans.
- Mainstreaming of disaster and risk management.
- Decision-making, plans, strategies need to have a science-base and common sense, and need traditional knowledge of local communities.
- Perception and attitude change is required among stakeholders with respect to integrated management and human security.
- Tourism and insurance sectors are highly motivated to be associated with ICM and climate change adaptation measures.
- ICM is a good approach to address climate change adaptation measures and development.

Recommendations

- Local adaptation, using existing ICM tools such as zoning schemes with setbacks, hazard zones and permit systems should be implemented based on existing climate change science.
- Local governments and their constituencies need to work together in planning the allocation of funds and budget specifications.
- Scientists need better communication with local communities and local governments, as adaptation is site specific.
- Awareness creation and capacity building are required at the local level, including capacity to generate and interpret high resolution data and computer modeling results, as well as other new and innovative technologies.

Workshop 3 - Impacts of Climate Change at the Coastal and Ocean Areas of the East Asian Seas Region

- Active discussion and sharing of experiences between natural and social scientists and policymakers facilitates reaching a common understanding of climate change issues as they affect vulnerability and adaptation in coastal settings.
- East Asia's very rapid environmental change emphasizes the need for integrated coastal management approaches.
- Disaster risk reduction strategies must simultaneously consider all components of the ecosystems rather than specific functions in isolation.
- In addressing global change issues, including climate change, as they affect coastal environments in East Asia, it is imperative to consider national frameworks but local implementation and enforcement.
- Allowing for "business-as-usual" and "science-as-usual" scenarios is no longer acceptable as the cost to ecosystems and human societies is too high.
- Disaster risk reduction and climate change adaptation must be integrated into development planning.
- A re-commitment to the achievement of the MDG goals to reduce poverty is of paramount importance in reducing vulnerability of coastal communities to climate change.

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- Immediate attention for countries and governments is to co-manage disaster management with local communities focusing on an adaptive management approach, and sharing of knowledge and lessons learned, planning and implementation of community-based disaster management.
- Civil society and academic institutions have important roles to play in early warning, mitigation and preparedness at the national and local levels.
- A sustainable regional training course on multi-hazards disaster management cycle is needed for middle-level management government officials.
- Major challenges remains, such as communication gaps among interagency departments and between governments and communities for effective early warning, mitigation, preparedness and response.
- Good practices have been developed and need to be shared, scaled up and expanded to cover multi-hazard frameworks and communities.

management plans and climate change strategies.

- ***Civil society***: Cooperation of civil society groups is particularly critical to identify community vulnerabilities, evaluate and implement adaptation and mitigation measures, and to help ensure bottom-up ownership of disaster risk management actions.

- ***Media***: Partnership with the media is vital to raise awareness on the causes, dynamics and adverse impacts of climate change as well as solution options. From print to multimedia campaign, information on the latest developments in policy, science, and technology need to be disseminated, and stories of good practices in climate change mitigation and adaptation need to be told.

- ***Communities***: National strategies for addressing climate change can succeed only with the full participation of the general public and major stakeholders, who need to be persuaded to adjust their activities in a way that reduces their direct emissions, conserves water and energy, and protects the environment.

Looking ahead

As one of the world's most dynamic regions, the rapid economic growth in Asia in the past few decades has helped lift millions out of extreme poverty. But the incidence of income and non-income* poverty is still high in many countries, and achieving the MDGs is still a daunting task. Compounding this problem is the fact that climate change is clearly upon us. Political and public debate — regarding global warming and its causes, degree of likely impacts, irreversibility, and policies and actions to be taken in response — rages on. It has been argued that regardless of the economic, scientific and technical options, the difficulty of achieving concerted political action on climate change, particularly on the significant reduction of GHG emissions and arresting rainforest conversion, requires a mix of approaches and actions at different levels and of various sectors.

The question is no longer whether we can afford to do anything about global warming, but whether we can afford not to. Climate change, if not addressed adequately, could seriously hinder the region's sustainable development efforts, jeopardize the gains made on poverty alleviation, and worse, irreversibly change the planet. As climate change effects continue and increase over the short-to-medium term, and threaten increasing numbers of people, infrastructure, and ecosystems, we need to collectively develop and implement strategies that are technically, financially, and politically achievable. Moreover, while each country faces distinct challenges and needs to prepare and act accordingly, commitment and coordinated responses globally — among countries and among different stakeholders — are also critically important. Crises often compel new thinking about political and social institutions and search for innovative solutions. The necessity to respond to the shared threat of climate change may be the reason that we are devising something more workable. Efforts of national and local governments, scientists, NGOs, development agencies and even small changes in practices of households and communities when replicated by hundreds of millions of people can make an enormous difference — making it possible to reverse the tragedy of the global commons.

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Theme 2 Workshop 2: United Nations Development Programme, Manila

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Special Session on Disaster Management: International Geographical Union

Presentations

Theme 2 Workshop 2: Meeting Challnges of Climate Change at the Local Level Through ICM

Baylon, A. "Addressing Climate change concerns in Bataan and Manila Bay through Public-Private Partnerships: The Bataan Coastal Care Foundation Experience."

David, L., et al. "Climate Change in Coastal Areas: A Community-based Adaptation Approach."

Dieu, N. "Effectiveness of ICM towards Climate Change Adaptation in Danang."

Diposaptono. "Climate Change Adaptation in Coastal Areas Based on Local Issue and Community Participation: Case Study at Demak District, Indonesia."

Francisco, H. and Arief Anshory Yusuf. "Climate Change Vulnerability Mapping in Southeast Asia."

Hilario, F., et al. "Climate Trends and Climate Change Projections in the Philippines."

Kanchanopas-Barnette, Chatchai Thimkrajang and Kashane Chalermwat. "Enhancing Multi-sectoral Coordination and

* Indicators of non-income poverty (or wellbeing) include education, health, nutrition, child mortality, housing, and access to water and sanitation.

Stakeholder Participation for Sustainable Coastal Development and Climate Change Adaptation in Chonburi, Thailand."

Larsen, R.K., E. Calgaro and F. Thomalla. "Stakeholder Agency in the Governance of Resilience Building in Thailand's Tourism Dependent Coastal Communities."

Lowry, K. "Local Climate Change Adaptation Measures in Hawaii."

McGregor, et al. "Development of Climate Change Projections in Southeast Asia."

Navann, O. "Climate Change Impact and Adaptation measures in the Cambodian Coastal Zone."

Sollestre, L. "Climate Change Adaptation in Batangas, Philippines through ICM."

Sombrito, E. and Jae Sol Lee. "Nuclear and Isotopic Techniques in Natural Hazards Associated with Climate Change."

Wen, et al. "Developing the Capacity Of Coastal Areas To Adapt To Climate Change Through Ecosystem-Based Approach."

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Chen, C.-T. A.. "Global Change and Human Activities in the Coastal zone: Implications for sustainable development in Monsoon Asia."

David, L., P. Aliño, M. Atrigenio, C. Villanoy, F. Siringan, W. Licuanan, J. Kho, E. Penaflor; R. Borja; K. Silvano; K. Cordero-Bailey, V. Ticzon; Ma. B. De Venecia; R. Maneja; S. Mamauag; O. Cabrera, M. Magno-Canto, E. Salamante; I. Alabia; E. Magdaong ; Y. Sta. Maria, L. Soria, R. Ramos, M. Samson, V. C. Horigue. "Climate Change Adaptation in the Philippines."

Goh, B.. "Vulnerability Assessment of Coastal Areas in South East Asia."

Ho, J. and J. Ng. "The Arctic Meltdown and its Implications on Shipping."

Kim, S. and Loh-Lee Low. "Emerging Issues of East Asian Fisheries Production in conjunction with Changes in Climate and Social Systems in the 21st Century."

Kitagawa, H.. "Shipping and Climate Change in East Asia: The Impacts of the Opening of the North-East Passage."

Lee, S.-H., J.-H. Hwang, S.-W. Park and K-I. Choi. "National Climate Change Adaptations: Initiative for Climate Change Adaptation at the Coastal and Ocean Areas in Korea."

Osbeck, M., N. Powell and S. Boromthanarat. "Coastal Change and Stakeholders' Realities: A Case Study from Nakhon Si Thammarat Thailand."

Peñafiel, S. "Global Change and Coastal Zone Management issues for the Asia-Pacific region: APN' response in addressing these threats."

Perez, R. "Mainstreaming resilience building and climate change adaptation to the national policy and planning in the Philippines."

Powell, N., M. Osbeck and S.B. Tam. "The Articulation of Co-governance: Stakeholder Agency in Coastal Development in Vietnam."

Uy, N. "Local Climate Change Adaptations: Linking Poverty Reduction, Disaster Risk Reduction and Climate Change Adaptation in Coastal Areas: The Case of Albay, Philippines."

Yu, W. "Monsoon Climate over South East Asia Region and Impacts on Ecosystem."

Special Session on Disaster Management

Cherdsak, V. "Building Community-based Tsunami Early Warning and Mitigation System for Thailand: Adaptive Management Approach."

Haruyama, S. "Community-based Activities for Building Capacity for Mitigation of Flood Disaster from Lessons of the Maruyama River Flood."

Hipolito, D. "Community-based Disaster Mitigation in the Philippines."

Maung Maung Aye. "Tropical Cyclone Nargis; The Worst Natural Disaster to Strike the Southern Ayeyarwady River Delta of Myanmar in Early May 2008."

Minoru Kamoto. "Flood and Sediment Management in Philippines, in View of Cooperation."

Murooka, Mizue, et al. Numerical Analyses of Flood Control Basin Capability in the Middle Part of the Amur River."

Tsubokawa, Hiroaki, et al. "Development of Participatory Risk Communication Method using Disaster Risk Scenario."Method using Disaster Risk Scenario.

References:

Allison, I., et al. 2009. The Copenhagen Diagnosis. UNSW Climate Change Research Centre, Sydney, Australia.

Asian Development Bank (ADB). 2009. The Economics of Climate Change in Southeast Asia: A Regional Review.

CCSR – Centre for Climate System Research, Univerity of Tokyo; CSIRO - Centre for Australian Weather and Climate Research; GCM - global climate models DB. 2009.

Environment and Economic Program of Southeast Asia (EEPSEA). 2009.

Hamilton, G. 2009. In Sea level rise will be greater than predicted, scientists tell legislators. OceanUpdate 14(9):2-3.

Hardin, G. 1968. "The Tragedy of the Commons." Science 162(3859). 1243 – 1248. DOI: 10.1126/ science.162.3859.1243.

Intergovernmental Panel on Climate Change (IPCC), 2007. Fourth Assessment Report. www.ipcc.ch.

Khatiwala, Samar, F. Primeau and T. Hall. 2009. "Reconstruction of the history of anthropogenic CO2 concentrations in the ocean." Nature, 462: 346-349.

Philippine Disaster Risk Reduction and Management Act of 2010. Signed into law 27 May 2010, www.philstar.com.

Stern, N. 2007. The Economics of Climate Change. The Stern Review. Cambridge University Press, Cambridge, United Kingdom.

Swedish International Development Cooperation Agency (SIDA). 2009. Cambodia Environmental and Climate Change Policy Brief.

World Health Organization. 2009. Regional Framework for Action to Protect Human Health from Effects of Climate Change in the Asia-Pacific Region.

Authors

Dr. Ki Dai Kim, Principal Research Scientist, Korea Ocean Research Development Institute (KORDI)
Mr. Alex S. W. Retraubun, Director General for Marine Coasts and Small Islands, Ministry of Marine Affairs and Fisheries, Indonesia (MOMAF)
Engr. Raul C. Sabularse, Deputy Director, Philippine Council for Industry and Energy Research and Development (PCIERD)
Dr. Choi Sang-Ki, Vice President, Korea Environmental Institute (KEI)
Dr. Vicente Tuddao, Executive Director, River Basin Control Office
Dr. Won Tae-Shin, Programme Specialist, PEMSEA
Ms. Kazumi Wakita, Programme Officer for Partnership Programs, PEMSEA
Ms. Maria Corazon Ebarvia, Consultant, PEMSEA

The Nexus of Water, Energy, Food and Environment:

CREATING A RIPPLE EFFECT

Water is our lifeblood, covering our oceans, flowing through our landscapes, rivers and lakes, spanning our atmosphere, and fuelling the processes that sustain all living things.

The picture of a 'Blue Planet' from space forever changed our perspective of the world we live in. It highlights our uniqueness and exposes our vulnerability at the same time. When you look at so many of the world's environmental problems, and socioeconomic and political issues, we can find a link; we can link it back to water. Water is the thread that links the web of food, energy, environment, climate, biodiversity, economic development and human security challenges (**Box 1**). As the most indispensable commodity of human life, water becomes the central theme of the world's environment and development instruments. This is because there are no alternatives to water. This is our predicament: there is no way of maintaining life and achieving sustainable development without securing water. As water becomes

Weather variability, climate change, population growth put a lot of pressure on water resources to meet ever increasing and competing demands for municipal water supply, irrigation and hydropower.

scarce, water security also develops into an increasing and serious concern in most of the countries, and could even lead to geopolitical instability within and between countries.

The causes of water scarcity are plentiful: population growth, pollution, oscillation between El Niño and La Niña, and failure in policy and management, such as disparities between water supply and demand, weak water use regulation and enforcement, over-allocation of water permits or licenses, overextraction of groundwater resources as well as inefficient water use stimulated by inadequate water pricing, among others. Changes in demands, priorities, and environmental conditions all pose considerable challenges to the government policy- and decision-makers, planners, scientists, engineers, economists, and other professionals responsible for managing our water resources and our watershed, river and coastal systems. Adding to the challenge is climate change, which affects the hydrological cycle. With anticipated increase in climatic uncertainties, the problem of water scarcity is expected to be exacerbated in years to come. How to achieve growth and development and alleviate poverty while saving our water resources and environment and helping cool the planet involves a difficult balancing act and tough choices to make. Water must be addressed in its entirety, in relation to agriculture, food production, industrial use, and in ecosystem preservation (Sachs, 2009).

There is a need to improve irrigation efficiency to conserve surface and groundwater - producing more crop per drop and more value per drop.

Inextricably Linked by Water

We forget that the water cycle and the life cycle are one.
- Jacques Cousteau

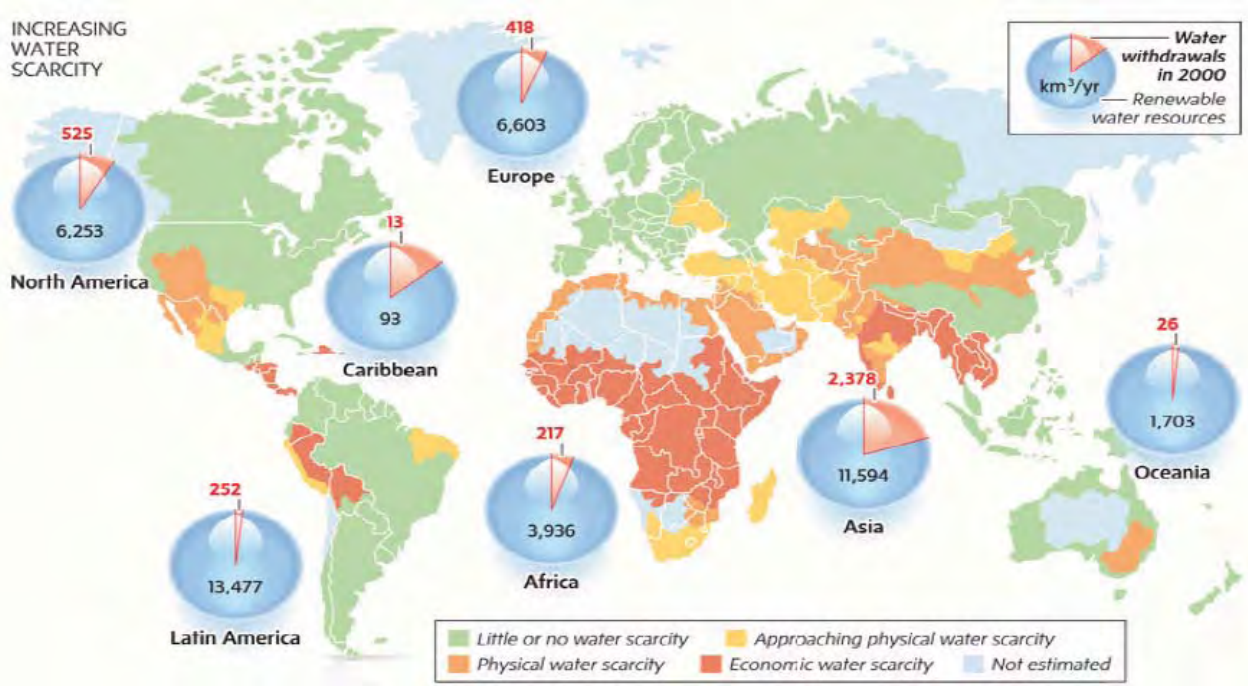
Despite the vast amount of water on the planet, decades of unsustainable management mean that water shortages have reached a crisis point in many regions (**Figure 1**). Globally, humans appropriate more than 50 percent of all renewable and accessible freshwater, while billions still lack the most basic water services (Pacific Institute, 2009). Water security can be defined as the ability to access sufficient quantities of clean water to maintain adequate standards of food and goods production, sanitation and health as well as maintain ecosystems. Water, in absolute terms, is not in short supply in the world. The earth is a

Box 1. Our Water Insecure World.

- 2003: According to United Nations Secretary-General Ban Ki-Moon, the fighting in Darfur, Sudan, resulted from water shortage: Fighting broke out between farmers and herders after the rains failed and water became scarce." Will water become a consistent flash point for conflict?
- 2008: Barcelona begins to import drinking water; Istanbul and Atlanta came close to dry out. Are these patterns the future of water scarcity for richer cities?
- 2008: Due to domestic water constraints, Saudi Arabia makes a policy decision to stop being food self-sufficient. It becomes a cash-rich, water poor state, searching for water and food outside its borders. Is this the future of water geopolitics?
- 2008: The rising costs of oil-based and food stuff commodities start to threaten social stability around the world. Does access to water lie at the centre of the food-energy-trade nexus?
- 2015: The target year for achieving the millennium development goals, but over 40 percent of the planet's population still does not have adequate access to sanitation facilities. Is a world system that fails to deliver on this most basic water service to upwards of 2 billion people living on borrowed time with regards to political stability?
- 2020: As predicted by the IPCC in 2007, there are now up to 250 million climate change refugees in Africa, as water insecurity causes a 50 percent drop in yields from rain-fed agriculture in less than a generation. Will cash-poor, water-poor states simply start failing?

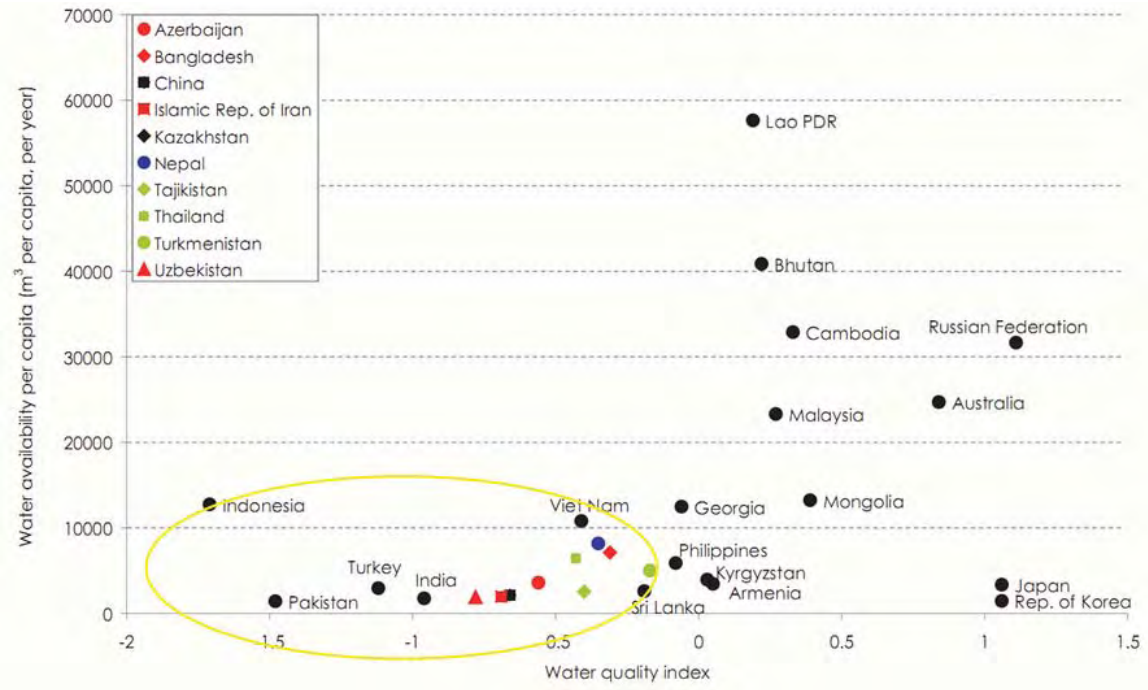
Source: World Economic Forum. 2009. Managing our Future Water Needs

Figure 1. Status of water scarcity.



Source: International Water Management Institute - 2007. Comprehensive Assessement of Water Management in Agriculture. National Research Council, 2009.

Figure 2. Water availability vs. water quality in Asia.



Source: UNESCAP, 2006.

water-rich planet, with annual human and animal consumption that is less than one percent of the world's total water supply. What is in short supply is clean and safe water that people can afford to buy. Some countries face actual physical water scarcity wherein water resource development exceeds sustainable limits or where more than 75 percent of river flows have already been withdrawn for agricultural, industrial and domestic uses. However, some countries face only economic water scarcity – human, institutional and financial capacities limit access to water supplies even though water resources are available to meet local water demands.

What is the water situation in Asia? Very serious. The water challenge in Asia stems mainly from the growth in population and economy. More than 60 percent of the world's population live in Asia and Pacific, two-thirds of the global population growth occurs in this region, urban population will be increased by 60 percent in 2025, but Asia accounts for only 36 percent of the world's water (Asia Society's Leadership Group on Water Security, 2009). Moreover, around 477 million people in this region have no access to safe water supplies, and 1.8 billion people have no access to improved sanitation (UNICEF-WHO Joint Monitoring Programme, 2010). Most of the Asian cities discharge their wastewater untreated – polluting groundwater, rivers and coasts. Between 30 percent and 70 percent of drinking water in the region is unaccounted for, partly due to leaking pipes (McIntosh, 2003). In this setting, Asia and Pacific is facing serious water challenges to sustain population and economic growth as water is needed for basic needs, growing cities, food and energy (Jønch Clausen). Many Asian and Pacific countries are already using too much of their water resources, and suffer from both the least available water and the worst water quality (**Figure 2**) (UNESCAP, 2005; 2006). There are significant health impacts of water shortages, quantity- and quality-wise. Waterborne diseases account for roughly 80 percent of infections in the developing world. Increased competition from different users has been a source of tension in many places around the world.

Yet, the way we manage our water resources is still fragmented, compartmentalizing each activity and water use, and forgetting the fundamental linkages and the ripple effects that can be created both upstream and downstream. Water for drinking, irrigation, energy, industrial use, sanitation, waste management, navigation, and protecting ecosystems has been treated separately, with distinct management, political and economic structures.

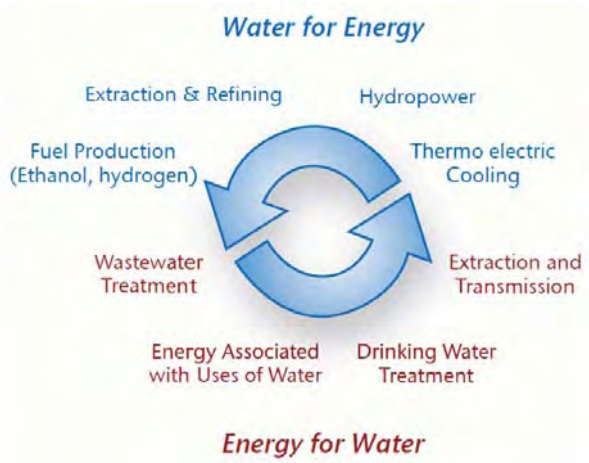
Water and Energy Security: Yin and Yang

Limits to energy are beginning to affect water systems and limits to water are

beginning to affect energy systems. Yet energy issues and water issues are rarely integrated in policymaking. The decisions being made today regarding the management of water and energy resources will deeply affect our socioeconomic and environmental future. Moreover, climate change and other stresses are limiting the availability of clean water and affordable energy. Drastic changes in rainfall patterns and severe droughts affect water reservoirs and hydropower systems. Even thermal power plants, which use water for cooling, are affected by drought.

It takes a considerable amount of water to produce energy (hydropower generation, thermal and nuclear cooling, cultivating biofuel crops), and it requires a significant amount of energy to deliver water (to collect, convey, treat water and wastewater; distribute water; pump groundwater; and desalinate sea water). Both water and energy are used to produce crops – crops for food and crops that can be used to generate energy through biofuels. In a situation of increasing urbanization and incomes, demand for more energy will drive demand for more water; demand for more water will drive demand for more energy (**Figure 3**).

Figure 3. Water for Energy, Energy for Water



Source: Paul Reiter / International Water Association

Energy production accounts for about 39 percent of all water withdrawals in the United States (and 3 percent consumption) and 31 percent of all water withdrawals in the EU (World Economic Forum, 2009). **Box 2** shows the amount of water needed to produce energy, by type. Water is needed by industry and power plants for cooling processes. Even if most of the water withdrawn is not consumed, it is returned to the water body after a rise in temperature, thereby creating thermal pollution, which affects fisheries and aquatic ecosystems. Energy conservation measures can therefore help reduce

Box 2. Water Required to Deliver Energy.

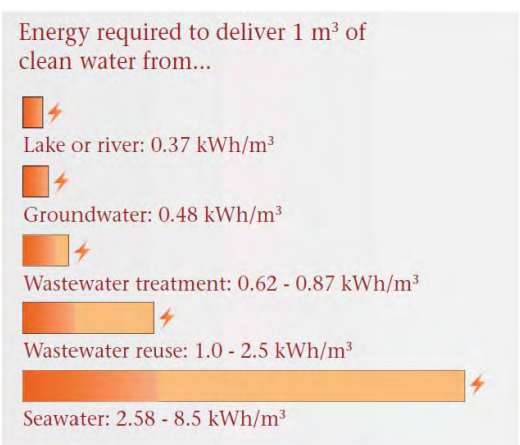
Water consumed to produce 1 MWh of electricity:

Wind turbines	0 m^3/MWh
Solar	0 m^3/MWh
Natural gas	0.2 m^3/MWh
Coal	0.7-3.0 m^3/MWh
Nuclear	0.9-3.3 m^3/MWh
Oil/petroleum	0.1-6.5 m^3/MWh
Hydropower (from evaporation)	17.0 m^3/MWh
First generation biofuels*	32.3-360.0 m^3/MWh

* The water intensity of biofuel feedstocks depends on the feedstock used and where and how it is grown. Irrigated crops are much more water intensive than non-irrigated ones. The higher numbers shown represent crops that are irrigated, while the lower numbers represent non-irrigated crops.

Source: World Economic Forum, 2009.

Box 3. Energy Required to Produce Water.



Source: Scientific American, 2008, with amended data from GHD.

Figure 4. Selected impacts by climate change in the Asia-Pacific region.

Source: UNESCAP, 2006.

water consumption, and consequently, conserve water resources.

On the other hand, a large amount of energy is expended to collect water at source, convey, treat, distribute and use water as well as to treat wastewater (**Box 3**). Energy needs will increase in the areas where groundwater levels are decreasing. This indicates that water-oriented strategies can result in significant reductions in energy use and greenhouse gas emissions. Understanding the energy and carbon implications of water use can inform resource management and policy decisions, and influence the actions of people in important ways.

Water and Food Security: Glimpses of the Future

The volatility in food prices in 2008 should be treated as an early warning sign of what is to come. Projected population increases require additional food production, and growing wealth in countries, such as China and India, further increases per capita food consumption. However, food security does not depend on total food production alone, but rather on access to food, and food that is affordable.

Moreover, growing competition between agricultural and urban uses of high-quality freshwater supplies, particularly in arid, semi-arid, and densely populated areas, will increase the pressure on existing water resources, and consequently on food production. To meet increasing demand for food and water, there is a need to increase the productivity of water already in use, producing more crops per drop and more value per drop — for food, for jobs, for health, and for the environment. This requires: (a) policy reforms in water management and institutional change — solutions that are not expensive, but tough to achieve; and (b) adoption of innovative technologies (e.g., drip irrigation systems) — solutions that often require capital investments, which may be beyond the reach of small farmers, as well as capacity development. Both solution options require time. Adding another facet to food security is energy security. Some

actions taken in response to finding alternative sources of energy, such as the recent expansion of crop production for biofuels, have placed greater demand on valuable water supplies, posing a threat to food security. Food crops now have to compete with energy crops for scarce water.

We also have to consider the environmental impacts of increased food production. Agricultural crops, livestock, and fisheries are completely dependent on predictable supply and good quality of fresh or marine water. Approximately 80 percent of all freshwater consumed on the planet is devoted to agricultural production, often in irrigated systems that are inefficient and environmentally unsustainable. More land is needed for crop and livestock production, and so more forest and watershed areas have been cleared. Living aquatic resources harvested from both freshwater and marine ecosystems, including aquaculture systems, supply 15-20 percent of the animal protein consumed worldwide. However, the increase in aquaculture farms has been accompanied by destruction of mangroves and degradation of coastal aquifers due to overextraction of groundwater in many areas. Livestock wastes, agricultural runoff and feeds from aquaculture farms are also affecting the quality of water bodies.

Water and Climate Change: Parts of a Single Equation

As atmospheric concentration of carbon dioxide is increasing, global warming will also continue for some considerable time in the future. Global warming causes serious problems in food, water, ecosystems, extreme weather events, and irreversible changes and these negative consequences are already happening across the world (Stern, 2007). IPCC report suggests that five key impacts of global warming, i.e., water, ecosystems, food, coasts and health, are all linked to water (IPCC, 2007).

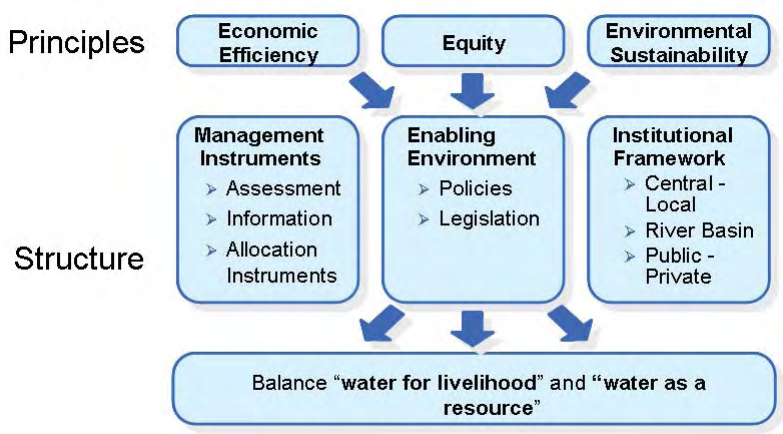


Figure 5. Principles and structure of IWRM (UNESCO, 2009).

Global warming will hit through water, for example, by changes in hydrological cycle (evaporation, runoff and water temperature), increased variability in extremes (floods, droughts and cyclones), and accelerated sea level rise. As a consequence, the mega-deltas of Asia, the small island states, and mega-coastal cities will be hotspots of impacts of climate change. **Figure 4** shows the potential impacts in different countries in the Asia-Pacific region.

When water is the conveyor of negative impacts of climate change, water should be at the center of climate change mitigation and adaptation. Without water as part of the equation, there can be no long-term solution to climate change. Adaptation to climate change involves both hard and soft solutions. Hard solutions include dams, dikes, levees, sewer networks, drainage canals, and desalination whereas soft solutions include demand management through the 3Rs (Recharge, Retention and Recycle), enhanced efficiency, reuse, watershed management, flood proofing, flood retention measures, insurance, and global trade/virtual water.

Making Ends Meet

We all end in the ocean
We all start in the streams
We're all carried along
By the river of dreams.
- Billy Joel

Debates regarding the proper balance between using river systems and coastal areas to support economic activities and growth, and ensuring ecological preservation, date back to more than one hundred years, perhaps since the time of the Industrial Revolution, although the concept of sustainable development came to the fore only in the past two decades. These issues have grown in importance over time, as growing population, rapid urbanization and industrialization, shifting economic values and social preferences, and important traditional uses all place demands on the planet's freshwater resources.

Rivers play a central role in the lives of millions of people, especially in Asia. Ancient civilizations prospered along the banks and delta of Tigris and Euphrates, Nile, Indus and Ganges, Yangtze and Yellow Rivers. Up until the present, rivers provide fish, fresh water, fertile silt, transportation, recreation, and many other essential functions. Ecosystems, such as well-managed river basins and forests, control runoff and siltation and provide natural purification processes and regulate water flows. However, rivers and their catchments — the lifeblood of the region — are increasingly threatened by ill-conceived development schemes. Industrial, agricultural,

domestic water and energy uses can have adverse impacts on ecosystems, including loss of habitat, pollution and changes in biological processes. Such ecosystem impacts also affect the amount of water supplies, and the ability of water resources to sustain ecosystem functions and support socioeconomic benefits.

Impacts of climate change will also materialize through our rivers. We may not be able to avoid the worst impacts of climate change, but a sustained effort to implement mitigation measures (e.g., water and energy conservation, rehabilitation of forest and watershed areas, use of renewable energy) and "no regrets" adaptation measures, such as disaster risk management, better flood warning and evacuation systems, and improved groundwater management could enable even the poorest countries to avoid the worst flood and drought disasters.

Working towards an integrated agenda

As an internationally promoted management framework, integrated water reasources management (IWRM) is usually adopted for freshwater management. It is also widely accepted that IWRM is considered as the best approach to address the impacts of climate change in the water sector (5th World Water Forum, 2009). IWRM is founded on three pillars of principles, namely: economic efficiency; equity; and environmental sustainability (**Figure 5**). IWRM is a process which promotes the coordinated development and management of water, land and related resources in order to maximize the resulting economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems (Global Water Partnership, 2000). On the other hand, water in the coastal area is managed within the framework of integrated coastal management (ICM) as one of the sustainable development aspects (**Figure 6**). The two management frameworks, IWRM and ICM, share common characteristics including intersectoral and functional integration, stakeholder participation, conflict resolution, adaptive management and systematic approach, and ecosystem-based management. The two approaches are also equally recommended by a number of international instruments, such as WSSD, Agenda 21 and UNFCCC.

Being the major water resources in Asia, rivers affect coastal areas through sediment transport and water quality and quantity. Hence, river basin and coastal area should be considered as one continuum and as one system. For example, building dams in the upper Mekong River will severely affect the ecosystems of the downstream areas, the delta of the river and eventually the coast. Also, in Bangladesh, the

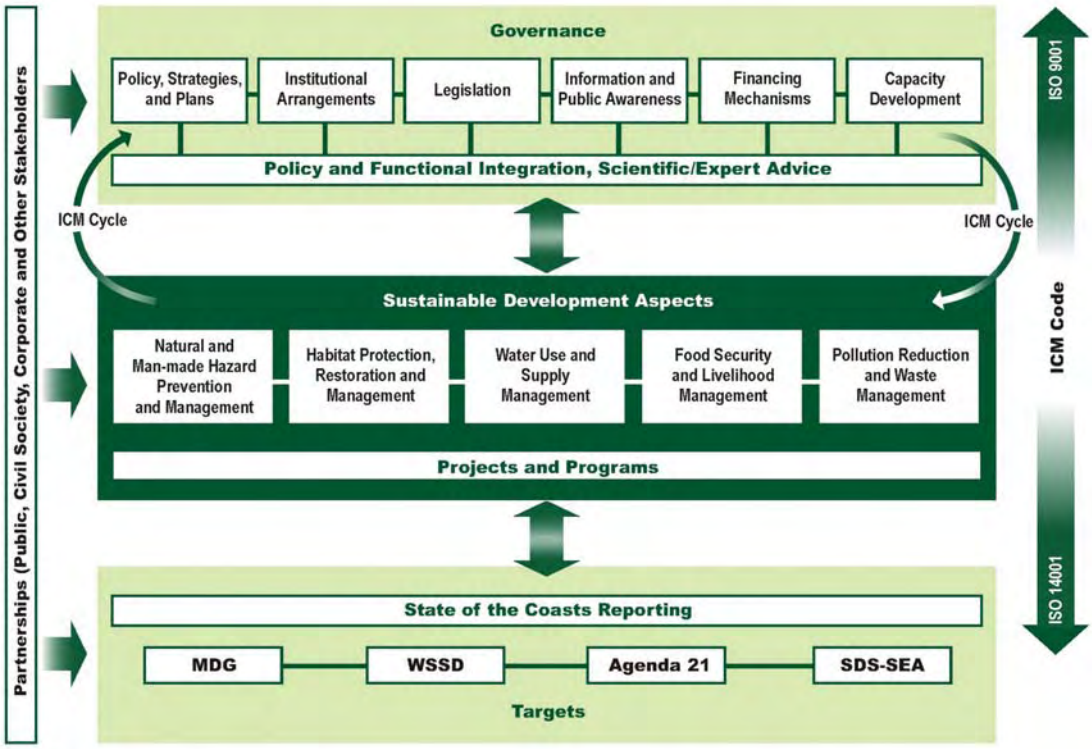


Figure 6. Framework for Sustainable Development of Coastal Areas through ICM Implementation (PEMSEA, 2007).

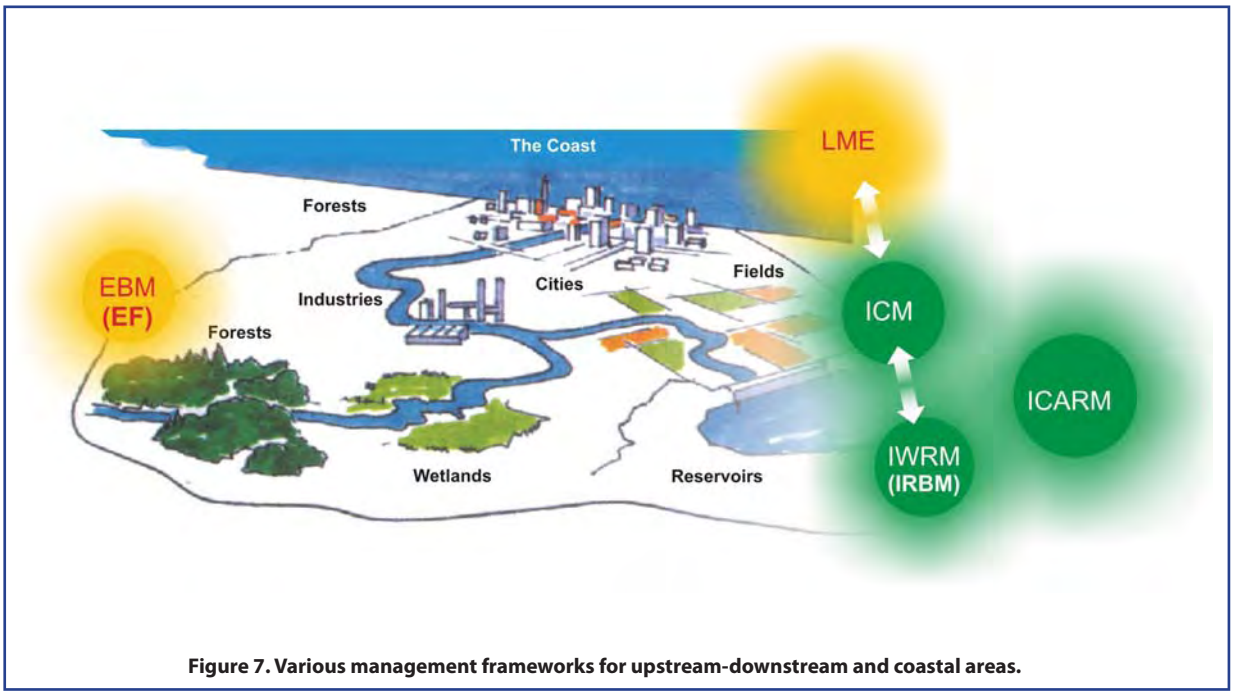


Figure 7. Various management frameworks for upstream-downstream and coastal areas.

Source: Clausen, 2009.

changes in snowmelt caused by climate change will affect the flood pattern, which will in turn affect the downstream development plans, such as hydropower construction, irrigation plan and zoning scheme.

Given this situation, ICM is expanding its management boundaries to upstream areas, which is called functional expansion linking upstream and downstream. Scaling up of ICM to include river basins has been attempted in ICM sites like Xiamen, PR China and Nampho, DPR Korea. There is a need to link the two management frameworks for better coordination between upstream and downstream. One such linkage can be illustrated through the application of integrated coastal area and river basin management (ICARM) programme (**Figure 7**).

Securing Water Resources through ICM Scaling up

Since 2000, DPR Korea has been implementing the ICM program and projects. The designation of Nampho as one of PEMSEA ICM demonstration sites in 2001 has been the fuel for the development of ICM policy within DPR Korea. In 2009, DPR Korea began focusing on the development of a long-term plan for Taedong River as a government priority. Taedong River flows through Pyongyang, the capital of the country, and reaches the West Sea at Nampho City.

Providing valuable water resources to the country's populous cities, the Taedong River is facing various threats, such as: variability of water resources induced by climate change; overexploitation of forests; and deterioration of water quality due to residential and industrial activities. To reverse the deteriorating quality of the river, the long-term Taedong River Management Plan covers five strategic areas: constructing reservoirs for maximizing the water storing capacity; developing programme of water re-use; developing regular environmental monitoring system and control; developing programme for modernization of sewage purification facility; and developing plan for arrangement of ports. Various preliminary studies, including river profiling and framework plan development have been conducted.

Realizing that the successful implementation of the long-term plan is highly dependent on the solidity of the management platform and the capacity of human resources, the government decided to include the Taedong River Management as a part of the ICM scaling up program (Ri). The implementation of the Taedong River management plan is expected to contribute to the achievement of the goals of the Sustainable Development Strategy for the Seas of East Asia (SDS-SEA).

Improving River Basin Management through Lessons Learned from ICM

The ICARM approach is gaining interest in PR China due to its holistic view on environment, economic and social aspects of a sustainable society. For this reason, many integrated watershed or river basin and coastal management programmes are now in place in this country.

In Fujian Province, China, the Jiulong River provides water to 5 million residents of Xiamen, Zhangzhou, and Lonyan City and accounts for 25 percent of GDP of the province (Peng). However, with the rapid economic growth of the

province, the river is facing numerous environmental problems, including discharge of polluted water that causes eutrophication and red tides (harmful algal blooms), reduction of fish species, and degradation of ecosystems. Hence, the Fujian Province initiated the Jiulong River Water Management Plan (JLRWMP), an integrated watershed management plan.

After ten years of implementation, the evaluation of the JLRWMP and the gap analysis on the plan revealed that it is only partially successful, and showed various implementation gaps. Although the plan succeeded in COD discharge reduction, policy and institutional problems remain, such as: (a) lack of integrated watershed management approach to address transboundary pollution issues; (b) no established coordinating mechanism at the watershed scale; (c) the lack of public participation; (d) ambitious goal setting which is not science-based; (e) improper institutional arrangements; (f) low rank of responsible authority; and (g) and limited resources (Peng).

Such problems have been addressed in Xiamen through ICM. The second cycle ICM plan in Xiamen includes the scaling up of ICM to incorporate Jiulong River Basin Management.

The conclusion of the evaluation study is that the most important consideration for a successful implementation of a watershed programme is the political and institutional will of the local government which is very dependent on the economic situation of the local setting. Hence, it was recommended that designing a watershed management programme should consider the local and site-specific social, economic and political background.

From Conflict to Cooperation: Balancing Freshwater and Coastal Water Uses

As a water-scarce country, Japan has a long history of managing water as a valuable resource with sophisticated laws and regulations in place. Almost all rivers in the country have several dams constructed along their path to the sea for water storage and multi-purpose use. As a consequence, annual river discharges were reduced significantly causing decreased nutrients and freshwater flows into the seas, which resulted in declining coastal fisheries and seaweed production. Dams have been blamed to be the main cause of diminishing stock of migratory fish species. Hence, the concept of "Water for the Sea" was introduced, and a law (the Ariake and Yatsushiro Seas Restoration Act in 2002) has been enacted to resolve the conflict between fisheries and other sectors related to water use. This law aims to address water for transboundary use, fisheries, and river and coastal environment.

In Okayama prefecture in western Japan, several consultations among the concerned sectors were conducted to resolve the conflict between the operation of the dam and fisheries. Discharges from dams of Takahashi River and Yoshii River were increased to support the seaweed culture during winter season in 2006. The national administrator of the dams

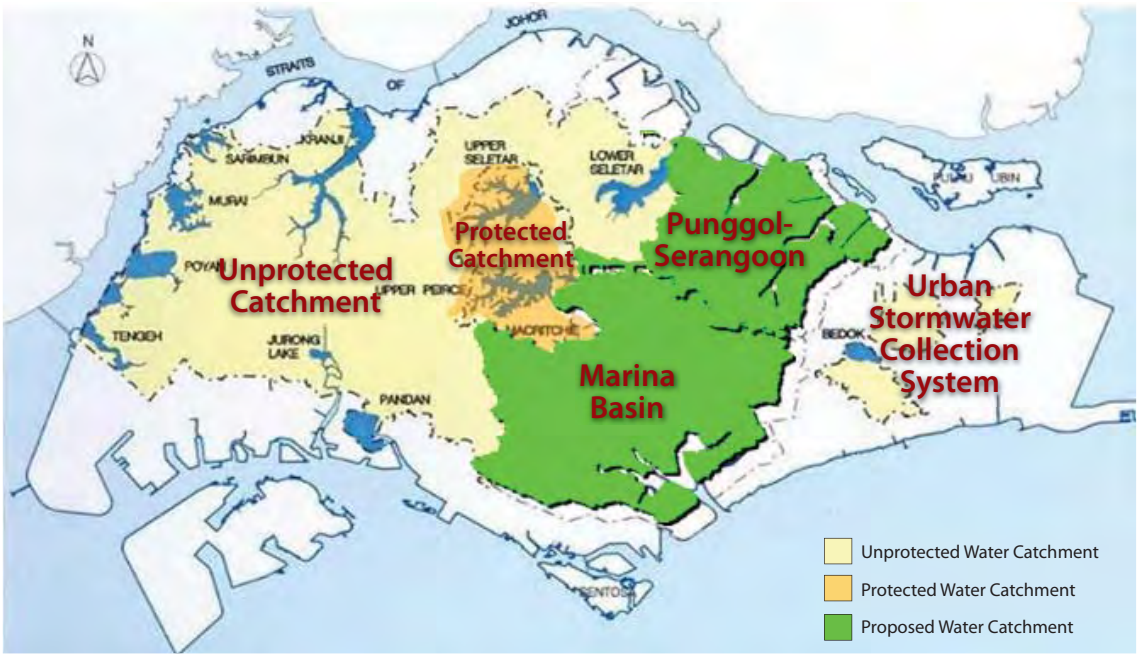


Figure 8. Singapore – A city built on water catchment.

Source: Yeo/PUB Singapore

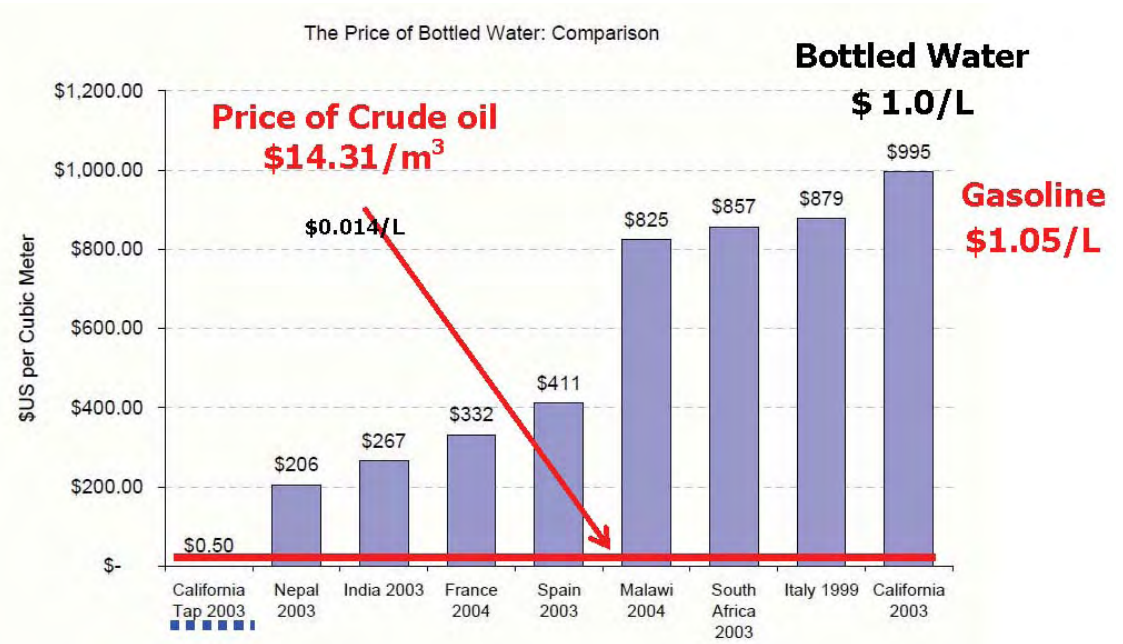


Figure 9. Comparison of bottled water and oil in various countries.

Source: Kim

and rivers took this action as an emergency measure. As shown in the case of Okayama prefecture, public consultations and citizens' participation are considered essential in conflict resolution in water use between sectors. It is also critical to re-optimize the operations of major dams by improving environmental flows while maintaining water supply, hydropower and flood control benefits.

Confronting Water Scarcity: Progress and Initiatives

Water security is being addressed in many countries through a combination of technical solutions (dams and reservoirs, diversion of river flows and desalination) and market-based solutions, involving water allocation rights, water licenses, tradable rights, pricing, and other demand-side management instruments.
As a small island country, securing water in Singapore is treated equally as securing its independence. In this situation, Singapore uses half of its territory as water catchment and will be increasing the catchment area to two-thirds of its territory in 2011 (**Figure 8**). Through the building of the Marina Barrage, the country is able to secure more than 90 percent of water needs within the country, importing only 10 percent (Yeo). The Barrage provides three benefits, namely: water supply, flood control and lifestyle attraction in downtown Singapore. Also, Singapore is utilizing advanced membrane technologies for desalinating seawater to increase water security.

Considering the high population around the barrage, maintaining water quality is also a challenge. Therefore, the government set out the integrated catchment management programme which comprises four main strategies: source control; applying mitigation measure; water quality monitoring and prediction using modeling; and stakeholder participation.

Completed in 2009 and employing the state-of-art technologies, the Marina Barrage became a center of lifestyle destination and tourist attraction of Singapore. As a project of then Prime Minister Lee Kuan Yew in 1987, the Marina Barrage is also a demonstration of how important the political will of a leader is for securing water resource. To share water solutions based on Singapore's experience, PUB, the national water agency, annually organizes the Singapore International Water Week.

More than 97 percent of water on earth is saltwater. As the population grows and freshwater resources are limited, the world is turning their eyes to the sea. Long considered as the Holy Grail of water supply, desalination offers the promise of an unlimited source of freshwater purified from the vast oceans that surround us. Singapore is the exemplary case for using innovative technology for securing water. Today, water from desalination and wastewater reuse through membrane technology is one of the main sources of drinking water in Singapore.

The potential benefits of seawater desalination are great and it is already vital for economic development in many arid and water-short areas of the world, but the economic, cultural, and environmental costs of wide commercialization remain high, e.g., high capital cost, high energy consumption, and environmental issues related to the rejects. Many plants are overly expensive, inaccurately promoted, poorly designed, inappropriately sited, and ultimately useless (Cooley, Gleick and Wolff, 2006).

The public, politicians, and water managers continue to hope that cost-effective and environmentally safe ocean desalination will come to the rescue of water-short regions. Many research institutions, including the Gwangju Institute of Science and Technology (GIST) in RO Korea, are devoted to developing technologies to make the desalination with low energy consumption, low fouling rate, and efficient scaling up to large-scale desalination plants (Kim Joon Ha). It is expected that desalination will become an affordable option for meeting water needs in some areas. For example, California Tap water costs about US$0.5/m^3 which is similar to the price of desalinated water from large-scale desalination plants (**Figure 9**). Considering that the current price of bottled water is about US$1/L and gasoline for US$1.05/L and crude oil for US$0.014/L, future demand for desalinated water will be high. With the advancement of the technology, desalination of seawater is becoming more and more affordable.

However, in many parts of the world, alternatives can provide the same freshwater benefits of ocean desalination at far lower economic and environmental costs. These alternatives include treating low-quality local water sources, encouraging regional water transfers, improving conservation and efficiency, accelerating wastewater recycling and reuse, and implementing smart land use planning (Global Water Partnership, 2000).

In RO Korea, the government is embarking on the restoration of major rivers to address water security issues. Having one-eighth of the global average for available water per capita per year, RO Korea is considered as a water-scarce country (Lee). Confronted with unequal seasonal distribution of precipitation, increasing water demand and deteriorating surface water quality, RO Korea is facing challenges of securing water for economic growth and meeting high standards of living. In addition, climatic variability is causing frequent droughts and floods. Lack of overarching authority and fragmented responsibilities in water management within the government is also a problem.

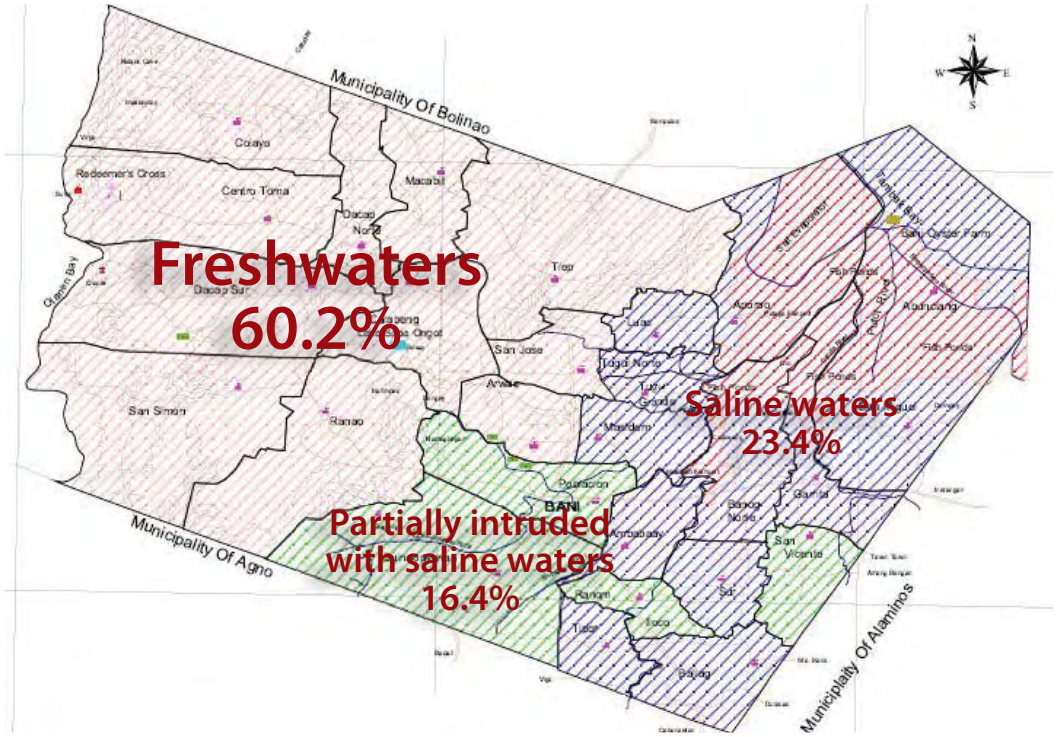
To resolve the water challenges, the government set out a holistic project entitled "the Four Major River Restoration Project" which aims to address water supply, flood control, water quality improvement and ecosystem restoration (**Figure 10**). The project also intends to develop the land areas along the four major rivers (Han River, Nakdong River, Geum River, and Seomjin and Youngsan River), which are relatively underdeveloped compared to the large cities in the country. It is expected that the project will provide comprehensive solutions to drought and flooding, improve water quality, and boost the local economy. The project, costing more than US$22 billion over four years, is a good example of demonstrating how important water security is in RO Korea. As a leading research institute in water management and policies in RO Korea, the Korea Environment Institute is providing research support and solution options for the project.

The municipality of Bani in Pangasinan Province, Philippines, is implementing the Water for Life program for securing its water resources from various threats, such as crowded fish traps in the river that impede ingress and egress of water, the planned operation of a quarry plant in adjacent municipalities, and natural hazards like floods. The dismantling of fish traps and nullification of the plan for the quarry plant operation took several years to resolve as they were brought to the court for a hearing and decision (Navarro).

One of the Water for Life program components is the scientific survey of groundwater resources of Bani. This has been conducted within four

Figure 10. Major components of the river restoration project in four major rivers in RO Korea.

Source: Lee.



Source: Navarro

Figure 11. Groundwater salinity map of municipality of Bani, Philippines.

years, and among the key outputs is the mapping out of saline-intruded areas and freshwater areas (**Figure 11**), providing information for planning and management interventions. Other program components involve the implementation of small water impounding projects, establishment of protected areas, and laying of water pipelines, and these contribute to the protection of groundwater resources. Other important components of the program, such as public participation and consultations and enactment of ordinances by the municipal council, have been carried out. The program is successful in solving water issues in the municipality through the leadership of the mayor. Just like the Jiulong River case in Xiamen, strong political will is essential to the success of local water program implementation.

Addressing Economic Scarcity of Water

Lao PDR has the highest available water per capita in Asia amounting to 55,000 m^3 annually. Although rich in water resources, accessibility to water is more dependent on socioeconomic factors, rather than on the natural environment. Currently, little of the available water resources have been developed to meet the need for safe water and sanitation and for industrial and agricultural uses in the country (**Figure 12**).

In line with the Millennium Development Goals (MDGs), specifically the target to reduce by half the population without access to clean and safe water, the country is supposed to ensure that 80 percent of the total population and 70 percent of the urban population have sustainable access to an improved water source. However, the country adopted a medium and long term policy and strategy in 2004 that set a higher target: to achieve 90 percent access to improved water supply in both rural and urban areas (National Strategy for Rural Water Supply and Environmental Health Sector, 2004). To achieve these goals, a development plan was made by the Water Supply Regulatory Office (WSRO) under the Ministry of Public Works and Construction (MPWC) in 2005.

The government reported some progress towards the implementation of the policy and strategy as well as reaching the MDG water target. The government completed 51 projects in urban areas in 2006, accounting for 31 percent of the total target. However, the country is facing the challenge of sustaining service delivery due to low cost-recovery and inefficiencies in the management of state-owned enterprises that are implementing the projects.

Such is the case with the Pakse Water Supply Development Project in Lao PDR, wherein water service covers only 13 percent of the entire provincial population leaving other residents suffering from water shortage. In Champasack Province, there is only one urban water supply system, located at Pakse District, while other districts use smaller scale community water supply systems. Pakse is susceptible to flooding because the city lies at the

confluence of the Mekong and Xedon Rivers, its central area is relatively flat, and drainage capacity is limited. Pakse has a strong agricultural base, and has been developed as an economic growth center with strong economic ties with the neighboring countries (Thailand and Vietnam). Due to the high population growth rate, water supply facilities and services must also keep up with the increasing demand. However, since a relatively high level of water tariff (compared to capacity to pay) is already being collected, it would be hard to charge additional tariffs to recover costs of investing in expansion and improvement of water supply facilities and services to increase coverage in the unserved sectors or areas (Souphasay). This implies the need for building staff capacity and improving efficiency in operating the state-owned water utilities to lower the costs, enhance the balance sheet, and improve service delivery.

Water as a Socioeconomic and Environmental Good

In implementing water policy and programmes, there are several measures and incentives that can assist and promote water policy. Water pricing is one of the efficient and effective measures to manage water demand as well as water resources. Many past failures in water resources management can be attributed to the fact that water is viewed as a free good. There is a need to change perceptions about water values and price and to recognize the opportunity costs involved in current allocation patterns. Treating water as an economic good may help balance the supply and demand of water, and obtain the maximum net benefits from available water resources. However, we need to distinguish between the value of water and pricing of water.

The full value of water consists of its use value or economic value, option value and non-use value or the intrinsic value (**Figure 13**). The economic value includes: direct use value (drinking, food, agriculture, fisheries, tourism, recreation, navigation, hydropower, etc.), net benefits from water that is lost through evapotranspiration or other sinks (e.g., return flows), indirect use value (biological life-support functions). Whereas direct and indirect use values reflect the value from current use, option value reflects the desire to preserve the potential for possible future use. The intrinsic value includes non-use values such as bequest or existence values. The value of water in alternative uses is therefore important for the rational allocation of water as a scarce resource (using the "opportunity cost" concept).

On the other hand, pricing or charging for water is applying an economic or market-based instrument (water tariff or user fee) to ensure cost recovery, provide incentives for demand management, conservation and efficient water usage, and to signal consumers' willingness to pay for additional water supply or service. The price of water usually covers only the direct cost of providing water (capital costs and operation and maintenance costs), and oftentimes does not reflect the total value of water. **Figure 14** shows the components of the 'price' of water.

In RO Korea, proper pricing is encouraged and the water prices have been continuously increasing to cover the production costs, thereby ensuring quality and sustainability of the service. However, 'lifeline' schemes for the lower income users who cannot

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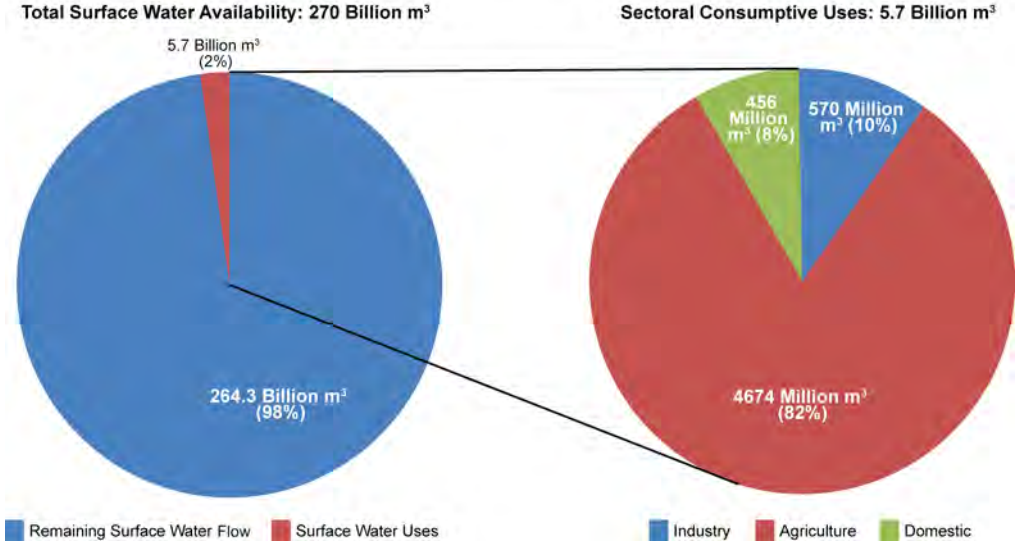

Figure 12. Water Availability and Usage in Lao PDR.

Source: Souphasay


AST ASIAN SEAS YOUTH FORUM
REE PLANTING
ACTIVITY


The East Asian
Partnerships At Work:
Local Implementation And Good Practices
eas congress 2009
23 – 27 November
Philippine International Convention Center, Manila, Philippines
WELCOME

The Second East Asian Seas Youth Forum:

Continuing the Innovation of Youth Involvement

With the theme, "Youth, Oceans and Climate Change", the Second East Asian Seas Youth Forum (YF) brought together 61 young leaders from 12 countries from the EAS region: Cambodia, PR China, Indonesia, Japan, Lao PDR, Malaysia, Philippines, RO Korea, Singapore, Thailand, Timor-Leste and Vietnam on 23-27 November 2009 at the Philippine International Convention Center (PICC) in Manila, Philippines. The young leaders were selected based on their active involvement in youth or environmental organizations and their capacity to carry on the YF outcomes. The lectures during the Forum were also attended by 39 students from Miriam College, Philippines, and junior staff from PEMSEA ICM sites. The 2nd YF was co-organized by the Swedish Environmental Secretariat for Asia (SENSA), the ASEAN Foundation, the Japan-ASEAN Solidarity Fund and PEMSEA.

For five days, the young participants, with different backgrounds and cultures, spoke the language of climate change, environmental issues and threats, and sustainable development, and shared how the youth can contribute to addressing these environmental issues.

Second EAS Youth Forum Speakers

1. HE Ambassador A. Selverajah, Singapore
2. Pres. Fidel V. Ramos, Former President of the Philippines
3. Sec. Jose L. Atienza, Jr., Secretary of the Department of Environment and Natural Resources (DENR), Philippines
4. Atty. Antonio A. Oposa, Jr., Environmental lawyer
5. Dr. Felino Lansigan, Professor, Institute of Statistics and the School of Environmental Science and Management, University of the Philippines Los Baños
6. Dr. Neviaty Zamani, Professor, Department of Marine Science and Technology, Faculty of Fisheries and Marine Science, Bogor Agricultural University, Indonesia
7. Dr. Beverly Goh, Assistant Professor, National Institute of Education, Singapore
8. Dr. Juergen Weichselgartner, Senior Science Coordinator, Land-Ocean Interaction in the Coastal Zone (LOICZ)
9. Ms. Sally Nay, Staff, ICM Project in Sihanoukville, Cambodia and 2006 EAS Youth Forum participant
10. Prof. Raphael P.M. Lotilla, Executive Director, PEMSEA
11. Hon. Senator Pia Cayetano, Philippine Senate
12. HE Mrs. Mean Som An, Cambodian Senate
13. HE Ambassador In May, Cambodia
14. Hon. Dr. Je Jong Geel, Former Senator, RO Korea
15. Hon. Dr. Nguyen Van Cu, Administrator, Vietnam Administration of Seas and Islands, Ministry of Natural Resources and Environment
16. Mr. Manuel Cira, Director, World Ocean Network
17. Dr. Filemon Uriarte, Jr., Executive Director, ASEAN Foundation
18. Dr. Laura David, Associate Professor, University of the Philippines–Marine Science Institute
19. Dr. Ir. Subandono Diposaptono, Director, Coastal and Ocean Affairs—Ministry of Marine Affairs and Fisheries of Indonesia (MoMAF)

Virtual Start

The 2nd YF started virtually through an online networking site, http://easyouthforum.ning.com. Moderated by one of the Philippine participants, the online discussions included the conceptualization for the YF exhibit and the identification of responsibilities, including materials that each of the participants were to bring during the Congress.

Steps Forward: The Youth Exhibit

Through various artpieces, the youth depicted their ideas on the threats our planet is facing and how they can "hand in hand" make it a better place to live in. Photos of their own involvement in environmental activities were showcased, as well as their promise to continue with their work for environmental protection, particularly in ocean development and climate change adaptation and mitigation activities.

From Knowledge and Inspiration to Empowerment

The participants were provided with the "Handbook for Youth, Oceans and Climate Change," which contained practical material to help guide them in planning and implementing activities upon their return to their countries. The Handbook featured environmental activities of selected participants from the 1st YF in Haikou City, PR China. The Handbook also included poster materials and activity sheets that participants can use in their information campaigns related to climate change.

Apart from the handbook, climate change experts, marine scientists and coastal management experts reinforced the earlier understanding of the participants on the pressing issues affecting the environment. The speakers lamented the reality of climate change and together with the other experts, explained the threats it posed to the region affecting all sectors. The speakers pointed out that much is being done and much needs to be done to abate it, however, it is not a hopeless case. They encouraged the youth to use their knowledge and their available resources (e.g., Internet), as well as learn from each other's experiences.

Apart from the scientific and practical information from experts, the youth also had a fair dose of inspiration from an environmental lawyer, a Singaporean Ambassador, the Secretary of the Philippines' Department of Environment and Natural Resources and former President of the Philippines, Pres. Fidel V. Ramos .

Executives of regional and international organizations provided a push towards action by speaking on the available support for the youth for their implementation of environmental activities. Similarly, legislators from the region encouraged the youth to be the beacon for environmental protection. Support for youth activities and the participation of youth in the policymaking process differs in each country; nonetheless, they can all do their share towards sustainable development.

Declaration of Commitment

The "Youth Statement" declared the participants' commitment to the sustainable development of the Seas of East Asia, the protection of the environment as well as their hope for a better planet for future generations. As testimony, the youth developed their country work plans which are sets of simple activities that they promised to undertake in the next three years. The next EAS Youth Forum in 2012 will be informed of the outcomes of their activities.

Translating to Action

Moving out of the confines of the lecture hall, the participants translated their gained knowledge and commitment into on-the-ground action by planting mangrove propagules in the Las Piñas-Parañaque Critical Habitat and Ecotourism Area (LPP-CHEA), a bird sanctuary in the Manila Bay area. They were joined by cadets from the training ship T/S MOL, which they later visited and learned of the training ship's social and environmental initiatives as well as had lively interaction with the ship's officers, cadets and crew.

Beyond the Forum

Back in their own country and communities, the YF participants have already initiated several activities, including a river cleanup (Isabela, Philippines), treeplanting (Timor-Leste), replacement of incandescent lamps to environment-friendly compact fluorescent lamps (CFLs) (Singapore), educating kids (Malaysia and RO Korea), and mangrove planting (Indonesia).

The youth participants have also extended their influence; sharing their YF experiences and building networks with other youths in the international arena. A participant from Vietnam participated in the December 2009 Climate Change meeting in Copenhagen, Denmark, to share his organization's initiatives on youth mobilization for climate change awareness campaigns.

Two youth representatives from Singapore and Vietnam were also invited to share their experiences and the outcomes of the 2nd YF, including their environmental activities








during the 4th World Ocean Network International Meeting in May 2010 in Boulogne Sur Mer, France. During the meeting, they had a chance to meet, share experiences and build friendship with alumni from a Youth Parliament conducted in Reunion Island in 2008.

Four youth representatives from Cambodia, Lao PDR, Philippines and Thailand were also selected to participate in the 5th World Youth Congress on 31 July–13 August 2010 in Istanbul, Turkey; another great opportunity for them to expand their network, not only to youth in the EAS region but to the other regions of the world.

Notable is the inclusion of the Youth Statement and the outcomes of the 2nd YF in the International Youth Proposal presented during the Oceans Day Celebration on 14 December 2009 at the Climate Change Meeting in Copenhagen.

This network of young individuals will continue to inspire and motivate their peers and friends to do something for the environment through the various social media (Ning, Facebook, Friendster, MSN, Yahoo) that their generation is used to.

Clearly the various environmental threats, the potential impacts of climate change are real and probably one of the biggest challenges faced by mankind today. But with a group of well-informed, inspired, empowered and committed young leaders, there is high hope that efforts for sustainable development will continue and will go a long way.

The Youth Statement, country work plans and the Full Report on the Outputs and Outcomes of the Second EAS Youth Forum are accessible at www.pemsea.org/eascongress/youthforum.

Prepared by Daisy Padayao and Vanessa Bautista.

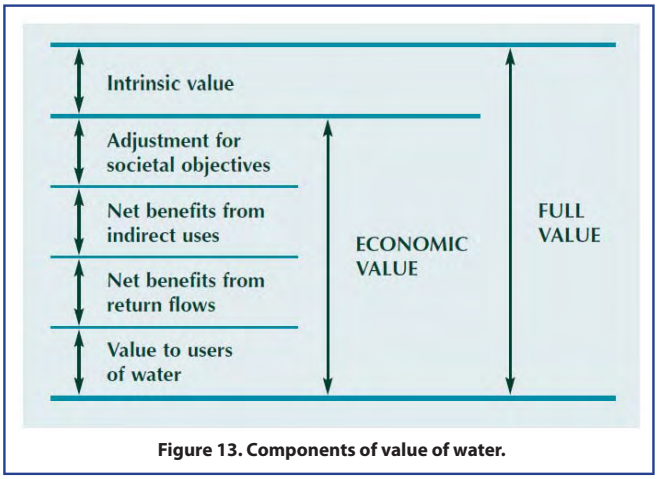

Figure 13. Components of value of water.

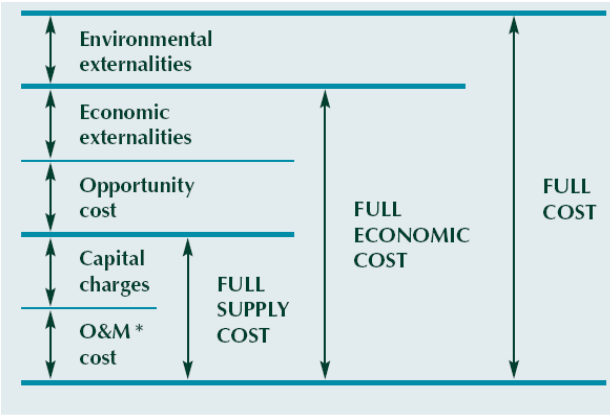

Figure 14. Components of full-cost price.

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afford the water fees are currently under implementation in RO Korea through tariff reduction and exemption provisions. For example, Seoul provides a support on the basic rate of water bill to the lowest income group, and the city of Daejeon supports 10 m^3/month of fundamental use water to the lowest income group.

To protect water resources and keep them as pristine as possible, it is necessary to regulate the upstream watershed area through designation of water resource protection zones. In this situation, conflict between upstream and downstream on land use often arises. To resolve this issue, the Korean government introduced the Water Use Charge in 1999 to introduce surcharge for piped water, and the revenues collected from downstream residents are used to compensate upstream residents for losses due to strict land use regulation (Moon). This is similar to the payment for ecosystem services (PES) scheme. **Figure 15** shows how the revenues from the water use charge are being utilized. The case of water use charges in Korea indicates the possibility of a cooperative solution to resolve the conflict between upstream and downstream residents under a cost-sharing principle. The government played a key role in resolving the conflict, through strengthening environmental regulations and providing a cross-subsidy scheme for affected residents.

In many places around the world, water has been consistently underpriced, wasting and overusing it as a result. Stocks of groundwater have been at the expense of future water needs. Metro Manila and other coastal provinces around Manila Bay are no exception.

The Philippines, a water-rich country, is experiencing various challenges relating to water management including: insufficient coordination among water-related agencies; ineffective regulations on water use and wastewater discharges; lack of regular and systematic monitoring; inconsistent enforcement of laws and policies; inadequate incentives for water conservation and waste management; and lack of facilities. These problems result in overextraction and depletion of groundwater, pollution of surface water bodies and contamination of groundwater, particularly in the Manila Bay Area where more than 10 percent of the Philippine population resides. It is also observed that the aquifers are dwindling seriously in many parts of Metro Manila, and saltwater intrusion and land subsidence are occurring along the coastal areas.

In response, the National Water Resources Board (NWRB) has adopted policies to preserve the groundwater aquifers. It has imposed a moratorium on new applications for groundwater extraction particularly in critical areas. A series of Cease and Desist orders have also been issued against numerous establishments that have been operating without the required water permits. To complement these regulatory measures, market-based instruments, such as full-cost pricing, have been considered to further enhance the policies.

The full cost price was estimated using the concept of marginal opportunity cost of water, and involves covering

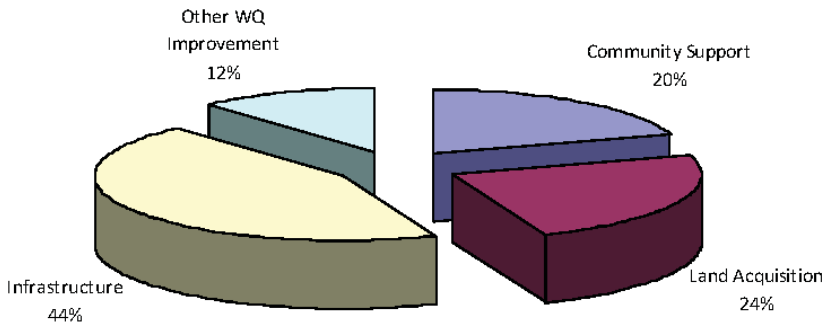


Figure 15. Utilization of revenue collected from Water Use Charge.

Source: Moon

the direct costs (capital and operating and maintenance costs), user costs (depletion cost or scarcity premium) and external costs. The study recommended the implementation of full-cost pricing in a gradual approach, considering the current level of institutional and administrative capacity as well as affordability. The study also suggested that the revenue generated from full-cost pricing would be used for implementing an integrated land and water use plan, and groundwater monitoring and assessment – which are essential in the implementation of the NWRB policy in critical areas (Ebarvia). Moreover, supporting policies including improvement of water service delivery (to discourage installation and use of deepwells), development of alternative water sources, and development of sewerage system and wastewater treatment facilities (to prevent groundwater contamination, and provide potential for augmenting water supply and recharging aquifers) were recommended as important components of groundwater resource management (Ebarvia).

From Pollution to Solution

Be careful what you water your dreams with. Water them with worry and fear and you will produce weeds that choke the life from your dream. Water them with optimism and solutions and you will cultivate success. Always be on the lookout for ways to turn a problem into an opportunity for success.
- Lao Tzu

Sad to say, wastewater management is not yet a priority concern in most Asian cities given the lack of infrastructure that could collect, treat and dispose of wastewater properly. Huge capital costs, unaffordable operating and maintenance costs, low willingness to pay, and low perceived benefits make wastewater management a low priority in the policymakers' (and politicians') agenda, and together with lack of enabling environment, inhibit investors from this business. This situation needs to be turned around, looking at wastewater as potential source of revenue rather than just a cost. Municipal wastewater is not waste at all. Reused water makes a sensible substitute, effectively easing existing supply problems or deferring the need for new sources to be brought online. Treated wastewater should be considered as a water resource, and introduced as such in the water supply planning process. Just like clean water that is returned to water bodies, biosolids — by-products of wastewater treatment — have the potential of returning nutrients back to the earth in an organic way. This will reduce the use of chemical fertilizers, which are energy-intensive to produce. Methane capture reduces greenhouse gas emissions. Biogas digesters produce cheap source of energy for lighting and cooking, especially in rural and remote areas, thereby helping improve quality of life in these areas. Just as water has an economic value, so does wastewater.

Turning Waste to Water

Compared to the tropical region of East Asia where water is relatively rich, water in the Mediterranean region (arid and semi-arid regions) is considered as a limited resource. Cyprus is particularly

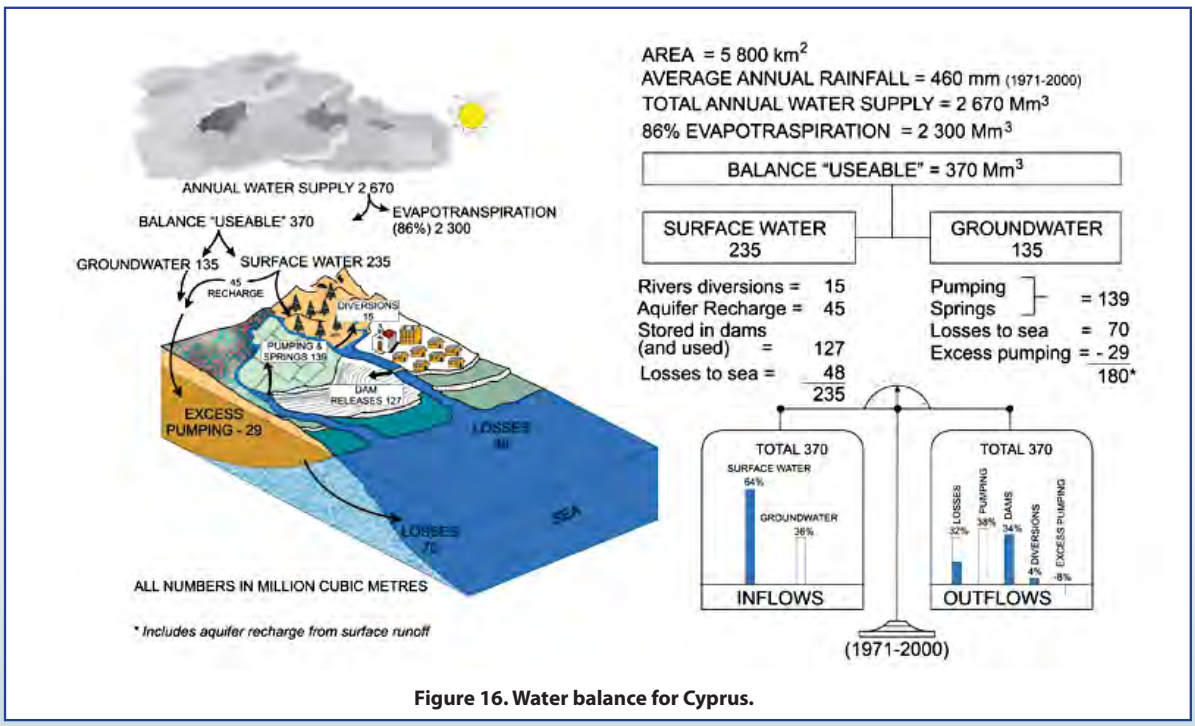


Figure 16. Water balance for Cyprus.

Source: Kathijotes

one of the water-poor countries in Europe and depends almost entirely on rainfall for water resources. **Figure 16** shows the water balance for Cyprus. Agriculture is the major water use sector, accounting for 70 percent of total use, but its economic contribution is low. In this setting, as future demands will not be met by traditional water resources like surface and groundwater, innovative solutions are required.

With the construction of wastewater treatment plants on the rise, reusing water from treatment plants is considered as beneficial for agricultural and other uses. The results of the use of recycled water in industrial and agricultural crops in Cyprus were very encouraging since in most cases, both the production and the quality of the products outweigh those watered with fresh water (Kathijotes). The use of recycled water has already been accepted by farmers and demand is rising rapidly. In addition, recycled water contains many nutrients which are directly taken up by plants, including nitrogen, phosphorus and potassium and trace elements that help significantly in the development of different crops. Although some constituents in treated wastewater may create undesirable effects on soils and groundwater (e.g., bacteriological contamination), careful management, including applying standards and regulations, help overcome these negative effects. Recycled water also showed no negative effect on soil salinity and infiltration rates in Cyprus. On the contrary, it improved and organically conditioned poor soils. Moreover, drip irrigation minimized problems caused by salinity.

Turning Waste to Energy

Taking advantage of the condition that Bali has a dominant agriculture sector and high availability of land space, a biogas digester utilizing animal waste has been introduced. Through the biogas digester, methane is captured and converted into cheap source of energy, which is utilized for cooking and electricity. In addition, the biogas digester produces residual solids, which can be used as organic fertilizer. Biogas digester also reduces odor and prevents surface and groundwater contamination. To promote the alternative energy utilizing the animal waste, there are some problems to overcome, such as the short lifetime of the plastic tube digester and access to financing for the installation of the digester (Winaya). It was found that public opinion on the biogas technology from animal waste is generally positive. Although the family-size biogas digester is dominant in Bali, large-scale biogas production for the big farms is expected in the future.

Turning Waste to Credits

The Clean Development Mechanism (CDM), defined in Article 12 of the Kyoto Protocol, allows a country with an emission-reduction or emission-limitation commitment (Annex B Party) to implement emission-reduction projects in developing countries. Such projects can earn saleable certified emission reduction (CER) credits, each equivalent to one tonne of CO_2, which can be counted towards meeting Kyoto targets (UNFCCC Clean Development Mechanism).

The Government of PR China has a subsidy program to introduce the Biogas Micro-Digester with CDM to promote rural development. The biogas micro-digester is a technology involving the installation of household-level biogas digester, mainly utilizing cattle manure and replacing coal (briquette) and/or (non-renewable) biomass. Farmers get to enjoy convenient, pollution-free and low-cost gas as well as good-quality fertilizers. The technology is well-known in Asia with institutional arrangements in some countries, such as China.

Programmatic CDM is introduced as a new channel to promote small and disperse activities that reduce greenhouse (GHG) emissions by adding their carbon credits (Matsuo). The carbon credits (typically CERs) may foster activities for rural development because they reduce CO_2 emissions, typically 5 T CO_2/yr - equivalent to 60 Euro/yr. Furthermore, the CDM projects also provide local employment, environmental protection and energy security among others.

It is emphasized that the cooperation and coordination with the local government is inevitable for the successful programmatic CDM. The utilization of the CDM opens a new door for successful implementation and/or enhancement of the existing policies and programs of the national and local governments on energy supply and sustainable development of rural and remote areas (**Figure 17**).

The Philippine-based Absolut Chemicals, Inc., in cooperation with the Mitsubishi Corp. of Japan, registered methane gas recovery as a CDM project in October 2006, with 96,000 ton-CO_2e/year emission reductions. Under the guidance of the Philippine Department of Environment and Natural Resources (DENR), the company was able to develop projects and programs that comply with the environmental laws and orders. The partnership with Mitsubishi Corp. was in terms of the application of technology — a Hybrid Anaerobic Digester System and a Covered In-ground Anaerobic Reactor Lagoon — to capture methane, as well as the coordination with the investors/buyers of the CERs, which enabled the CDM project to materialize (Tan). The company also operates a reed bed system for further polishing of the initially treated wastewater. This is a less energy-intensive and lower cost alternative. In addition, the effluent from the company's distillery is being used as liquid organic fertilizer. The

application of the distillery slops in sugarcane fields in Batangas, Philippines, has resulted in a 60 percent increase in yield (Tan).

Harnessing Water, Wind and Sun for a Clean Energy Future

If you build it, they will come.
From the movie *Field of Dreams*

The growing concern over climate change — and how it will hurt the region's environment, human health and economy — has forced economic planners, advocates and business leaders in Asia to search for a stable energy source that can moderate carbon emissions. Energy resources should also have diversity so that there will be more security in case a particular resource is in short supply or affected by weather and climatic conditions. We are at a critical juncture as we endeavour in looking for ways to save our water resources, find alternative energy sources and optimize water and energy utilization while minimizing our water and carbon footprints.

Energy, in absolute terms, is not in short supply in the world. The world's total annual use of commercial energy is on the order of 400 quadrillion BTUs (Quads), and the sun pours about 6 million Quads of radiant energy into the earth's atmosphere each year (Hoffman, 2004). What is in short supply is cheap energy, energy that people can afford to buy. Exactly what was said about water – what is short in supply is cheap, safe and potable water.

Water is embedded in energy: water is essential in cooling in nuclear-, oil- and coal-fired power plants; and water is in renewable energy types (WBCSD, 2009):

- Hydropower produced 89 percent of the world's renewable electricity in 2006, and 16.6 percent of total electricity generation worldwide. Energy output from hydropower is dependent on sustainable upstream water use as well as hydrological patterns, and is therefore susceptible to climate change impacts.

- Solar thermal power plant water consumption is about 1 m^3 of water per 103 kWh (electric) or 277 m^3 of water per 1,000 GJ.

- Wind energy and solar energy (photovoltaic cells that produce electricity directly from sunlight) are considered to have negligible water use, however, they are dependent on weather patterns, and hydrological cycle.

- Wave energy is still a largely untapped source of renewable energy, which, like hydropower, uses water, but does not consume it.

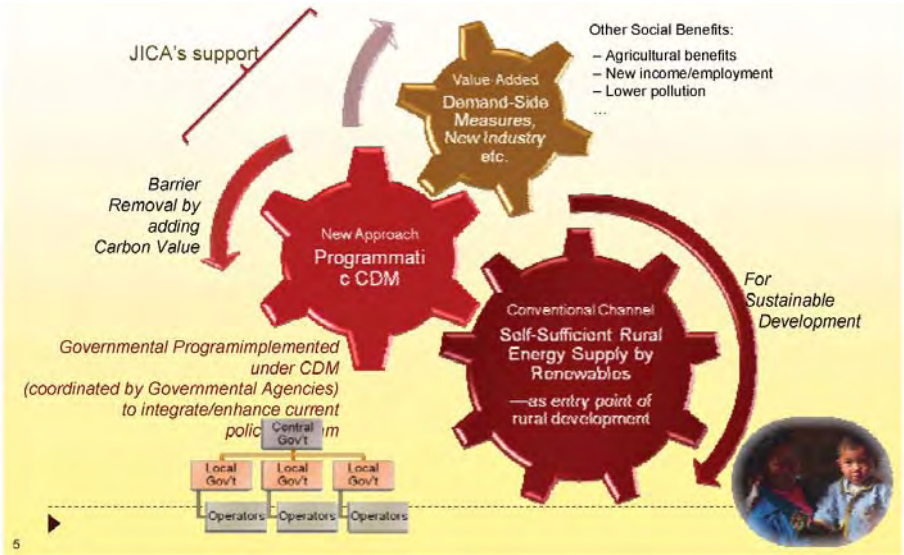


Figure 17. New Channel to Enhance Governmental Policy utilizing CDM.

Source: Matsuo

Forging an Energy-secure Future

Energy is critical in the achievement of the MDGs. It is estimated that about 1.6 billion people do not have access to electricity and about 2.4 billion are still dependent on traditional biomass for cooking needs (Velumail). Limited access to energy also has implications on health. The WHO estimates more than 4,000 premature deaths per day, of which more than half are under 5 years old, due to indoor air pollution caused by use of solid fuels (85 percent from biomass). The poor pay more for their basic energy needs. Enabling energy access to the poor therefore, would make a difference in achieving the MDGs. A major strategy is promoting community-based access to energy to promote equitable access to energy and to maintain sufficient power to fuel productive uses. Experiences in Indonesia (Cinta Mekar), Bhutan (Sengor) and Nepal (Rural Energy Development Programme) prove the reality that energy should be used to increase income. More attention should be given to linking energy and its productive uses to promote livelihood and other income-generating activities among communities. This could be done with the help of micro-finance institutions. In the same manner, there is a need to link nongovernmental organizations (NGOs), governments and bilateral and multilateral institutions engaged in livelihood enhancement

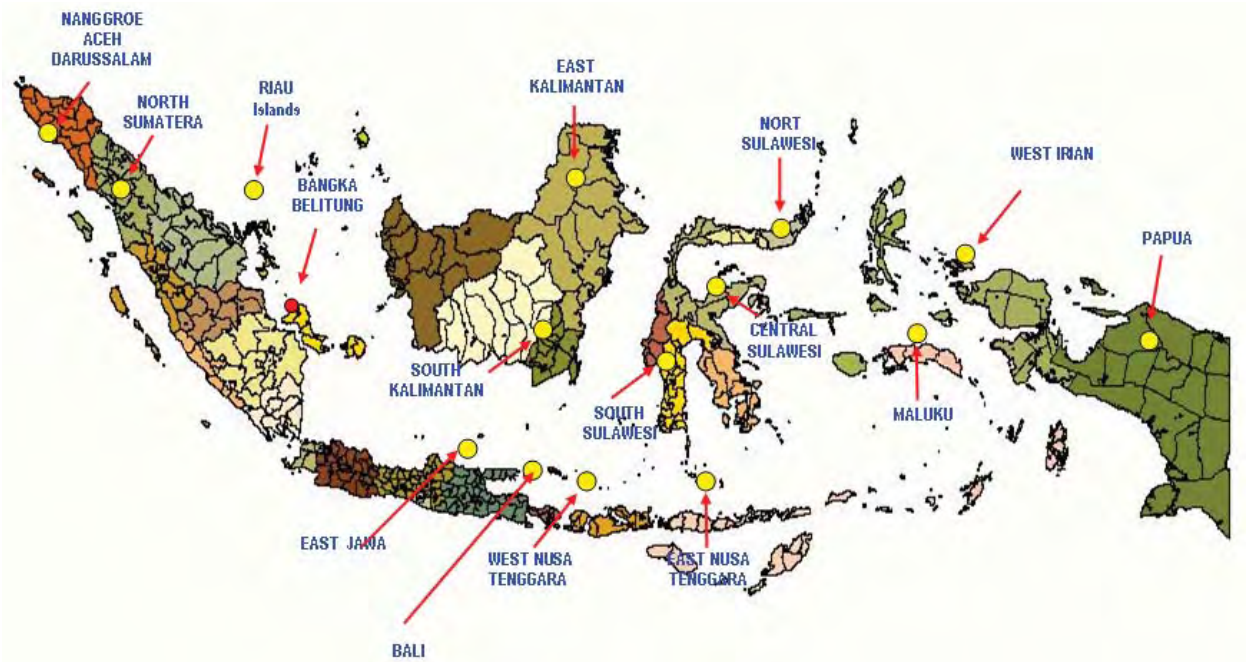


Figure 18. Indonesia's small islands greatly depend on alternative energy sources.

Source: Rachimat

initiatives to introduce energy services especially at the community level (Velumail). Small and medium-scale enterprises should promote programs where renewable energy can make a contribution. Private sector vendors of renewable energy targets (RETs) should also focus on income-generating activities.

Developing countries in Asia have the potential to become global and regional technology manufacturing hubs for renewable energy technology goods and equipment. China is among the world's major manufacturers of wind turbines, and has a cumulative wind power capacity of over 12 GW. Another major investor in wind energy is India, which now has roughly 10 GW of wind power capacity. Adequate resources and friendly government policies (such as the granting of fiscal incentives and implementation of national renewable energy policy) supported the growth of wind energy in these two countries (Dow Jones Factiva, 23 June 2010). RO Korea is leading the way in developing tidal power and ocean current energy technologies.

In the Philippines, harnessing alternative sources of energy is one of the strategies of the government to provide sustainable energy supply for the country. The Renewable Energy Law was enacted in 2008. The primary thrusts of the country's Department of Energy (DOE) are on energy security and power sector reforms. One of the objectives under Energy Security is to aggressively develop renewable energy potential, such as geothermal, biomass, hydropower, solar, wind and ocean energy resources (Sargento). The Philippines is a leading producer of geothermal energy in the world. Current initiatives are directed towards creating a market-based environment that is conducive to private sector investment and participation, while at the same time encouraging technology transfer and research and development along this field (Mariño). The Philippines has already secured US$125 million from the Clean Technology Fund for various projects in areas, such as solar, wind and hydroelectric energy (Dow Jones Newswires, 23 June 2010).

The Philippines is also implementing a rural electrification program that uses renewable energy technologies, e.g., solar and micro-hydropower to bring light and renewable energy-based social services to remote, off-grid, and mostly conflict-affected areas in Mindanao. The Alliance for Mindanao Off-Grid Renewable Energy or AMORE project was able to provide electricity to 474 barangay (villages), 13,014 households, and 224 schools with 43,972 student beneficiaries, and improve access to safe water in 155 barangays (Cayetano). The project is a collaboration of USAID, the Philippine Department of Energy (DOE), and private sector funders, principally Mirant Philippines and SunPower Corporation. Other benefits, such as carbon dioxide mitigation, job creation, improved living standards, increased productivity, more livelihood opportunities, health benefits, increased student participation and peace promotion were also created by the AMORE project (Cayetano).

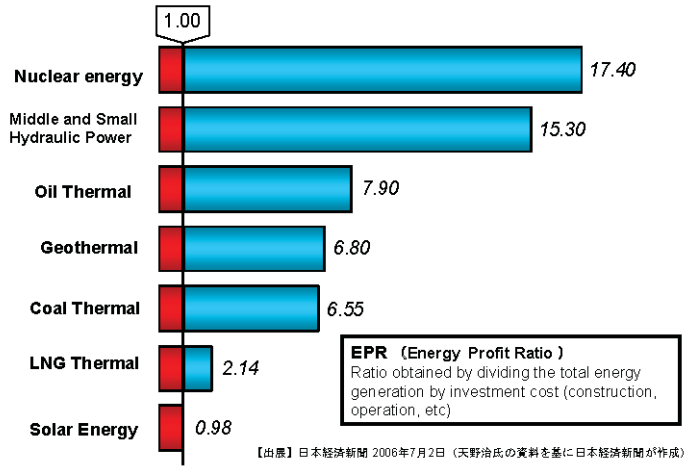


Figure 19. Energy Profit Ratio of Alternative Energy Sources.

Source: Takemura

Indonesia is embarking on developing alternative sources of energy for small islands based on its resources to improve the quality of life in these communities. Currently there are already solar home systems, hybrid solar cell systems and biogas production. There are ongoing projects on sea current energy and wind energy. The other possible options considered by the government are the wave energy and Ocean Thermal Energy Conversion, and research is being undertaken (Ruchimat). However, there should be an assessment of the general condition of small islands in Indonesia, the issues and problems surrounding them, future development based on the available resources of small islands (**Figure 18**), and overall, the Indonesian government's energy policy.

Back to Basics: Power from the River

Japan relied on firewood under the federal system of the Edo era for 250 years, from the beginning of the 17th century. Water mills were also used extensively. At the onset of the Meiji era 150 years ago, Japan started its industrialization. Modernization was accompanied by introducing energy sources, such as coal and oil. Now in the 21st century, Japan needs to seek out future energy alternatives, given the unstable oil prices and supply and the need for climate change mitigation. A low carbon future is a must, and Japan identifies solar and water resources as alternative energy sources. In 2005, the National Committee for Promoting Small Hydraulic Power Generation was established. It has done research on technical improvements to reduce the cost and provided policy support in order to expand the small hydraulic power generation. Although the small hydraulic power generation alone cannot sustain big cities, it can be an important energy source for local communities and sustain energy needs in rural areas. Thus, Japan is moving from centralized energy to distributed energy (Takemura).

Medium and small hydropower generates high energy profit ratio compared to fossil-based energy sources (**Figure 19**). There are also lower environmental and social costs involved compared to large dams and hydropower projects. In the Philippines, there are a number of small hydropower projects, such as the UNDP-CBRED, the JICA-supported Village Electrification Project, the NEF Mahaganao Micro-hydro project, the ADB-funded Renew Negros Project and the e8 Ambangal Mini-hydro project. However, there are still challenges being faced in project implementation, including high initial costs, inadequate financing mechanisms, limited technical capabilities, limited expertise on management and operation, and reliability of equipment used (Sargento).

Catching the Wave

Ocean energy is one of the largest potential sources of energy in the East Asian region. Ocean energy can be exploited from a number of conversion methods, such as wave power, hydrokinetic energy from tides and ocean currents, tidal barrage, and ocean thermal energy conversion (Yum). **Figure 20** provides a status of technology development on the alternative ocean energy in the East Asian Seas region. Technology on tidal energy and offshore wind utilizations are already commercially available while wave and current energy are still under development. Thermal and marine biomass are still on the early stages of research. There is a large potential for ocean energy — it can meet a significant share of the

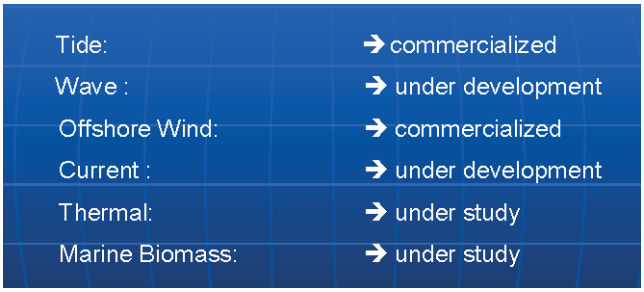


Figure 20. Status of Technology Development on Alternative Energy in the Seas of East Asia.

Source: Yum

Figure 21. KORDI's Tidal Current Power Project in the Uldomok Channel.

Source: : Lee

world renewable energy aspirations and is adequate enough to supply local requirements. However, the marine environment is also providing difficulties in terms of economics, sustainability and reliability of the energy converting systems. Thus, the system should be harmonized with the environmental and climate change issues while accelerating ocean energy research and development.

There are a number of benefits to be derived from harnessing coastal wave energy. It contributes to a lower carbon energy future by reducing consumption of fossil fuels, pollution and greenhouse gas emissions. Moreover, wave power offers many advantages over the renewable sources like wind and solar since the latter forms of energy require hundreds of square acres of useful open land for their installation and operation. In addition, wind farms are also a source of noise pollution while solar energy is largely dependent on weather consistency.

In India, coastal wave energy has a lot of potential similarly with the development of new fishing harbours and breakwater systems. It is a cost-effective and viable option since the costs will be shared between the breakwater wall and the power plant (Paimpillil and Baba).

In RO Korea, pilot projects on harnessing energy from tides using state-of-the-art technology have been initiated. The Korea Ocean Research and Development Institute (KORDI) is implementing the Tidal Current Power Project (TCPP) in the Uldolmok Channel (**Figure 21**). The project started in 1986 involving a series of comprehensive field measurements and numerical modelling. A pilot TCPP, with a capacity of 1 MW, was designed and constructed. To enhance the efficiency of the generating system, research works are being conducted in the pilot TCPP, including monitoring of the structural stability diagnose system. The basic development plan of the commercial scale Uldolmok tidal current power plant will be made on the basis of experimental results from the pilot TCPP (Lee, et al.).

Another example of Korean alternative energy technology development is the Shihwa Tidal Power Plant Project. The power plant has ten 25.4-MW turbines that can generate a total capacity of 254 MW, with an annual generation of 552.7 GW, which can supply energy to around 200,000 residents (Kim). To ensure enough water circulation, eight culvert-type sluice gates were also planned. The project was started in 2003, and will be developed in seven years, and will cost about US$355 million. The Shihwa Tidal Power Plant will help boost RO Korea's energy self-sufficiency and contribute to cutting down oil imports by 862,000 barrels

per year and reducing the emission of carbon dioxide by 315,000 tons per year (Kim).

In the Philippines, ocean energy resource has been recognized as having significant potential for future energy development. Its application can significantly contribute to the self-reliance program of the government. Due to the country's archipelagic nature, the ocean energy resource area is about 1,000 km^2 and the potential theoretical capacity for this resource is estimated to be about 170,000 MW (DOE Report). Based on the convergence from large bodies of seawater in the Philippines and the constricting point of islands, the San Bernardino Strait, Basilan Strait, Ilo-ilo Strait, San Juanico Strait and Surigao Strait were initially identified with awesome marine current strength. Among these potential sites, San Bernardino Strait proves to have the highest potential in hosting large ocean current power plant stations (Mariño). The Philippine Council for Industry and Energy Research and Development (PCIERD) also conducted an assessment of marine current technologies that have potential for application. Most of these technologies were developed abroad. While there are technologies developed locally, these are still at the prototype development stage and no working system is installed in actual local power application.

The Heat Is On

Solar energy has been regarded as one of the fastest growing power generation technologies in recent years. Enabling policies, regulatory frameworks, increased public awareness, advances in technology and changes in cost structure have given impetus, driving an impressive growth in developed countries. Economies of scale can reduce costs to make solar energy more competitive with other sources of energy. Solar energy has great potential for application in the East Asian Seas region because of more rapidly growing electricity demand, and countries in this region have greater solar radiation and more available land than developed countries.

In Japan, initiatives to promote solar energy and energy conservation have been boosted by the establishment of an innovative fund, 'South Shinsyu OHISAMA Fund' by the Ohisama Energy Corporation. The organization started as an NGO, which established solar power generation funded by the municipal citizens in Iida City. Accordingly, the NGO transformed into a corporate entity and started calling for donation from all over Japan for the sustainable management of the solar power facilities. **Figure 22** shows the fund mechanism. As of November 2009, 162 solar power generators which approximately generate 1,300 kW are running in the Prefecture. Through this initiative, significant amount of greenhouse gas has been reduced. Furthermore, the power generators

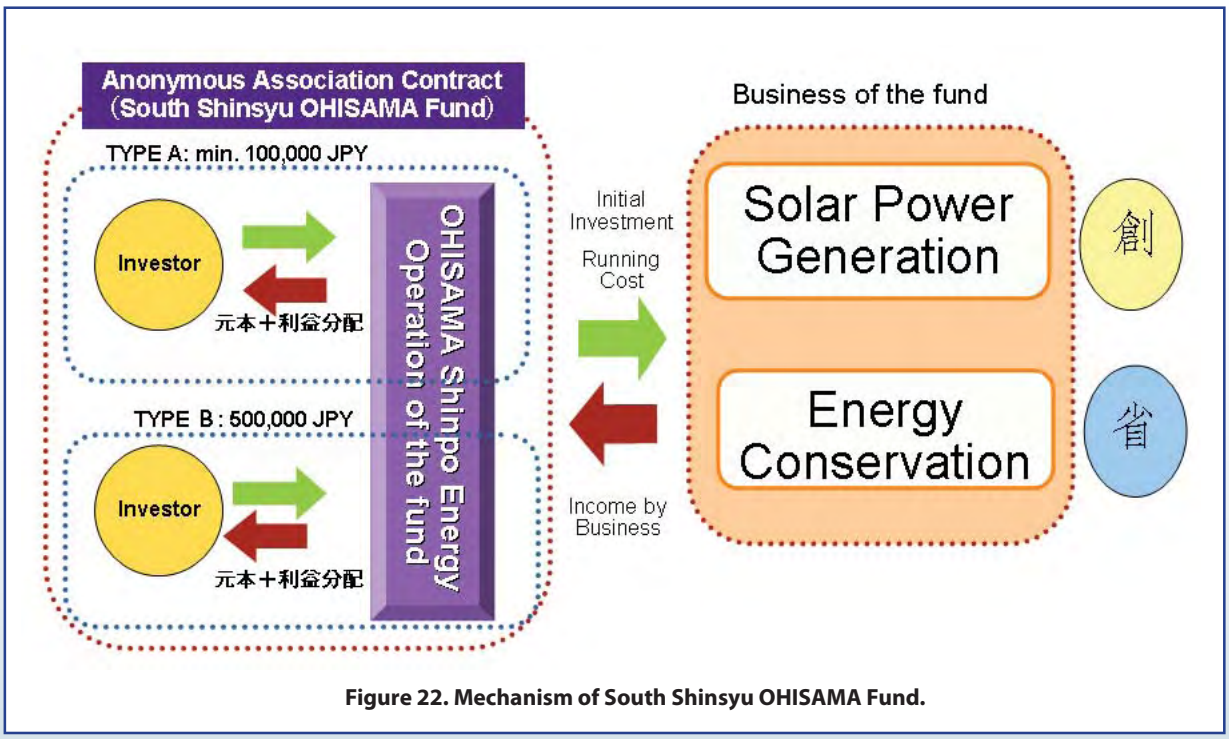


Figure 22. Mechanism of South Shinsyu OHISAMA Fund.

Source: Hara

are used as an environmental educational tool for the school children. This shows that changing society through changing the money flow can be done for sustainable development (Hara).

Conclusion: Managing Our Way Out of the Water-Energy-Food-Environment Crisis

Most people spend more time and energy going around problems than in trying to solve them.
- Henry Ford

Water is indeed more than an environmental issue. The "water-energy-food-environment nexus" is a broad label for the set of interactions caused when humans develop and use water and energy, with implications on food, health and environment. The nexus manifests itself in many ways, indicating substantial tradeoffs and opportunity costs associated with the manner we use water and energy. Producing hydropower requires damming rivers and thermoelectric power requires large amounts of water for cooling, while nearly every stage of the water use cycle involves energy inputs. Moreover, climate change and other stresses are limiting the availability of clean water and cheap energy. Frequent extreme weather events are causing numerous water-related disasters and the frequency is worsening. The combined effects of climate change, pollution and population pressure are likely to trigger a "cascading" set of negative consequences on human health, food production, livelihood security, energy supplies, human migration, economic growth and geopolitical stability.

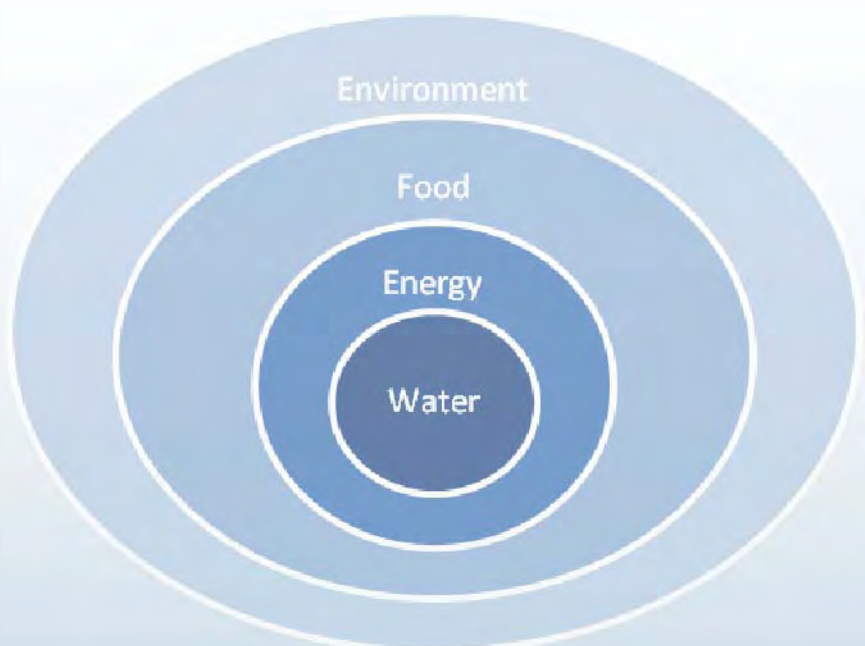
The big challenge for the world today is how to manage water security, food security, energy security and ecological security in a sustainable and holistic way. Increasing water problems are recognized by developed and developing countries alike around the world as real issues that impact our lives, our health, our livelihoods and businesses, and our future. A better understanding of the water-energy-food-environment nexus will allow integrated resource planning and management that optimizes the use of invaluable and increasingly scarce resources, and waste treatment and reuse.

Apply Integrated Management Approach

Those who have power over the control and engineering of the world's rivers have largely failed to protect these natural systems for the greater benefit of everyone. Better standards are needed, more options need to be considered, more voices need to be heard, better planning of water and energy infrastructure needs to be provided, and coordination needs to be improved. The ICARM approach offers a way of ensuring proper management of the interconnected water resources, and allows for the implementation of IWRM principles at the basin level and ICM in coastal areas. Poor water management in the river basins affects availability of water downstream and results in pollution of coastal waters (from point and non-point sources) as well as changes in coastal morphology. Thus, upstream and downstream coordination is important. There must be recognition of "what you do not measure, you cannot manage"; hence, proper monitoring in all river segments is a must.

Improve Water Governance

The most significant constraint is poor and fragmented water governance. In most countries, water is managed by a number of different government agencies and jurisdictions. Proliferation of different laws related to water and inadequate capacity to enforce them and low-cost recovery in the water sector are also problems. Therefore, there is a need to institute a lead oversight government agency and coordinating mechanism to rationalize



the fragmented and uncoordinated water plans and programs, and move towards an integrated and intersectoral approach.

Promote Effective Collaboration among Various Stakeholders

Public awareness and stakeholder participation are also essential to ensure implementation of water management measures. Upstream and downstream collaboration among stakeholders can be promoted through cost sharing, partnership, and participation in monitoring, protecting and restoring natural ecosystems, and management of water resources. International cooperation, knowledge management, and sharing of experiences and technologies through partnerships are the way forward.

Employ both Demand-side and Supply-side Measures

There are innovative ways of securing water, ranging from demand-side management approaches, such as full-cost pricing and the 3Rs — Recharge, Retention and Recycling — to supply-side interventions, such as small impounding dams, low-cost desalination and drip irrigation. Measures to reduce 'lost water', unaccounted or non-revenue water is also important. However, capacity building for local governments and both public and private utilities and stakeholder participation are key factors for the adoption of innovative solutions and improving water resources management, especially in critical and vulnerable areas.

Expand Water and Wastewater Treatment and Reuse

Using water and treating water and wastewater involve energy. We can turn around the equation by recycling water, reusing treated wastewater, using the biosolids, capturing methane and producing biogas — allowing us to save water, energy and money. There are technology options available to choose from. However, reusing treated wastewater and applications of biosolids in crop production require capacity development to ensure that standards are followed to ensure public health. It also requires public acceptability. The "yuck" factor — or the psychological aversion to reusing wastewater — requires application of information, education and communication tools to overcome significant barriers.

Improve Financial and Economic Tools

Water pricing and payment for ecosystem services are market-based instruments that would encourage protection of water resources and forest and watershed ecosystems. Such mechanisms also allow for compensation of upstream stakeholders to protect water and land resources for the benefit of downstream stakeholders.

Charging full-cost water pricing, which includes both direct costs and externalities, can ensure efficient water allocation and optimal level of use, promote behaviour change towards water conservation, and allow utilities to be financially viable and provide reliable and sustainable service, which consumers would be willing to pay for. However, full-cost pricing is complex, and it is suggested to move forward, but in a step-by-step gradual process. The first step is cost recovery so there will be funds for operation and maintenance, ensuring service delivery for consumers and financial viability for utilities.

Reduce Water Footprint in Energy and Carbon Footprint in Water

Unless our water supplies are properly managed, the carbon footprint of water use will continue to grow at a time when climate change necessitates reducing carbon emissions. IWRM, ICM, and IRBCAM or ICARM, which promote sustainable water supply and use management, must be acknowledged as integral to climate change mitigation and adaptation. Every drop of water conserved reduces energy consumption and associated carbon emissions. With so many interconnections, policies and techniques to decrease water-related carbon emissions, reduce water and energy use, and shift to renewable energy have to be adopted. Just as water, energy, food, environment and climate change are linked and issues are interconnected, so also are the solutions.

Shift to Energy-efficiency Technologies and Renewable Energy

Breakthroughs in renewable energy technologies, energy-efficiency improvements and decentralized energy systems require greater investments in research, development, piloting and full-scale deployment. Small/micro/mini-hydropower, solar energy and biogas provide solutions for energy supply and security, especially in small islands and remote areas. Ocean energy, tidal power, wave, marine current, and offshore wind power are still in the development stage.

Set in Place the Necessary Enabling Conditions

Integrated and comprehensive assessment of alternative energy resources in each country is recommended for the establishment of long-, medium- and short-term national plans for the development and utilization of appropriate and cost-effective technologies. Supporting policies and set of clear regulations and incentives provide an environment

Theme 4 Water Use and Supply Management Conclusions and Recommendations
Presented by Theme Chair, Prof. Torkil Jønch Clausen

Workshop 1: Alternative Energy: A Solution for Energy Security for Islands and Remote Areas

Conclusions
- Ocean energy sources are site dependent. Relevant technologies should be pursued accordingly.
- Tidal power — suitable for large scale — is in the commercial stage; Wave, current, and offshore wind which could be installed in the local scale are still in the development stage.
- Small/Micro-hydropower, solar energy and biogas are potential solutions for energy supply and security for small islands and remote areas.
- However, expansion of those energy generation solutions face difficulties, e.g., low cost-efficiency and technology limitations.
- The CDM mechanism provides a potential benefit in energy supply and security : revenues generated by the CDM to be invested in other alternative energy projects.

Recommendations:
- Small/micro scale power generation calls for further research, technical development, more experiences and projects to be pursued.
- Government support is essential to promote the alternative energy development, both large and small-scale alternative energy.
- North-south and south-south technology transfer, knowledge and information exchange needs to be further promoted.
- Countries need to prepare long-, mid- and short-term national plans for the development of technologies, and for efficient and economic use of the energy.
- Collaboration among various stakeholders — national and local governments, academia, NGOs, private sector — is key to make the alternative energy development successful.

Workshop 2: Addressing Water Crisis in Rapidly Growing Cities

Conclusions:
- Poor water management in the river basins results in pollution of coastal waters (from point and non-point sources), as well as changes in coastal morphology.
- All options for better water management must be considered, from improved agricultural water management to advanced reuse and desalination technologies.
- A major constraint is poor and fragmented water governance, by a multitude of different government agencies and jurisdictions.
- Proliferation of different laws, and inadequate capacity to enforce them add to the problem.
- Low-cost recovery in the water sector is a major constraint to sustainability.
- Capacity building is key to improving water resources management in many developing countries.

Recommendations
- Coordinate IWRM at the basin level with ICM at the coast — through the ICARM approach — for both sustainable management and climate change adaptation.
- Establish a lead oversight and central coordinating government entity to rationalize fragmented and uncoordinated plans and programs.
- Move forward towards full cost water pricing in a step by step gradual process.
- Collaborate upstream/downstream among stakeholders through active participation and partnerships.
- Create mechanisms to encourage and compensate upstream stakeholders to protect water and land resources for the benefit of downstream stakeholders — from ridge to reef.
- Ensure proper monitoring of water resources in all river segments.
- Recognize water demand management as the first step to reduce pressure on water resources — and as a "no regret" adaptation measure — including the "3R: Recharge, Retention and Recycling."
- International cooperation and sharing of experiences and technologies through partnerships is the way forward.

conducive for such investments. Making water and energy security a national priority signals government commitment. Leadership and political will are a pre-condition for change to happen. Likewise, the will to change by all levels of society is an indispensable condition.

Advance Cooperation for Knowledge Management, Capacity Development and Financing

However, technical and financial assistance are needed by most developing countries to find a cleaner, more efficient and low carbon energy path, and avoid projects that repeat the mistakes of the past. North-south and south-south cooperation must be advanced to promote technology transfer, knowledge and information exchange, and capacity development. Collaboration among various stakeholders, including national and local governments, academe, NGOs and the private sector is essential to make alternative energy projects successful.

Provide Incentives for Pollution Reduction

Clean development mechanism (CDM) and carbon financing provide incentives not only for reduction of greenhouse gas emissions, but also for waste management. It allows turning wastewater into water supply for agricultural and industrial use, turning waste to energy, turning waste to organic fertilizers, and turning waste to revenues. The CDM is designed to start off developing countries on a path towards less pollution, with industrialized countries paying for these reductions.

Conclusion

Increasing pressures on water from population growth, pollution, and economic production are exacerbating old problems and threatening to create new crises. Promoting economic and agricultural development, protecting human health, preventing conflicts, and safeguarding the environment all demand much better water resource and energy management than has taken place in the past. The decisions being made today regarding the management of water and energy resources will create ripple effects and profoundly affect our economic and environmental future.

The water-energy-food-environment nexus presents a valuable opportunity to better manage water and energy — two of our most valuable resources. Water and energy are the critical elements of sustainable development. Without access to both, poverty cannot be alleviated. We need to refocus our attention on improving and preserving the quality of our water, and ensure that water continues to be the source of life in this planet. Furthermore, as the inevitable impacts of climate change become evident, our freshwater resources and the ecosystems they support will be further affected. The linkage between water and energy therefore provides opportunity to address climate change. Water, energy and climate change are parts of the same puzzle. As the world struggles to reduce carbon emissions in response to global warming, investments in water conservation, efficiency, and reuse are among the largest and most cost-effective energy and carbon reduction strategies available. Effective water policies and institutional arrangements, political will, innovative solution options, shifting to renewable energy, pollution reduction, and a sense of shared responsibility would allow us to mitigate the worst aspects of global warming today. Such actions can result in subsequent improvements in water quantity, quality, river health and ecosystem integrity, providing a critical buffer as humans and ecosystems adapt to the climate of tomorrow.

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Theme 4 Workshop 1: Korea Ocean Research and Development Institute (KORDI)

Theme 4 Workshop 2: Korea Environment Institute (KEI)

Presentations

Theme 4 Workshop 1: Alternative Energy – A Solution for Energy Security for Islands and Remote Areas

PART 1: Overview of Trends of Policy and Technology on Alternative Energy

Yum, K.D. "Status of the Technology Development on Alternative Energy in the Seas of East Asia."

PART 2: Status and Feasibility of Introducing Ocean and Coastal Energies

Kim, S.H. "Shihwa Tidal Power Plant Project, RO Korea."

Lee, K.S.*, K.D. Yum, J. S. Park, and J. W. Park. "Tidal Current Power Development Project in RO Korea."

Mariño, A. "Philippine Initiative in Harnessing Marine Current Energy Resource."

Paimpillil, S. J.* and M. Baba. Variety of Alternative Energies and Viability: Coastal Wave Energy Utilization Coupled with Coastal Protection."

PART 3: Various Approaches of Utilizing Alternative Energies Through Partnerships and Innovative Mechanisms

Cayetano, C. "Renewable Energy for Island and Other Remote Communities in Mindanao: The Alliance for Mindanao Off-Grid Renewable Energy."

Choi, S.K. "Theme Paper Presentation: Water Security and Integrated Water Resources Management in Asia."

Hara, A. "Evolution of Financing Mechanism from NGO into Corporate Entity for Solar Energy Promotion."

Marasigan, M. "Micro-hydro Power Projects in the Philippines."

Matsuo, N.. "Biogas Micro-Digester as a Rural Development Program under CDM- How to Utilize Programmatic CDM to Enhance Low Carbon Development Policy

Ruchimat, T. "Development of Alternative Energy on Small Islands in Indonesia."

Takemura. K. "From Centralized Energy to Distributed Energy From Modern to Post Modern."

Tan Tee, G. "The CDM Project of Absolut Chemicals, Inc., The First in Philippine Manufacturing Industry."

Velumail, T. "Financial Sustainability of Access to Energy Services for the Poor: Experiences from the Asia Pacific Region."

Winaya, I.N.S. "Methane into Markets Utilizing Animal Waste."

Theme 4 Workshop 2: Addressing Water Crisis in Rapidly Growing Cities

Session 1. Case Studies on Issues and Challenges to Water Management

Ebarvia, M.C. "Economic Valuation of Groundwater in Metro Manila and Adjacent Areas."

Lee, J.-H. "Integrated River Management Strategies in Korea."

Seino, S. "Status and Perspective on 'Water for the Sea' in Japan."

Session 2. Water Resource Management Through an Integrated Coastal Management (ICM) Approach

Navarro, M.E.G. Jr., "Water for Life Programme of the Municipality of Bani, Pangasinan."

Peng, B. and Z. Liu. "Empirical Appraisal of Small Watershed Management Program: A Case Study of Jiulong River Watershed Management Programme. "

Ri, K. H. "Securing Water Source of Nampho and Pyongyang through ICM Scaling up in the Taedong River Basin."

Souphasay, K. "Domestic Water Supply Development and Need in Lao PDR."

Session 3. Good Practices and Innovative Tools for Water Management

Kathijotes, N. "Climatic Changes and Wastewater Reuse in Challenges in the Mediterranean Region."

Kim, J. H. and S. Kim. "Recent Development of Desalination Technology and its Application to Address Water Problems in Small Communities."

Moon, H.-J. "Water Pricing and Cost Sharing for Water Resource Protection in Korea."

Yeo, W. "Singapore's Marina Barrage and Reservoir in the City."

Panelists: Dr. Torkil Jonch Clausen, Global Water Partnership; Prof. Zhou Quilin, Third Institute of Oceanography (TIO), SOA, China; and Dr. Chu Jang-Min, Korea Environmental Institute

References:

Asia Society's Leadership Group on Water Security. 2009. Asia's Next Challenge: Securing the Region's Water Future.

Cooley, H., P.H. Gleick and G. Wolff. 2006. Desalination, with a Grain of Salt: A California Perspective. Pacific Institute for Studies in Development, Environment and Security.

Dow Jones Factiva. 23 June 2010.

Dow Jones Newswires. 23 June 2010.

Global Water Partnership. 2000. Integrated Water Resource Management. Technical Advisory Committee (TAC) Background Papers no. 4.

Hoffman, A. 2004. The Connection: Water and Energy Security. (downloaded from: http://www.iags.org/n0813043.htm)

Inter-Governmental Panel on Climate Change (IPCC), 2007.

McIntosh, A.C. 2003. Asian Water Supplies: Reaching the Urban Poor. Asian Development Bank (ADB) and International Water Association (IWA).

National Strategy for Rural Water Supply and Environmental Health Sector. June 2004.

Pacific Institute. 2009. The World's Water 2008-2009.

Sachs, J. 2009. http://asiasociety.org/policy-politics/environment/securing-asias-water-future.

Scientific American, Earth3.0, Special Issue, "Energy vs. Water. Why both crises must be solved together", October 2008, with amended data from GHD.

Stern, N. 2007. The Economics of Climate Change. The Stern Review. Cambridge University Press: Cambridge.

UNICEF-WHO Joint Monitoring Programme. 2010. Progress on Sanitation & Drinking Water: 2010 Update.

United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). 2005 and 2006

United Nations Framework Convention on Climate Change (UNFCCC) Clean Development Mechanism. N.d. http://unfccc.int/kyoto_protocol/mechanisms/clean_development_mechanism/items/2718.php

World Business Council for Sustainable Development (WBCSD). 2009. Water, Energy and Climate Change: A Contribution from the Business Community.

World Economic Forum. 2009a. Energy Vision Update (to be published).

World Economic Forum. 2009b. Managing our Future Water Needs.

**Presenter*

By Dr. Magda Lovei, The World Bank, USA
Dr. Rudolf Wu, The University of Hong Kong
Mr. Edward Clarence-Smith, United Nations Industrial Development Organization (UNIDO)
Dr. Alexander Tkalin, Coordinator, NOWPAP of UNEP
Dr. Anatoly Kachur, Director, POMRAC of NOWPAP
Mr. David Nemazie, University of Maryland Center for Environmental Science, USA
Dr. Zhou Qiulin, Third Institute of Oceanography, State Oceanic Administration, PR China
Ms. Cristine Ingrid Narcise, Country Programme Manager, PEMSEA
Mr. S. Adrian Ross, Chief Technical Officer, PEMSEA
Ms. Maria Corazon Ebarvia, Consultant, PEMSEA

Weaving through the Pollution Conundrum: Getting it Right

"Humankind has not woven the web of life.
We are but one thread within it.
Whatever we do to the web, we do to ourselves.
All things are bound together. All things connect."
— Chief Seattle, 1855

The Pollution Challenge

It is well known that about 70 percent of the planet is covered with water. Hence, it seems that there is little risk for water resources to become depleted any time soon. However, with 97 percent of the water undrinkable and another 2 percent frozen, only 1 percent of the water on Earth is available for use by mankind. Furthermore, this water is not evenly distributed in space or time, or necessarily located where the largest concentrations of people reside. Specific regions are plagued with problems of freshwater scarcity and drought, or oversupply and flooding. When you factor in pollution and natural disasters, the percentage of available water resources is reduced even further. It is essential, then, that we find ways to prevent our remaining water resources from becoming unusable.

Down the drain

Water pollution is a growing problem. There are many stories in the media of big oil spills in the ocean, and/or companies dumping harmful chemicals into lakes or rivers, but there are also water pollution problems generated from our homes. Everyday household activities are a major contributor to polluted runoff, which is among the most serious sources of water contamination. When it rains, greywater, untreated sewage, litter/garbage, used oil from driveways and boats, paint and solvent residues from walls, fertilizer from lawns, and even waste from our pets are all washed into storm sewers, nearby lakes, rivers, streams and seas or leached into aquifers.

In addition, there are the discharges from small- to large-scale industries and mining operations that contain heavy metals and toxic and hazardous wastes, as well as agricultural runoff that contains nutrients from fertilizers and livestock waste, and toxins from herbicides and pesticides. Some of the discharges contain synthetic organic

chemicals (e.g., organophosphates, organochlorines, dioxins, polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs) and organometals), which are highly toxic, persistent, and lipophilic, can be bioaccumulated, and pose health threats to predators at high trophic levels and to humans (Wu). There are also endocrine disrupting chemicals (e.g., dioxins and furans, tributyltin or TBT, PCBs, pharmaceutical drugs and industrial chemicals), which can cause imposex, altered sex ratio, reduced fecundity, reproductive failure and birth defects in affected animals, such as shellfish, birds and polar bears (Wu).

These pollutants end up in the same lakes, rivers and streams that we rely on for drinking, bathing, swimming and fishing and ultimately end up in our seas affecting key ecosystems, human health, livelihoods and quality of life.

The grasshopper effect

Another problem is atmospheric deposition of pollutants. This occurs when pollutants are transferred from the air to the earth's surface and water bodies. Pollutants (e.g., PCBs, organochlorine pesticides, and PAHs) can be transported across hundreds and even thousands of kilometers by wind and ocean currents (Wu). These chemicals can deposit to the ground or bodies of water, or revolatilize back into the air if it is warm enough. This cycle can occur numerous times, with the chemicals traveling to cooler places until the air is not warm enough for revolatilization to occur. For instance, persistent organic pollutants (POPs) can be carried through great distances by the wind up to the Arctic region. This is sometimes called the "grasshopper effect" or global distillation (**Figure 1**). This is why high levels of persistent bioaccumulative toxic substances (PBTs) can be found in the cold Arctic, far away from cities and factories. The remarkable distances that pollution can spread means that it is not limited within the boundaries of any single nation. National boundaries can make water and pollution issues political. Politics always adds complexity to an already multifaceted problem.

Stitching a Common Thread: Framework to Address Transboundary Pollution Issues

Over the last several decades, water quality management in several regions and countries has focused on control of point sources of pollution and the use of effluent-based (discharge-based) water quality standards. Nonpoint sources of pollution have not been as successfully controlled. Pollutants can be transported through rivers across jurisdictional boundaries within and across countries, posing a challenge to the effectiveness of separate management efforts among national and sub-national entities, and between river basins and coastal areas. An integrated approach in managing shared water systems and in addressing identified priorities, such as pollution, at various levels, is considered an imperative.

By harnessing and linking best practices, policymaking and scientific understanding, we can find options and provide real solutions to the world's water, environment and development problems. Two workshops during the East Asian Seas Congress 2009 provided a venue for showing various

Figure 1. Grasshopper Effect.

perspectives and actions to address pollution reduction and transboundary issues, taking into consideration the similarities and differences between countries, regions of the world, climatic conditions, phases of development, political systems and institutional capacity as well as availability of information, technologies and financing mechanisms. Getting transboundary, national and local pollution management "right" is not simply important but vital to secure the health and livelihoods of billions of people and sustain the resources and ecosystems across the globe.

Integrated management

Transboundary transport of pollutants through rivers is recognized as one of the main causes of ecological problems in coastal and marine areas. The concept of managing rivers as single, spatially-integrated systems across their entire watershed and into downstream areas is an idea that has changed in complex ways over time. Water resource management programs are moving towards ecosystem-based management, linking freshwater and marine water systems, and integrating water and wastewater management. Water-related projects are moving away from traditional civil works construction and increasing their focus on more efficient and sustainable operation and maintenance, habitat restoration and rehabilitation, recreation, and cost-effective pollution reduction. Today, successful water project planning requires an integrated systems approach capable of balancing all relevant issues and identifying unintended consequences or cumulative effects within the river basin and down to the coastal areas.

Integrated coastal area and river basin management (ICARM) links the principles of integrated coastal management (ICM) and integrated river basin management (IRBM) to ensure the stability and productivity of aquatic ecosystems in a given coastal region through sustainable economic and social development of the region and its associated river basin. In establishing an integrated management system for river basins and coastal zones, it is necessary to adopt a process of pro-active governance, planning, monitoring and a strategic framework of goals, policies and actions. An integrated approach leads to better coordination of policymaking and action across different sites, sectors (water, forestry, agriculture, fisheries, urban development, habitat and environmental protection, etc.), and stakeholders, consequently resulting in a more rational use of resources and more effective environmental protection.

The technical aspects of nutrient over-enrichment require both immediate local action by river basin and coastal managers and a longer-term national and regional strategy that incorporates policy design, classification of affected sites, laws and regulations, knowledge management, coordination, and communication. Success in addressing coastal nutrient problems also depends on having a solid scientific understanding of the causes of the problems and the full range of possible management alternatives.

Adaptive management

Adaptive management can be valuable where there are competing uses of waters, in which the same streams and rivers that sustain habitat for numerous species also provide water resources for millions of people. Adaptive implementation is, in fact, the application of the scientific method to decisionmaking (National Research Council, 2001). It is a process of taking actions of limited scope corresponding to available data and information to continuously improve understanding of a problem and its solutions, while at the same time making progress toward attaining a water quality standard (National Research Council, 2001). The adaptive implementation process begins with initial actions that have a high degree of certainty associated with their water quality outcome. Future actions must be based on: (1) continuous monitoring of the water body to determine how it responds to the actions taken; and (2) carefully designed experiments in the watershed.

Key to adaptive management is the measurement and monitoring of ambient water quality. To help confront the disparity between controlling pollution from point sources and pollution from surface runoff and nonpoint sources, the U.S. Environmental Protection Agency (EPA) implements the Total Maximum Daily Load (TMDL) program to meet water quality standards. The adaptive management program is being applied to reduce pollution loading into Chesapeake Bay. The monitoring and control of total pollution loading is also being applied in other countries like China and Japan.

A River Runs through It

Over the past 20 years, scientists, watershed and coastal managers, and government decisionmakers have come to recognize that coastal ecosystems suffer a number of environmental problems that can, at times, be attributed to the introduction of excess nutrients flowing from upstream watersheds into estuarine settings through rivers. Nutrient sources include runoff from urban areas, agricultural land and livestock production, atmospheric deposition of compounds released during the burning of fossil fuels, and discharges of untreated wastewater and even from wastewater treatment plants. Nutrient over-enrichment is the common thread linking such diverse coastal

problems as fish kills, harmful algal blooms (HABs), outbreaks of shellfish poisonings, coral reef destruction, change of species composition, and large-scale hypoxia/anoxia causing "dead zones". Reduction of pollution inputs from rivers is recognized as a prerequisite in addressing downstream pollution impacts in receiving coastal and marine waters.

A key issue is cooperation among governments within the river basin. Cooperation can be facilitated by acknowledging that collective action may be driven as much by common goals to reduce risk as it is to share benefits (Sadoff and Grey, 2002). Different modes of cooperation must be taken into account in response to different conditions. Three models of cooperation on the development and management of basin-wide transboundary issues, involving investing in institutions, information and capacity, as well as in natural and man-made infrastructure, are discussed here.

Danube River - Black Sea Strategic Partnership for Nutrient Pollution Reduction

The Convention on Cooperation for the Protection and Sustainable Use of the River Danube (Danube River Protection Convention or DRPC), was signed in Sofia, Bulgaria, in June 1994 by eleven Danube River Basin countries and the European Commission. The signatories to the Danube Protection Convention, which is based on the UN-ECE Framework Convention on the Protection and the Use of Transboundary Watercourses and International Lakes (Helsinki Convention), have agreed on "conservation, improvement and rational use of surface and groundwater in the catchment area, to control the hazards originating from accidents and to contribute to reducing the pollution loads of the Black Sea from sources in the catchment area" (The Danube Pollution Reduction Program).

The aim of the Danube River Pollution Reduction Programme is the improvement of water quality in all the water bodies in the Danube River Basin. This includes the surface water in the rivers as well as groundwater. The Danube discharges its waters into the Black Sea (**Figure 2**). Several other rivers also discharge into the Black Sea, which is negatively influenced by nutrients and other polluting substances. However, the Danube River Pollution Reduction Programme is of great importance for the overall reduction of pollution going into the Black Sea.

The main objective of the GEF Nutrient Reduction Programme for the Black Sea is to assist in the implementation of the 1996 Strategic Action Plan (SAP) for the Rehabilitation and Protection of the Black Sea as agreed on by the coastal countries. The SAP provides the policy framework to implement priority actions and address transboundary environmental concerns such as sustainable fisheries, tourism, conservation of living marine resources and coastal landscapes, and pollution from shipping and land-based sources. The most important transboundary issue identified in the Transboundary Diagnostic Analysis (TDA) and addressed in the SAP is the reduction of nutrient inputs to the Black Sea from riverine and land-based sources (Danube/Black Sea Basin Strategic Partnership on Nutrient Reduction).

To address pollution from excess nutrients, and the associated eutrophication in the lower Danube and the Black Sea, the GEF Danube-Black Sea Basin Strategic Partnership for Nutrient Pollution Reduction was launched in 2001 with an initial commitment of US$98 million in grants from the Global Environment Facility. The initiative was coordinated by The World Bank, UNDP, UNEP, and other sources of financing, as well as 16 basin countries and the Danube and Black Sea Commissions. The Strategic Partnership was composed of three components: The Danube River Basin Regional Project, the Black Sea Ecosystem Recovery Project, and a Partnership Investment Fund (Zavadsky).

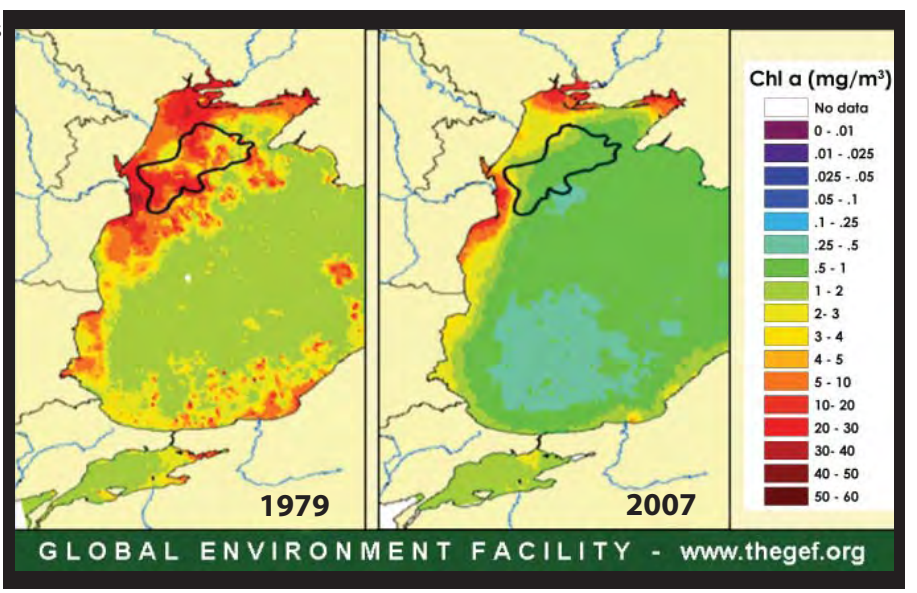
The GEF-WB Partnership Investment Fund provides a focused regional framework for country-level investments

Figure 2. The Black Sea Basin and Tributaries.

aimed at a common goal of reducing nutrient pollution in the Black Sea and helping to jumpstart and further accelerate key investments in sectors such as municipal wastewater, agricultural runoff, and industrial pollution.

The intervention has yielded positive outcomes for the region. Nitrogen effluents have decreased about 20 percent and phosphorus by almost 50 percent in the Danube Basin in the last 15 years. An EU-funded review documented that eutrophication has been reduced, the "dead zone" in the Western Black Sea has been virtually eliminated (**Figure 3**), and improvements in biodiversity have been identified. The number of benthic species increased 1.5 to 2 times with respect to 1980 levels while invasive alien species (*Mnemiopsis*) has been significantly curtailed. Moreover, the upper reaches of the Danube Basin is no longer considered at risk in terms of hazardous substances, nutrients and organic pollutants (Zavadsky).

Figure 3. and Hypoxia in the Black Sea, 1979 and 2007.



The Amur/Heilong and Tumen River Basins

In the northeastern Asian region, rapid economic development of PR China, Russia, Mongolia and countries of the Korean peninsula are causing environmental and natural resource degradation in the Amur and Tumen River Basins (**Figures 4 and 5**).

The **Amur River** or Heilong Jiang (in Chinese) is the world's ninth longest river, flowing over 4,500 km from the mountains of Inner Mongolia to the Sea of Okhotsk, and forming a border between the Russian Far East and Northeast China. It drains a remarkable watershed that includes diverse landscapes of desert, steppe, and taiga of Northeast Asia.

The **Tumen River** is a 546 km-long river that starts from Mount Baekdu and flows in northeast Asia, on the border between PR China and Democratic People's Republic of Korea (DPRK) in its upper reaches, and between DPR Korea and Russia in its last 17 km before entering the Sea of Japan (or East Sea).

Three key problems confront the Amur and Tumen river basins and coastal areas: (1) habitat degradation; (2) pollution of transboundary ground and river waters, and (3) non-optimal utilization of resources. These are caused by unsustainable agricultural activities and forestry in combination with growing industrial activities, along with inadequate land use planning. Trade of endangered wildlife (e.g., Amur leopards, Siberian tigers, cranes, river turtles, etc.) is also a major concern. These are further compounded by inadequate institutional and management systems, absence of coordinated planning, poor legal frameworks, lack of enforcement of existing regulatory instruments, insufficient public involvement, unbalanced regional capacity development, and inadequate financial mechanisms to address these problems in an integrated and sustainable manner.

As a response, the UNDP/GEF projects, Integrated Management of the Amur/Heilong River Basin and Tumen River Area Development Programme, aimed to develop an overarching regional strategic action programme (SAP) and establish an effective institutional mechanism to address transboundary land-based threats to the aquatic environment of the basins and their associated continental coastal areas.

The first task of the Amur/Heilong River Integrated River Management approach was the creation of a mechanism (Regional Framework) to solve transboundary environmental problems between Russia, China and Mongolia. The project aimed to initiate pilot activities for the integrated management of the river basin and its associated continental and Sakhalin Island coastal areas, and

Figure 4. Amur River Basin.

develop a replicable, inter-country and multi-stakeholder cooperation model to address threats to resources and biological diversity in the Lake Xingkai/Khanka basin in an efficient and cost-effective manner. The main components of the UNDP/GEF project included analysis of the freshwater and coastal zone management issues, causes and impacts of unsustainable use of water resources in the basin with a focus on land-use practices, point and non-point sources of pollution, and water resource regulations. The two final outputs were the Transboundary Diagnostic Analysis (TDA) and the ICARM Action Plan. Among the technical components of the ICARM Action Plan are contingency planning, water quality monitoring, and planned infrastructure projects (Kachur).

The TumenNET project, which formed part of the broader Tumen River Area Development Programme, was designed to help prepare an SAP (for 2006-2015) for the Tumen River Economic Development Area. The project was a regional partnership involving local, provincial and national governments, the business sector, grassroots communities, academic and research institutions and environmental NGOs. Coordination was achieved through a network of regional lead agents and national partners, which gave the project its nickname: TumenNET.

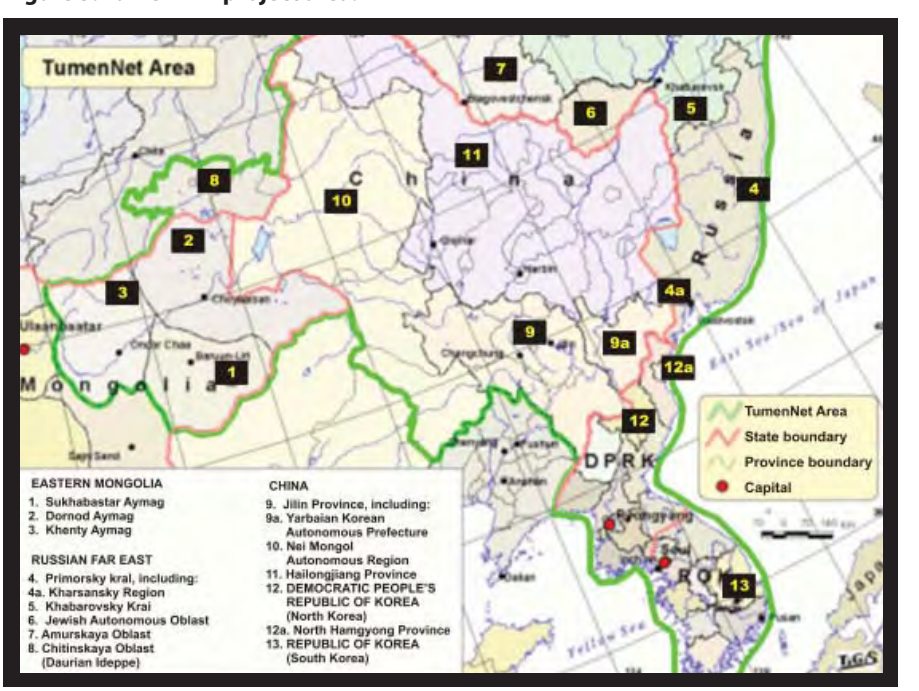
Five major components were involved, and each of the participating countries were responsible for one component, which was managed in cooperation with national Partner Institutions in the other four countries:

- EIS (Environmental Information System, lead: PR China);
- TDA (Transboundary Diagnostic Analysis, lead: Russia);
- AWARE (Awareness Raising and Small Grants Program, lead: Mongolia);
- SAP (Strategic Action Programme, lead: RO Korea); and
- SURVEY (Regional Water Monitoring, lead: DPR Korea).

The implementation of the TDA and SAP assisted in carrying out the Memorandum of Understanding among the Tumen River Area Development Programme member states by integrating and applying sound land and water resource management strategies. The SAP provides a common framework for the identification and formulation of strategies, programmes and projects, which were focused on the conservation of biodiversity and management of international water resources; designed to obtain national, regional and global benefits and respond primarily to transboundary issues of environmental management that could be financed and implemented by the five participating countries.

Taking into account the experiences from these projects, the following

Figure 5. TumenNET project area.



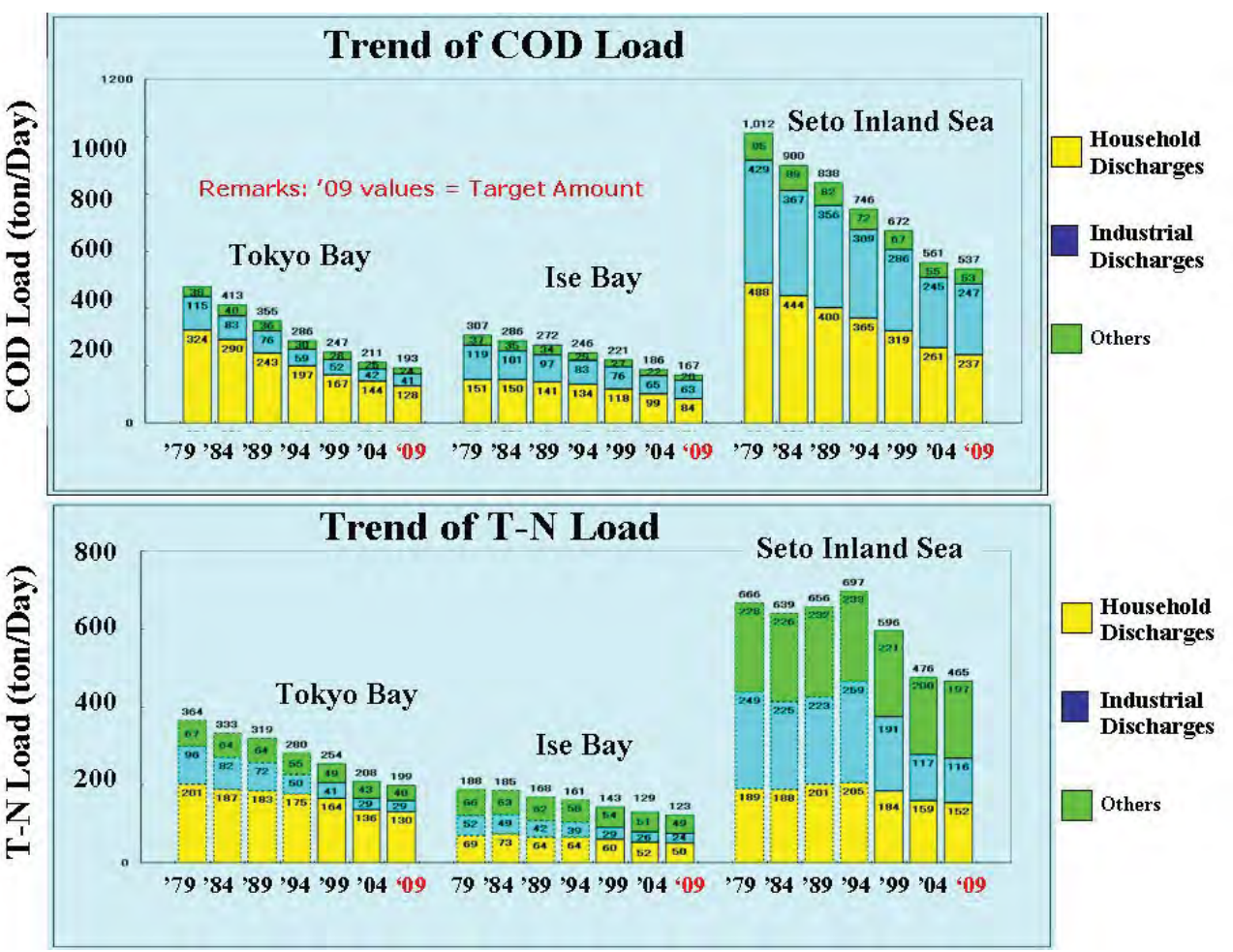
course of action was recommended to ensure pollution reduction and habitat restoration in the river basins and coastal areas: (1) fostering close cooperation among neighboring countries in coordinating protection and use of natural resources; (2) promoting development of coordinated economic policies; (3) developing contingency plans in case of environmental emergencies and joint ecological monitoring systems; (4) facilitating more active role of civil society; and (5) establishment of international commission to manage transboundary river basin and coastal areas similar to the Mekong River Commission and Yellow Sea Commission (Kachur).

Seizing the watershed opportunity to save the coasts

Japan's Eco-Compatible Integrated Management of River Basin and Coastal Area

In Japan, most of metropolises have developed along the enclosed coastal seas and river basins with both intensive agricultural areas and quite industrially-advanced areas having large populations and big cities. These land areas have continuously supplied the pollutant loads, and sometimes resulted in water pollution and degradation of marine ecosystems. Hence, the Japanese Government has been aggressively implementing the Total Pollution Load Control System (TPLCS), an environmental protection measure directed at controlling and reducing land-based pollution at source in the river basin (Murakami, et al.). The purpose of TPLCS is to reduce the pollutant loads entering into the enclosed seas, especially the specified water bodies of Tokyo Bay, Ise Bay and Seto Inland Sea. Every five years, the Minister of Environment formulates a Basic Policy for Total Pollutant Load Control System (BPTPLCS). The governor of each prefecture makes a Total Pollutant Load Control Plan to achieve the pollutant load reduction target according to the BPTPLCS. Such a plan generally consists of concrete

Figure 6. Reduction in pollutant load in Tokyo Bay, Ise Bay and Seto Inland Sea between 1979 and 2009.

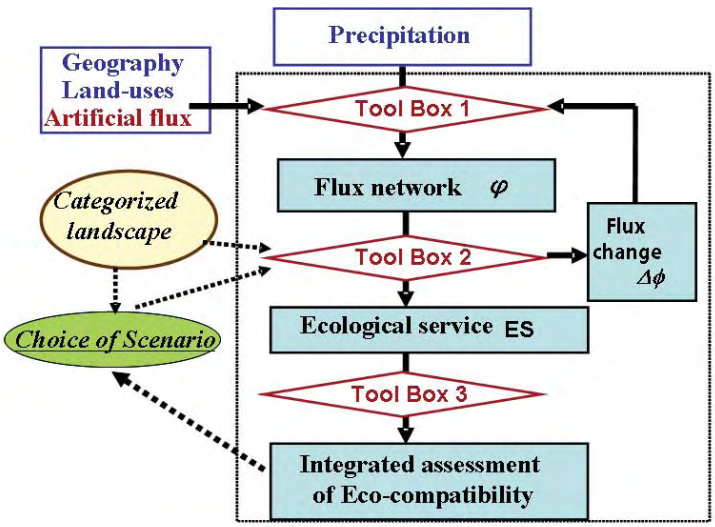


measures to reduce pollutants from households, industries, and agricultural lands. These measures significantly reduced the COD and TN loads in Tokyo Bay, Ise Bay and Seto Inland Sea between 1979 and 2009 (**Figure 6**).

Nevertheless, further environmental improvement from the watershed and forest to the sea areas was called for, and the ICARM approach was recommended by UNEP/NOWPAP. In 2007, a strategic environmental policy was formulated and the Basic Act on Ocean Policy was enacted, which emphasized the integrated management of coastal area and river basins.

For the development of ICARM in Ise Bay, an assessment framework for eco-compatible integrated management of river basin and coastal area was applied (Murakami, et al.). It consists of three tool boxes: (1) for evaluation of natural and man-made flux network (e.g., water, sediment, pollutant load etc); (2) for evaluation of ecosystem service for each categorized landscape which forms the river basin, coastal area and bay; and (3) for integrated evaluation of results from tool boxes 1 and 2 (**Figure 7**).

Figure 7. Schematic diagram of eco-compatible assessment.



Tool Box 1 Flux network analyzing model: land and coast
Tool Box 2 Ecosystem service modeling: Categorized landscape
Tool Box 3 Integrated eco-compatibility assessment model

National Program on ICARM in RO Korea

In RO Korea, intensive coastal development since the 1970s has led to degradation of coastal habitats, rapid increase in pollutant loading from land-based sources into coastal waters, about 40 percent increase in BOD during the last decade, and 20 percent decrease in wetlands due to reclamation projects from 1987 to 2005. Not until the mid 1990s did marine environmental protection come into the public agenda. Since then, RO Korea has implemented national strategies to achieve the goal of ICARM by consolidating the coastal and watershed management regime, applying a site-specific and issue-dependent approach, strengthening a decisionmaking support system, involving the public, revising the legal and institutional framework, and forging cooperation between national government agencies and local communities (Oh). Several policies and laws covering land, estuary and sea areas also set policy directions and standards for environmental management. In 2008, to improve integration and coordination at the national level, the Ministry of Maritime Affairs and Fisheries (MOMAF) and the Ministry of Construction and Transportation were merged into the Ministry of Land, Transport and Maritime Affairs (MLTM). Likewise, a significant portion of the national budget was allocated for pollution prevention from land-based activities, with sewage, POPs, heavy metals, and physical alteration and destruction of habitats as high priorities.

China's experience in pollution reduction in rivers and coastal zones using ICARM approaches

The main target of ICARM in the Yellow Sea in China is to control land-based pollution discharged through the river systems since this was identified as the key factor contributing to the pollution of the coastal zone. In 2007, the State Council promulgated the National Eleventh Five-year Plan for Environmental Protection (2006-2010). Under this plan, there are five targets to reduce marine pollution: (1) reduce amounts of land-based pollution; (2) speed up the steps of important marine environmental protection; (3) protect the sea from pollution from port and shipping; (4) strengthen marine ecological protection, including establishment of marine conservation areas; and (5) avoid sea-based environmental disasters (Xin Xie, et al.). The State Environmental Protection Agency (SEPA) also adopted the Songhua River Water Pollution Prevention Plan (2006-2010) and the Huai River, Liao River, Chao Lake, Dianchi Lake, Upper and Middle Reaches of the Yellow River Water Pollution Prevention Plan (Xin Xie, et al.).

Between 2006 and 2008, China adopted several measures to reduce pollution and improve water quality, namely: (1) land-based pollution reduction through control of industrial

pollution discharges, improvement of municipal wastewater treatment systems, delegation of responsibilities in improving water quality to local governments, and regular monitoring of results; (2) establishment of national aquatic resource conservation areas and periodic closing of some fishing areas; and (3) adoption and implementation of ship-based pollution reduction and mitigation measures at the national and local levels.

ICARM approach in the Russian Far East and application of coastal area zoning

In the Pacific coast of Russia, ICARM is being implemented on the basis of the analysis of natural peculiarities, environmental conditions, and socio-ecological issues in the areas covered.

For the organization of integrated and sustainable management of natural resources in the Far Eastern coastal zones of Russia, a hierarchical structure of delineation and zoning of coastal areas and recommendations for their development on the basis of natural resource and socioeconomic zoning was developed (Arzamastsev). It involves the following process:

1. Since there is no legislation on coastal management and no legally approved definition of coastal zone and its boundaries in Russia, the coastal zone was defined as the borders of the coastal regional subjects/administrative units (encompassing the watershed area) and the boundary of the continental shelf.

2. The zoning for coastal areas was defined in terms of environmental quality or conditions that can support life and human activity.

3. Recommendations were made as to zoning of coastal areas based on sustainability principles so that conflicting resource use (e.g., fishery versus extraction of oil and gas production) would be avoided.

4. Recommendations were also made to delineate the responsibilities of the federal, regional and municipal authorities for specific areas in the coastal zone. The area of *federal responsibility* on the whole is the territory and entire sea area of the country. However, exclusive Federal responsibility would cover the continental shelf from the outer boundary of territorial sea to the outer boundary of the continental shelf. *Regional responsibility* (of coastal Krais and Oblasts) would cover their land borders and inner waters and territorial sea from the marine side. *Municipal responsibility* would include territories of municipal subjects located in river basins and parts of the sea of two nautical mile-wide, or marine surface limited by perpendiculars to median lines dividing large bays and gulfs.

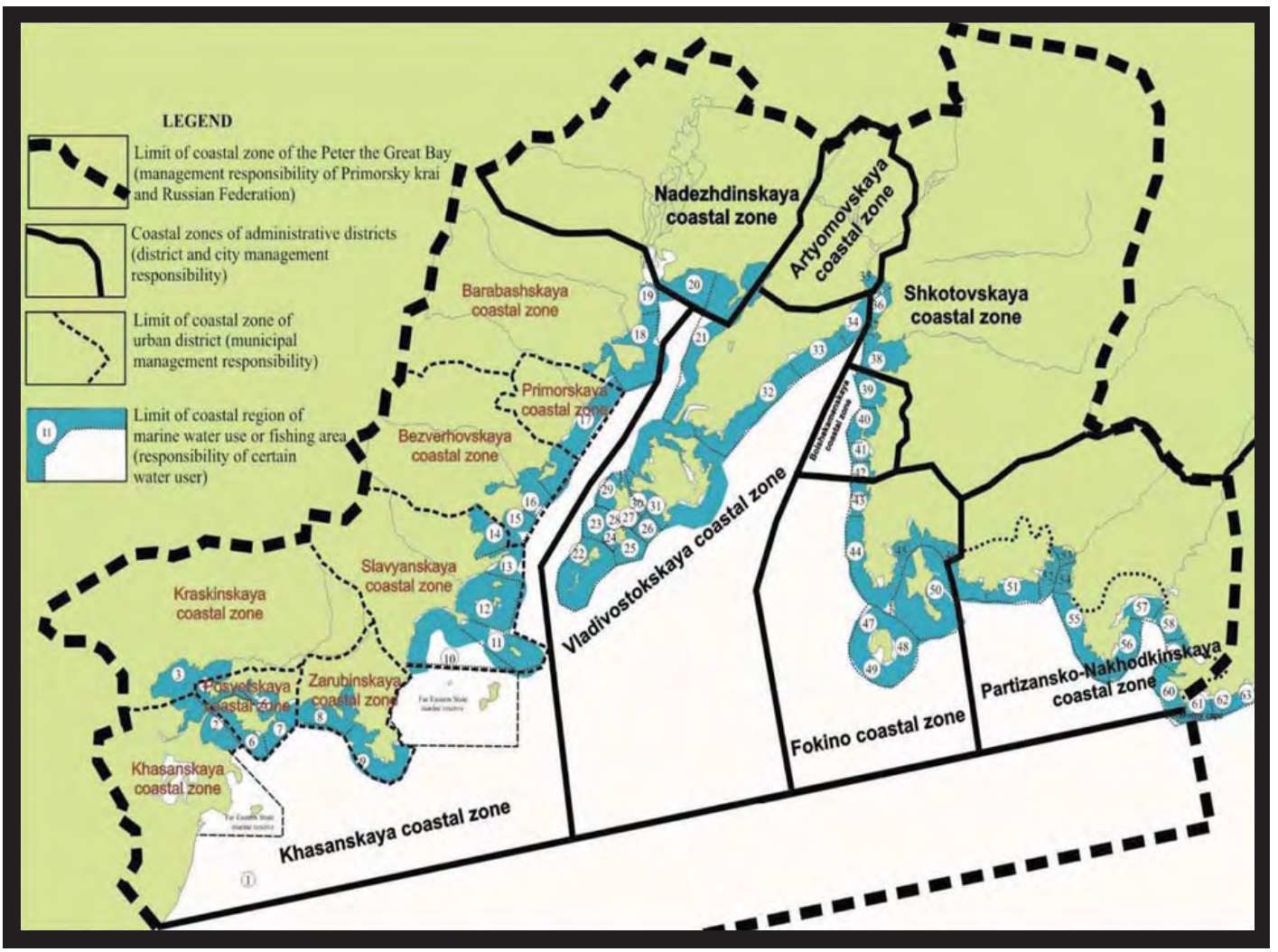
Other users of natural resources will be in charge of land and sea water assigned to them. The proposed delimitation scheme considers the coastal zone as a whole physical-geographical natural system, takes into account the interests of federal and regional structures and the needs of municipalities and the population of the coasts, and corresponds with existing Russian and international legislation. **Figure 8** shows the delimitation of coastal zones in the Peter the Great Bay near Vladivostok.

ICM, IRBM and pollution reduction in Selangor and Klang River System

In the Selangor and Klang River system in Malaysia, pollution is one of the biggest threats apart from dams and the destruction of highland catchments. The sources of pollution include domestic and industrial sewage, effluent from livestock farms, manufacturing and agro-based industries, suspended solids from mining, earthworks, and road construction, logging and clearing of forest. To ensure that the water resources and environment are in manageable and sustainable condition, the Selangor Waters Management

Photo: H. Li

Figure 8. Coastal Zones in Peter the Great Bay near Vladivostok.



Authority, a one-stop agency for the management of water resources, river basin, groundwater, coastal water and other water bodies, was set up by law in 1999. In the past, the approach was to treat river basin and coastal management separately. Eventually, however, the need for integrated management of river basin and coastal zone as a single interactive entity was recognized. This was demonstrated in Port Klang through the expansion of the ICM project boundary to cover the boundaries of IRBM of two major adjoining upstream rivers, namely the Klang and Langat Rivers. Klang River, with an area of 1,300 km^2, passes through Kuala Lumpur and Klang Valley, while Langat River, with an area of 2,400 km^2, drains the Kuala Langat Basin. Both river estuaries meet at the coastal waters of Port Klang ICM area (**Figure 9**). The process of integration required synergy among different sectors (government, private, NGOs, civil society, etc.), different government agencies (local authorities, land administrators, fisheries, tourism, shipping, agriculture, etc.), and different levels of government (Federal, State and Local). Harmonization of the legislative and institutional development agenda as well as setting up the supporting financing mechanisms were recognized as basic prerequisites for a successful IRBM-ICM program.

Comprehensive multi-sector pollution reduction strategies to restore Chesapeake Bay

The Chesapeake Bay is shallow with an average depth of 6 m, but with a large watershed area of 166,000 km^2 and population of 16 million. It is the largest estuary in the United States. Its basin includes the District of Columbia and parts of six states: New York, Pennsylvania, Delaware, Maryland, Virginia and West Virginia. More than 150 rivers and streams drain into the Bay.

The Chesapeake Bay has been degraded in the last 100 years due

to pollution as indicated by the decline in aquatic life. Nutrient enrichment from all sectors has caused fundamental and pervasive alteration of its ecosystem. Seagrass has declined by 8-to 10-fold while oysters are now at only one percent of historic population levels. The Chesapeake Bay Agreement was signed in 1987 by the states of Maryland, Virginia, and Pennsylvania, and the District of Columbia, committing to achieving a 40 percent reduction of 1985 nutrient levels (nitrogen and phosphorous) in Chesapeake Bay by the year 2000 and capping nutrient levels thereafter (Nemazie). Although the goal was not met, significant nutrient reductions were achieved. Various laws and measures applied to reduce nutrient pollution include the: (1) Critical Areas Law (1984) concerning protection of shorelines (revised in 2008); (2) Phosphate Laundry Detergent Ban of 1988 to reduce phosphorous loads; (3) Water Quality Improvement Act of 1998 incorporating nutrient management on farms; (4) Chesapeake Bay Restoration Fund of 2005, which charges a fee to support wastewater treatment plant and septic tank upgrades; (5) Water Resources Element of Comprehensive Plans of 2006 to ensure water and sewer capacity available for growth; and (6) the Chesapeake Bay 2010 Trust Fund to support reduction of non-point sources of pollution.

Following the principles of adaptive management, Maryland's governor established BayStat in 2007 to review monthly progress, assess the effectiveness of nutrient reduction programs from all sectors, and consider changes to increase their efficiency (**Figure 10**). Two-year goals on nutrient reduction were incorporated to hold politicians accountable. TMDL allocations will also be enforced beginning 2011. Adaptive management is also being employed based on the improvements made on ecosystem health. For all these measures to effectively lead to full recovery of Chesapeake Bay, nutrient reduction actions from all sectors must be undertaken. Restoring the Bay must also be considered in the context of climate change. Given its shallowness, a rise in water level and temperature due to climate change will have big impact on Chesapeake Bay's resiliency.

Figure 9. Port Klang ICM and river basin area.

Testing the waters

Information is essential to effective management. There are new technologies that help in getting and providing necessary information. There are innovative technical and social approaches to monitoring and data collection across local, national, regional and international boundaries. There are also technologies and approaches for data interpretation, information management and systems modeling, and decision-support tools, such as geographic information systems (GIS) and computer simulation tools. Case studies described below show how such tools and approaches can be woven together to provide inputs for more effective policymaking and planning.

Water quality assessment is a continuous process. The finding of an impaired water body during assessment should trigger a sequence of actions that may include listing of the water, development of a TMDL program, planning of national and local actions, and implementation of activities/projects designed to comply with water quality standards. In NOWPAP, the monitoring of pollution loading and river inputs contributes to development of spatial zoning and other management interventions.

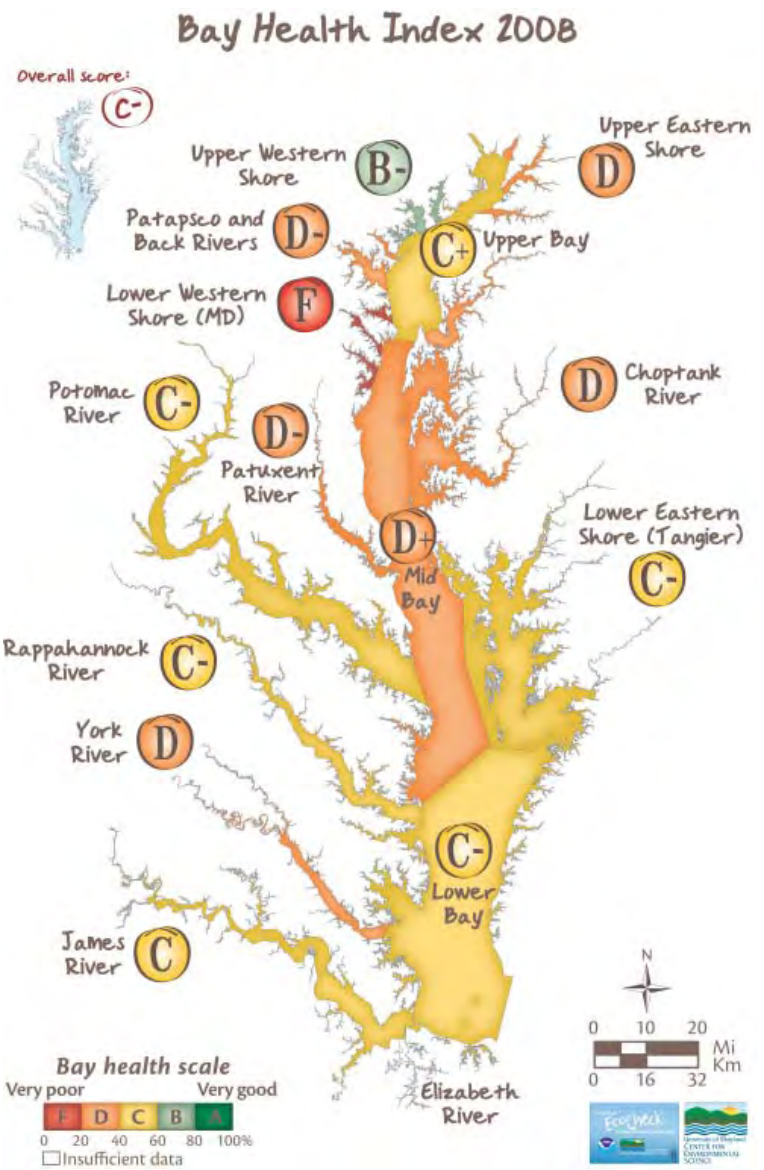
In Xiamen, multi-objective optimization and numerical models were applied to calculate wastewater discharges and

the marine environmental carrying capacity (Chen, et al.). The results can be used in developing programs to reduce sewage flux in Xiamen waters. In particular, pollution loadings in certain rivers in the watershed and discharge rates from point and non-point sources can be capped so that overall water quality is maintained in accordance with standards. The information from this model can also be combined with another model, likewise developed in Xiamen, to show the sources of pollution loading and their share in the total loading. This has implications on planning and law enforcement. In particular, the sea-use zoning scheme in Xiamen took into consideration the water quality in designating different functional zones.

Quantifying land-based pollutant loads in the coastal area in China

Quantification of land-based pollutant load is an important step before any planning is done or any practical steps are taken to address pollution. However, in many cases, data regarding water quality of effluent and storm water runoff, streamflow, climate variables, etc., in the coastal area are insufficient or inappropriate for the purpose of modeling or accurate direct estimation of land-based pollutant loads. A systematic approach for quantifying land-based pollutant loads in coastal bays with limited data was developed in China with the integration of Raster GIS, USLE, SDR, and empirical export coefficient method (Huang, et al.). This approach can quantify the source apportionment of land-based sources of pollution, in terms of point source, non-point source (including soil losses, fertilizer use, livestock and poultry breeding, and domestic wastewater), and river discharges, and identify the critical areas of land-based pollution in coastal areas.

The application of the approach in two bays (Xiamen Bay and Luoyuan



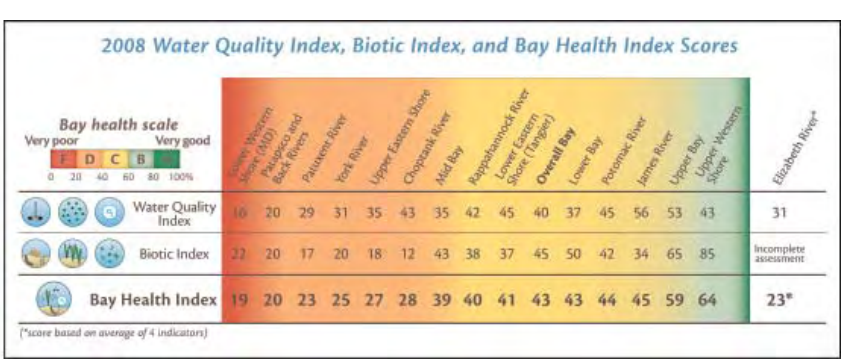
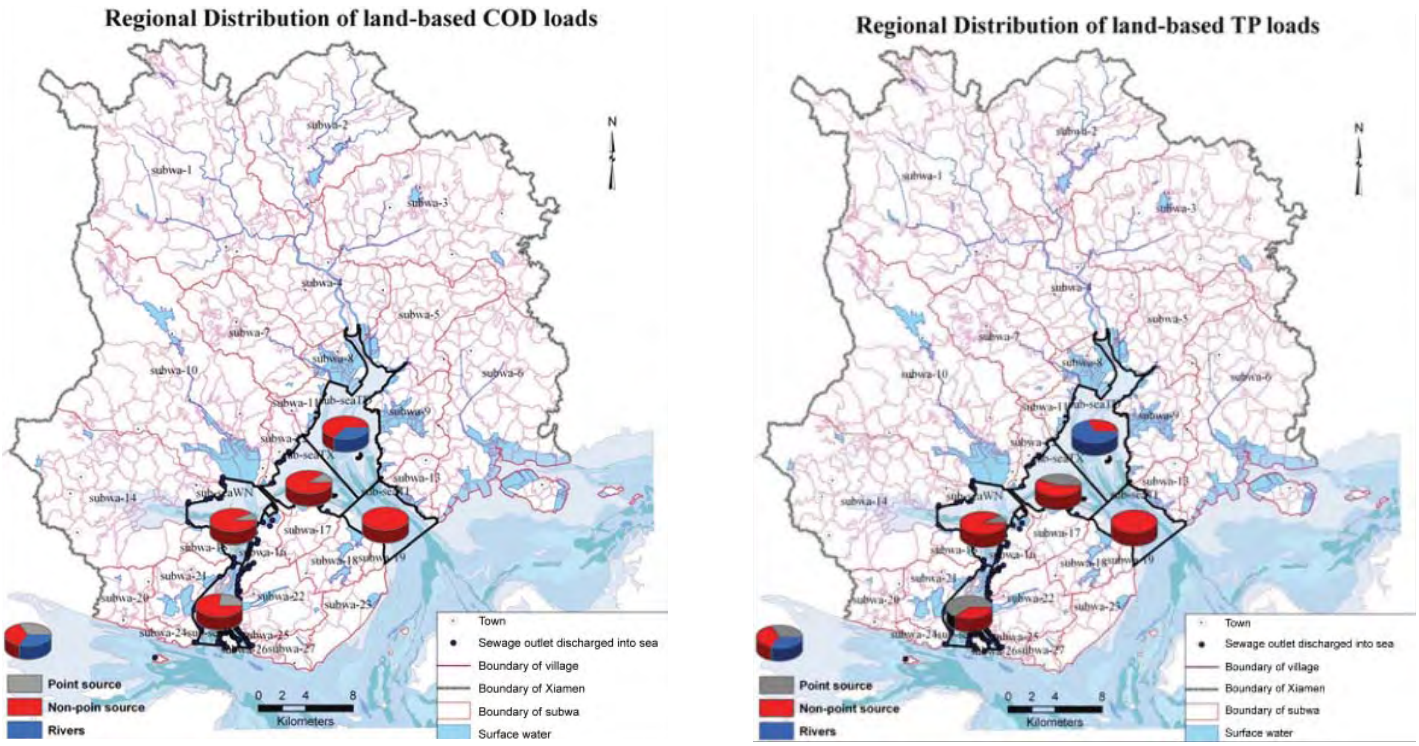


Figure 10. BayStat.

Figure 11. Sources and Distribution of Pollution Loading in Xiamen, PR China.



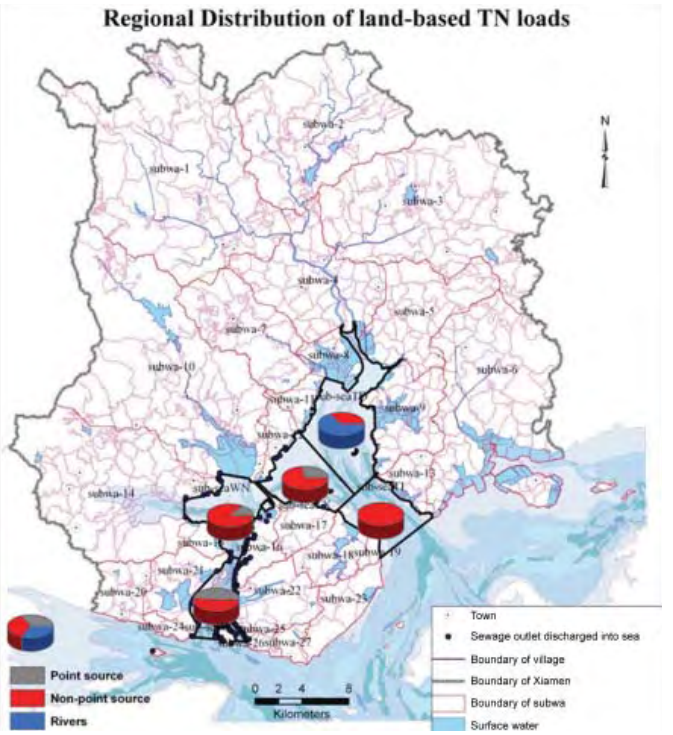
Bay) with different natural conditions and levels of urbanization resulted in clear identification of the sources of land-based pollutant loads and their respective share or contribution. In Xiamen Bay, which suffered from a more intensive urbanization process, the results showed that over 55 percent of the land-based pollutants (COD, TN and TP) were caused by non-point source pollution (**Figure 11**). On the other hand, the results obtained in Luoyuan Bay showed that 63 percent of the land-based pollutant COD was mainly from rural domestic wastewater pollution, 22 percent from soil erosion, whereas point sources only contributed 4 percent. The results also provided implications for river basin and coastal management in the study areas. Nonetheless, there are still some uncertainties and limitations for such an approach. For example, land-based pollutants in this model just focused on TN, TP and COD. More research work should be done in order to refine and further validate the model.

Pollution load assessment in the Marilao-Meycauayan-Obando River System

Under the Philippine Clean Water Act of 2004, the Department of Environment and Natural Resources (DENR) is required to designate areas that have bodies of water whose water quality needs to be improved. The Water Quality Management Area (WQMA) should cover the same physiographic unit that affects the physico-chemical and biological reactions and diffusion of pollutants in the bodies of water draining the said area. A WQMA is managed by a Governing Board which is composed of representatives from national government agencies, the local government and other key stakeholders in the area. The Governing Board is tasked among others, to prepare, approve, and update a WQMA Action Plan.

One of the first three WQMAs in the Philippines was the Marilao-Meycauayan-Obando (MMO) river system, which is a sub-basin in the Manila Bay area. It covers 130 km^2, and flows through three cities and four municipalities. There are 1.28 million residents (2007), and 794 industries (21 industry types) mapped.
A pollution load assessment for the MMO river system shows that 75 percent of the BOD loading is contributed by domestic sources, 20 percent by industries and 5 percent by aquaculture (Valenton and David). **Figure 12** shows the estimated domestic BOD loading into the three rivers.

This river system also receives untreated waste discharges from tanneries and establishments involved in production of leather, jewelry making, recycling used oil, etc. In the downstream and coastal areas, an aquaculture industry has been established. Hence, one of the issues raised during the study was the sole focus of this project on BOD loadings, given that previous studies,



and the environmental risk assessment and water quality monitoring results have shown that the major bay-wide concern is the nutrients, while there are localized concerns (in the MMO river system) regarding heavy metals, and oil and grease. The study noted that monitoring of BOD only will not result in a comprehensive pollution loading assessment, and may in fact lead to insufficient/inappropriate pollution control facilities.

Significance of the River Input of Nutrients in relation to Coastal Eutrophication

The assessment of a sea area where land-based sources determine the characteristics and ecological problems is a prerequisite for the success of the ICARM approach. In the NOWPAP region, which includes countries with very different natural and socioeconomical conditions, there is a need for indicators that would allow zoning of the vast coastal sea areas according to the influence of land-based sources. River runoff is the main land-based source of chemical substances, including nutrients, to the coastal areas and excessive input of nutrients is believed to be a main reason for eutrophication of coastal waters. The high natural and socioeconomic non-uniformity within the NOWPAP region makes it necessary to normalize the riverine fluxes of nutrients that are influencing the sea areas.

At present, the traditional area-normalized discharge (specific discharge, Q/S), which is a characteristic of watersheds, does not address the influence of river inputs on coastal waters. Hence, as a further step, an evaluation of coastal waters, where increasing levels of plankton production or eutrophication could be a consequence of the observed riverine flux of nitrogen, is proposed as a proxy estimation or indicator of the influence of river runoff on the adjacent coastal waters (Shulkin). The bigger area of influence, the greater the affect of land-based sources of nutrients on the eutrophication in coastal waters. The main disadvantage of such an indicator is the lack of connectivity with oceanographic and/or biological features in the concerned localities. The indicator, however, allows comparison of the situation at regional and subregional levels within large sea areas and distinguishes between those sea areas where the ICARM approach is strongly recommended and those areas where influence of the land-based point sources of nutrients is less probable.

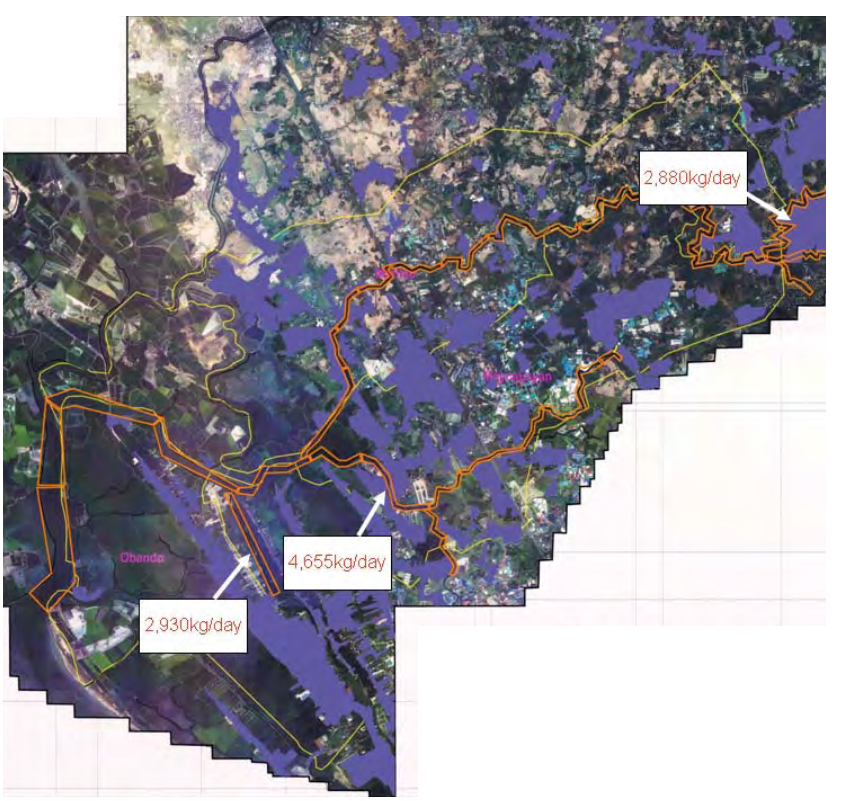
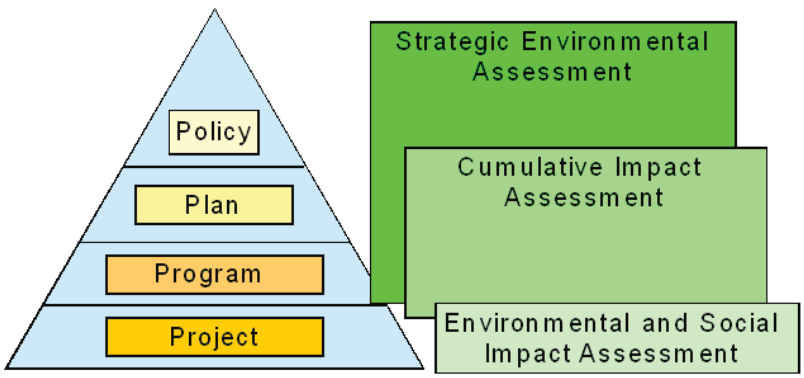


Figure 12. Estimated domestic BOD Pollution Loading in the MMO river system (2007).

Figure 13. Upstreaming SEA in decisionmaking.



Source: The World Bank. 2005. Good Practices in Strategic Environmental Assessment

Applying Strategic Environmental Assessment in ICM

Compared to project-specific Environmental Impact Assessment (project EIA), strategic environmental assessment (SEA) is a process of anticipating and addressing the potential environmental impacts or consequences of proposed initiatives at higher levels of decisionmaking, and integrating environmental considerations into the earliest phase of policymaking, planning and program development (**Figure 13**). The SEA is a method and approach for conducting environmental assessment of policies, sector development plans, and programs, and can also be used as a tool in country environmental analysis. It also involves assessment of economic and social impacts as well as cumulative impacts, which are important because impacts of individual projects may be minor when considered in isolation, but significant when the projects are viewed collectively. In contrast to project-level EIA, SEA brings environmental and sustainable development considerations, including temporal and spatial scale of cumulative and indirect effects, into decision-making early, before any decisions on project location and scale have been made, resulting in a broader range of alternative proposals and mitigation measures.

The SEA approach was used in evaluating the proposed land reclamation projects, developing options and recommendations, and augmenting the sea-use zoning scheme in Xiamen (Fang). A well-designed SEA framework can therefore support and improve decisionmaking in ICM and ICARM programs (**Figure 14**). Increased rigor in implementing legislation to better link SEA to ICM, however, is needed.

Embedding Pollution Reduction in the Political Agenda

Political will: Control of land-based pollution and cleaning up the Singapore River

In Singapore, major sources of pollution affecting the marine area include ship-borne pollution and land-based pollution. Being a city-state, the main sources of land-based pollution in Singapore are domestic sewage and industrial wastewater. There are also some commercial farms in the suburban areas that generate wastes, which, if not properly managed, would also pollute inland and coastal waters.

A big challenge that Singapore faced in the late 1970s was the serious pollution of the Singapore River. In 1977, then Prime Minister Lee Kuan Yew issued a challenge to have the Singapore River cleaned up in ten years. This resulted in a 10-year master plan aimed at cleaning up the Singapore River and Kallang Basin. The goals were

Figure 14. Integrating SEA into ICM.

Dimensions of Integration in ICM		How SEA Facilitates ICM
Administrational	Intersectoral integration	Analysis consistence of proposed target with existing PPPs; Public participation
	Intergovernmental integration	Tiering of SEA: its application at different levels of decisionmaking; public participation
	International integration	Assess transboundary and global impacts
Spatial	Integration of the terrestrial and marine components	Assess interaction between land and ocean, especially impacts of land-based activities
Decisionmaking	Science-management integration	Start at earliest stage; Iterative (technical process and review procedure)
Methodologies	Integration of variety of natural science and social science	Integration of different assessment tools
Objectives	Sustainable development balancing economic well-being, social justice and environmental objectives over the long run	Extend SEA contents to broader concerns
Guiding Principle	Integration of human and nature	Framework designed based on ecosystem management

Source: Source: Fang

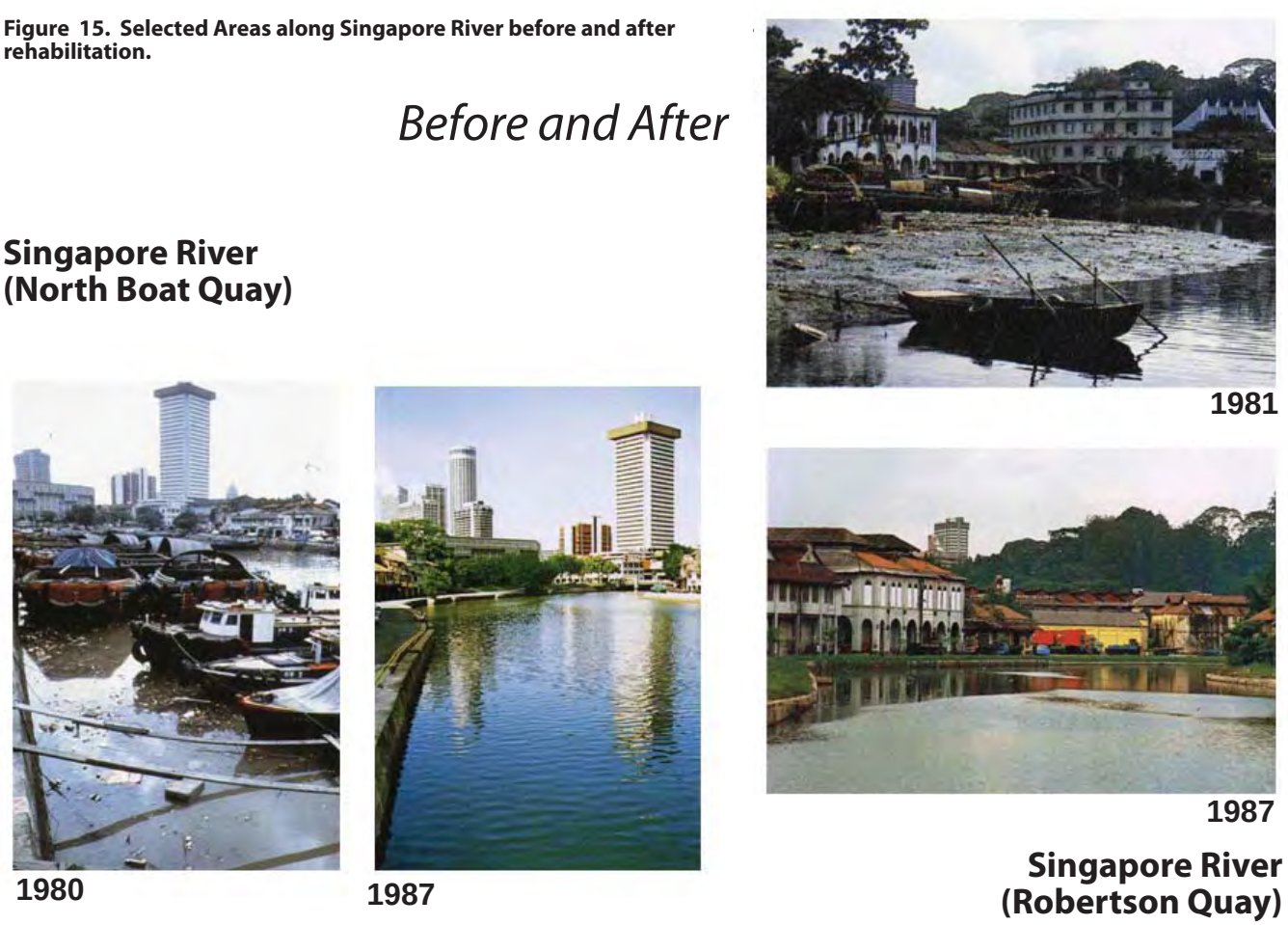
to remove sources of pollution and to ensure water quality that would support fish and other aquatic life, and water recreational activities. An interagency committee was led by the Ministry of Environment, which adopted action programs meant to: (1) identify sources of pollution and measures to remove them; (2) upgrade environmental infrastructure and construct new infrastructure; (3) review existing institutional structure and legislation to strengthen environmental pollution control; (4) resettle industries and illegal settlers along riverbanks; and (5) implement river rehabilitation and beautification.

With proper planning and development, provision of environmental infrastructure and pollution control facilities, stringent enforcement of pollution control legislation and an effective monitoring programme, Singapore managed to control land-based pollution sources effectively and keep the inland and coastal waters clean and healthy (Hui). After just ten years, river quality improved dramatically as indicated by the return of aquatic life, resurgence of water recreational activities, and aesthetic improvement of various areas along the river (**Figure 15**). The success of the program was attributed to political will, a clear mandate for agencies to carry out their tasks, close coordination among government agencies and partnerships with stakeholders.

Policy and institutional reforms: Pollution Reduction in the Jiulongjiang Basin and Xiamen Bay

The Jiulongjiang, with a total basin area of 14,240 km^2, is the second largest river in Fujian Province running from the hills of Longyan City through Zhangzhou City, entering the sea in Xiamen City. The Fujian provincial government has paid great attention to the control of pollution in the river basin of the Minjiang (the largest river of Fujian running into the sea in Fuzhou) and the Jiulongjiang. However, after a decade of ICM practice in Xiamen, the managers and stakeholders in Xiamen came to realize that the Jiulongjiang Basin still was having a great impact on ecosystem health and marine

Figure 15. Selected Areas along Singapore River before and after rehabilitation.



biodiversity conservation in Xiamen Bay. The Jiulongjiang accounts for 50 percent of the non-point source pollution in the Bay. Therefore, the Strategic Management Plan of Xiamen ICM (2004) made the control of transboundary pollution from the Jiulongjiang Basin one of its priority objectives. Since 2004, the Xiamen Government has initiated a comprehensive program for transboundary pollution reduction in the Jiulong River through institutional, technical and financial arrangements with the upstream and downstream cities (Zhou).

In terms of institutional arrangements, several actions were made, such as the setting up of a Xiamen, Zhangzhou and Longyan City Alliance in 2004. This led to a united effort in coastal zone management, pollution reduction, conservation of rare and endangered marine species, coastal disaster prevention and mitigation, intensive fishery law enforcement, and marine environmental monitoring. In terms of technical arrangements, workshops and forums were held among the cities to exchange knowledge and lessons learned. Every year, the mayors of the three cities sit down to summarize what has been achieved and lay down the target for the coming years.

Over the past six years, the Fujian Government has invested in water pollution control and ecological management. Moreover, since 2004, the Xiamen Municipal Government has been providing financial assistance to its upstream partners for pollution reduction activities in the upper reaches of the watershed. Arrangements were also set up to relocate, move or shut down activities and industries that significantly pollute the watershed.

Linking Policies and Technologies

Both policy and technology solutions will be critical to solving the environmental infrastructure gap. Institutional capacities are too weak, regulatory frameworks are either not in place or not enforced. As such, investors are wary to invest. Oftentimes, technologies being offered are too expensive, too energy intensive, or too complex to be set up in areas where there are limited capacities and resources. Innovations in both policy and technology will serve to close the gap between these two challenges. Various wastewater treatment technologies — conventional or innovative; low cost or high cost — are available, but there must be supporting policies in place and institutional and technical capacities to ensure appropriate technology selection (suitable, affordable, cost-effective, energy-efficient), implementation and replication. In some settings, simpler, less expensive technologies might be appropriate for meeting immediate needs, while larger scale solutions are being planned for implementation as capacities improve. Decentralized and community-based wastewater treatment systems may be explored in rural and urban poor communities. Moreover, tapping the potential for energy generation and reuse of treated wastewater and application of biosolids in agriculture can result in multiple benefits — alternative sources of energy, water supply and organic fertilizers while at the same time addressing the pollution problem. In looking forward, the most innovative approaches will reflect the following considerations: (1) the linkages between policy and technology; (2) the need to specifically tailor solutions to the local situation; (3) the relationships between water, agriculture and energy; and (4) the importance of capacity building for effective implementation of both policy and management interventions. Breakthroughs in technology that change the economics or environmental impacts of water supply and wastewater treatment processes would make the adoption of certain policies less risky to political leaders. Some examples follow.

Livestock Waste Management in East Asia: Waste treatment and energy generation

The GEF-World Bank Livestock Waste Management in East Asia Project aims to reduce the major negative environmental and health impacts of rapidly increasing concentrated livestock production on water bodies. The project is a collaboration between PR China, Vietnam and Thailand, three of the major livestock producing countries in the region, and the Food and Agriculture Organization (FAO).

The project focused on moving from the business-as-usual approach of inadequately addressing the environmental problems that are being created by the rapidly increasing large-scale livestock production units to a strategic framework for a cost-effective and environmentally sound livestock production. The project also involved capacity and institution building in the countries concerned, and comprised: (a) awareness raising and development of policies and replication strategy; (b) livestock waste management technology demonstration and training involving introduction of a better spatial distribution of intensive livestock production to bring the nutrient effluent more in line with the adsorptive capacity of the surrounding land, and the use of improved manure management technologies to reduce the environmental damage that industrial livestock activities currently cause; (c) setting in place a project management and monitoring and evaluation system; and (d) regional support services to be provided by FAO (Chaiyakul and Chatsanguthai).

Through this project, examples of innovative wastewater and sludge treatment (see **Box 1**) and biogas electricity generation systems in pig farms were applied, demonstrating technologies that treat waste, convert

waste into a resource (energy source) and generate revenue (carbon credit) (**Figure 16**).

The project benefits included: (a) organic (BOD) stabilization and nutrient conversion; (b) pathogen reduction and odor control; (c) energy generation – reducing use of fossil energy and additional revenue stream to farms, greenhouse gas reduction and obtaining carbon credits (in Thailand); and (d) social contribution – Community Benefit Plan (in Thailand).

Box 1. Introduction of innovative technologies in pig farms.

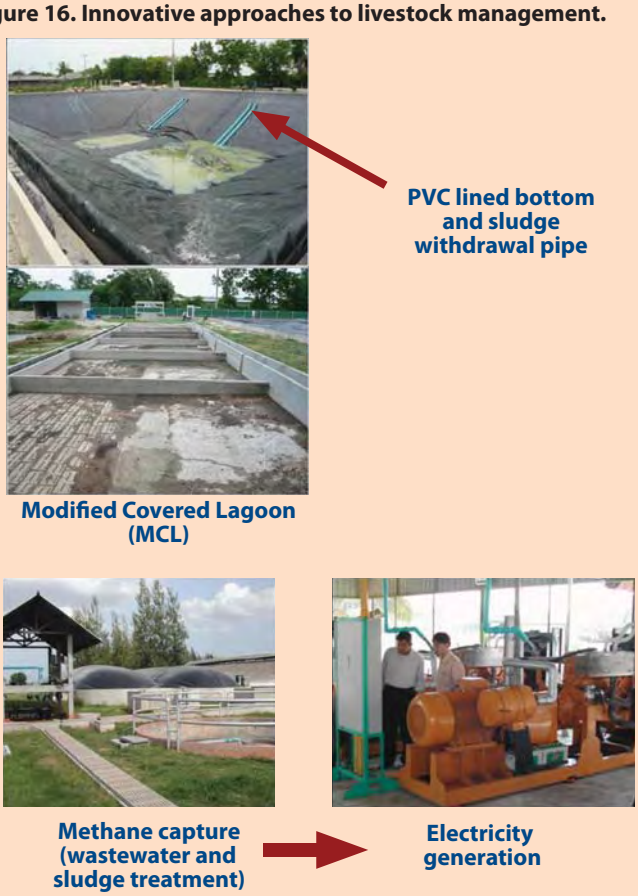
In Thailand:
- Modified Covered Lagoon (MCL) - Additional: PVC lined bottom and sludge withdrawal pipe
- Channel Digester Plus - to improve sludge withdrawal efficiency and sludge storage during monsoon season

In China:
- Upflow anaerobic sludge blanket (UASB) digester
- Factory-fabricated combined digester and gas storage
- Red mud plastic baffled reactor

In Vietnam:
- Communal system
- Cluster household system

Source: Livestock Waste Management in East Asia (LWMEA) Project Management Office, Bangkok

Figure 16. Innovative approaches to livestock management.



Source: Livestock Waste Management in East Asia (LWMEA) Project Management Office, Bangkok.

Supporting policies, plans and regulations have also been set in place. In Thailand, the Ministry of Natural Resources and Environment, with the assistance of the project preparation team, has passed a regulation for waste management for pig farms and developed a Code of Good Agricultural practice for the certification of standard farms, which includes conditions for management related to health, food, water, animal welfare and waste management. In addition, regulations that ban the discharge of wastewater into surface water has been put into place. In Viet Nam, a national strategy and a law on environmental protection has been enacted while in China, a general national regulation on wastewater management has been passed, which also addresses industrialized livestock production.

Ningbo Water and Environment Project: Natural systems for wastewater treatment

The Ningbo Water and Environment Project (NWEP) is the first project financed under the Strategic Partnership Investment Fund for Pollution Reduction in the Large Marine Ecosystems (LMEs) of East Asia established by the GEF and The World Bank. In line with the Fund's objective, the overall project development objective was to reduce land-based pollution along the Cixi coast and the East China Sea, promote the replication of innovative, low-cost wastewater treatment techniques, and encourage coastal zone conservation. This project's concept, objectives and components were previously presented during the East Asian Seas Congress in Haikou City, Hainan Province, PR China in December 2006. Since then, progress has been made starting with the establishment of the Wetland Center in 2007.

The GEF/World Bank Ningbo Water and Environment Project was implemented

by Ningbo Municipality (in Zhejiang Province), which is located 175-km south of Shanghai and borders Hangzhou Bay, China's second-largest port. Investments in water supply and pollution control in the municipality have lagged far behind its rapid economic development, so its coastline is severely polluted. Its local governments have now declared pollution reduction a priority and adopted a progressive, sub-regional and multisector approach to it. The project demonstrated cost-effective and innovative solutions, including a constructed wetland for tertiary treatment of the Cixi Wastewater Treatment Plant and a natural wetland conservation area for non-point source pollution control, restoration of degraded wetlands and tidal mudflats, biodiversity protection, and environmental education (Li). The Cixi County– Ningbo Government also established a Wetland Management Company to develop and manage the Wetland Center, and engaged a Consortium consisting of Wetlands International, Global Environmental Center and East China Normal University to provide technical assistance on design and operations of the Wetland Center (Li).

Quarterly monitoring of the site indicates that populations of migratory and breeding birds have increased and that vegetation communities are colonizing the new freshwater wetlands. The water quality at the wastewater treatment wetland outflows, however, has yet to show significant changes as the treatment wetlands are not yet fully functional.

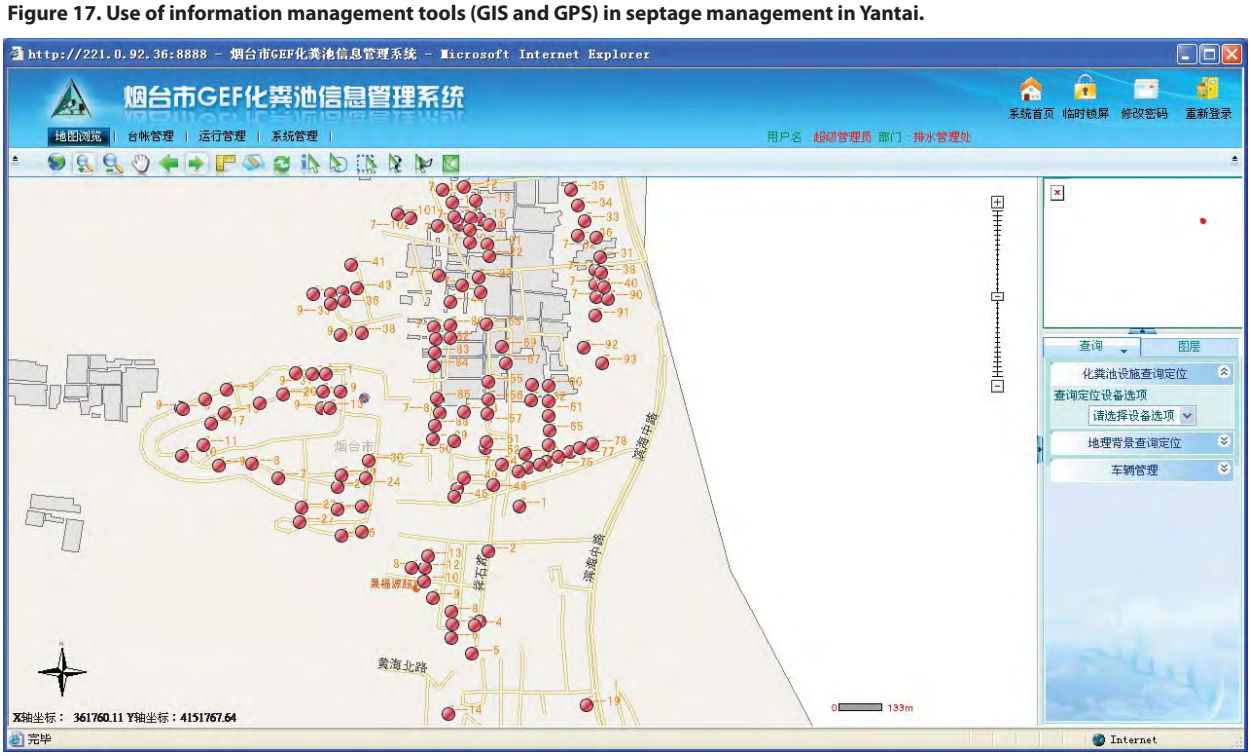
Yantai Pilot Project: An integrated approach for septage management

The Yantai GEF-World Bank Pilot Project is ongoing and is part of the bigger second Shandong Urban Environmental Protection Project II. The Shandong project aims to promote sustainable urban development in Shandong province by implementing the following projects:

- Upgrade the urban wastewater treatment facilities, solid waste disposal and water supply facilities;
- Improve the efficiency of urban wastewater treatment plants, solid waste disposal companies and water supply companies;
- Disseminate results of the Yantai GEF Pilot Project in Shandong province; and
- Facilitate institutional and capacity development.

The Yantai GEF-World Bank Pilot Project is addressing septage management issues, such as lack of regulations on obligations, responsibilities, design, construction, operation and maintenance of septic tanks, and septage collection,

Figure 17. Use of information management tools (GIS and GPS) in septage management in Yantai.



Source: Yantai GEF-World Bank Pilot Project

treatment and disposal (Jin, et al.). The major project components include:

- Policy and Regulation Study: reviewed and analyzed current policies and regulations, developed a new policy framework and specific regulations on septage management in Yantai;
- Institutional Development: To develop the structure and analyze the costs of management, inspection, and field operation for sustainable and financially viable septic tanks management;
- Establishment of GIS/IMS System (database with GIS of spatial and attribute information of septic tanks, and GPS for vacuum trucks' operation and transport optimization);
- Construction of septage treatment station, including procurement of vacuum trucks and treatment equipment with GEF funds; and development of Operation and Maintenance Manuals;
- Environmental Monitoring;
- Project Assessment;
- Training, Public Education and Technology Transfer;
- Development of septic tank training and certification center for practitioners; and
- Investigation on decentralized/ on-site wastewater treatment technologies.

The role of the improved GIS and GPS for mapping, monitoring and regulating septic tank systems in Yantai has been successfully demonstrated (**Figure 17**), and this could be replicated and scaled up in other cities in PR China (Jin, et al.).Once the equipment, vacuum trucks and septage treatment plant have been procured, this septage management project is expected to result in additional BOD reduction of 25 percent per year, and would complement the wastewater treatment facilities (Jin, et al.).

Reducing pollution in the Pasig River: Strategies, good practices, achievements and challenges

The Pasig River is one of the major rivers and most important natural waterways in the Philippines. Located at the heart of the nation's capital, the 27-km river serves as the only link between Manila Bay and Laguna de Bay, which is the largest freshwater lake in the Philippines.

The Pasig River also has four major and 43 minor tributaries which are directly and continuously discharging polluted water into it. These tributaries, and the Laguna de Bay were causing the degradation in the water quality of the Pasig River and Manila Bay.

In 1999, the Pasig River Rehabilitation Commission was created through an Executive Order, with the main objective of upgrading the water quality of Pasig River to Class C level — water quality that is fit for fishery, secondary recreation and water supply for manufacturing processes (after treatment). The Commission set 12 targets, namely to: (1) eliminate offensive odor; (2) reduce BOD load from 330 tons/day to 200 tons/day; (3) reduce solid waste; (4) increase and control the flow of water; (5) reduce flooding; (6) enforce zoning ordinances by respective local government units (LGUs); (7) remove sunken vessels; (8) develop linear parks; (9) relocate informal settlers; (10) establish water transport service; (11) undertake bioremediation/aeration and filtration; and (12) implement phytoremediation. From 2000 to 2008, the PRRC was able to reduce dumping of garbage and

Figure 18a. Snapshots of Progress in Pasig River

Before **After**

PUP Linear Park
Sta. Mesa, Manila

Development of Linear Parks. Out of 38 km on both banks of the Pasig River, a total of 25 km has been developed.

discharging of industrial waste into the river; remove sunken vessels and other materials from the river bed; develop linear parks and turn the riverbanks into environmental preservation areas (**Figure 18a and 18b;** resettle informal settlers to decent and socialized housing units **(Figure 18c)**; revive the commercial ferry; continuously monitor the water quality of the river; and create public awareness (Tablan and Mallari). A river dredging and rehabilitation work was also initiated in 2009.

Presently, the Commission faces several challenges, such as: (1) fast-tracking the construction of septage treatment plants (STPs) and wastewater treatment facilities by the concessionaires; (2) strengthening involvement of LGUs in the relocation of informal settlers and construction and operation of Material Recovery Facilities (MRFs); and (3) establishing biological treatment stations for households, commercial and industrial establishments and the 43 minor tributaries of the Pasig River.

Rising to the Challenge: Initiatives in the Pollution Hotspots

Jakarta Bay–Ciliwung River Pollution Reduction Project

Jakarta, the capital city of Indonesia, has been the economic development center of the country, and the resulting urbanization has created environmental as well as social problems. The city has a night-time population of 10 million and

Figure 18b. Snapshots of Progress in Pasig River.

Before **After**

Brgy. Pineda Linear Park
Manila

Figure 18c. Relocation of Informal Settlers. PRRC has resettled 9,217 out of 10,113 informal settler families from the Pasig River to decent and socialized housing units.

Before **After**

Figure 19. Spatial Planning of Coastal Areas of Jakarta — Protected zone (N1), Cultivation zone (B1, B6, B7) and Buffer zone (P2, P3 and P5).

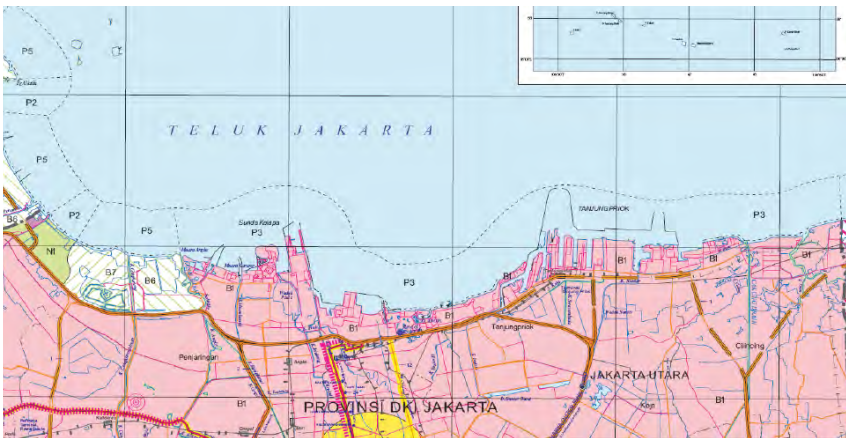
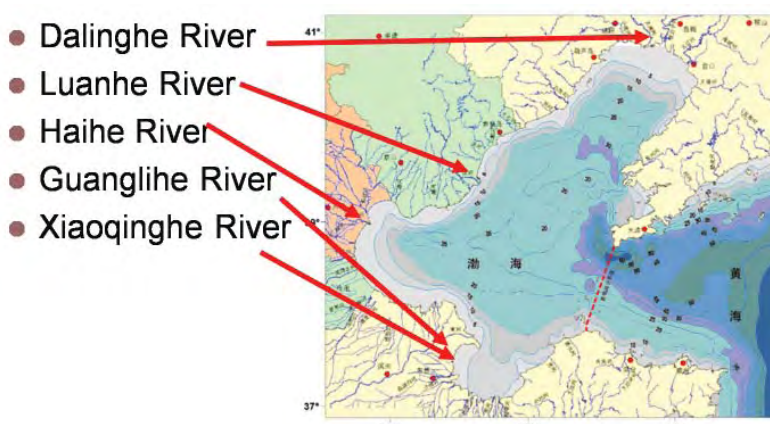


Figure 20. Approaches for the 5 Major Rivers Draining Bohai Sea.



River	Approaches
Dalinghe River	• Protected Area (PA)-based targets • Protected areas: - National level: 1 - City level: 2 - Country level: 6 • Total area of protected areas: 51872 ha • Country-level model • Protected Area (PA)-based targets
Luanhe river	• Zoning for total control of quantity of pollution discharge • Network for control of discharge • Ecosystem-based targets
Haihe river	• Controlling under rapid development • Coastal water-based targets
Guanglihe river	• Reconstructing relationship between water and human use • City river with eco-landscaping
Xiaoqinghe river	• Sewage - Wastewater - Non-point - Eco-engineering • Integrated control in 5 cities/10 counties:

day-time population of 12 million, while the Greater Jakarta area has a total population of around 25 million people. The city's geographical condition is characterized as a low-lying region, with 13 river systems coming from the neighboring administrative regions of Banten and West Java Provinces flowing to Jakarta Bay in the northern part of the city.

One of the rivers flowing into the bay is the Ciliwung River, which in the past used to be an economically important transportation route but is now functioning mainly as a flood control canal. Ciliwung River flows through 72 sub-districts with many areas along the riverbanks occupied by informal settlers. Large volumes of solid waste and sedimentation due to upstream land erosion have resulted in a decrease in the water flow of the river. In addition, industrial waste, agricultural waste, livestock manure and market waste flow into the river without treatment. This has resulted to pervasive water pollution in the river and the receiving Jakarta Bay. The local government has implemented a Clean River Program, undertaken periodic environmental quality monitoring, endeavored to control effluent pollution from industrial and commercial activities, and actively undertaken river clean up campaigns (Susanti). With regard to coastal water pollution, the city has signed a Letter of Declaration for improvement of the waste management performance of companies, which are located along the coast, and undertaken spatial planning of the coastal area (**Figure 19**), strategic environmental assessment (SEA) for coastal reclamation and revitalization, and beach cleanup campaigns (Susanti).

Despite the programs undertaken by the city government, the need to address the pollution problems in a sustainable way was recognized. A strategic plan for the integrated management of Jakarta Bay Area and tributary rivers has been prepared, and

Jakarta Province will be formulating future actions in line with this plan.

A master plan to reduce pollution and improve the water quality of the Ciliwung River has also been developed.

It includes: (1) water pollution control – for domestic, agricultural, livestock and industrial wastes; (2) environment degradation control to address erosion and sedimentation; (3) spatial planning – including zoning of both upstream and downstream areas; (4) law enforcement; and (5) community empowerment – through raising community awareness, information dissemination, training and community participation in composting and biogas projects, harvesting rainwater and recharge of deep and shallow wells (Sigit).

IRBCAM Project in Bohai Sea: Current status and the future

The integrated river basin and coastal area management (IRBCAM) project in the Bohai Sea Economic Region in northeast China is focusing on pollution reduction in the watershed and coastal areas of five major river systems: Dalinghe River; Luanhe River; Haihe River; Guanglihe River; and Xiaoqinghe River (**Figure 20**).

Programs/projects that will be implemented include: (a) implementation of the National Plan for Bohai Sea Environment Protection; (b) infrastructure for pollution control; (c) establishment and networking of protected areas; (d) zoning and ecoengineering; and (e) ecosystem-based management (Wen, et al.).

Manila Bay: Role of Corporate Social Responsibility

One of the special events of the EAS Congress was the PPP for the Rehabilitation of Manila Bay: A CSR Forum. The CSR Forum highlighted the importance of public-private partnerships (PPP) in addressing pollution and other issues, particularly the application of CSR in the rehabilitation of the Manila Bay. The Forum also discussed the contributions of the corporate sector, both existing and prospective, to the rehabilitation of Manila Bay and how they can strategically realign their efforts in achieving the goals and objectives set forth in the Operational Plan for the Manila Bay Coastal Strategy (OPMBCS). The CSR Forum highlighted the role of integrated coastal management (ICM) as a management tool that could address the three areas of concern in the OPMBCS, namely: (a) Partnerships and Governance; (b) Water Pollution; and (c) Overexploitation of Resources. The OPMBCS aims to scale up ICM to cover 100 percent of the Manila Bay coastline, and implement an integrated river basin and coastal area management program for the entire Manila Bay Area.

In terms of Partnerships and Governance, the private sector has been an active partner in the ICM program of the Province of Bataan. The Provincial Government, in partnership with the Bataan Coastal Care Foundation, Inc., local governments, civil society groups, fisherfolk and other stakeholders, was able to institutionalize the Bataan Integrated Coastal Management Program (BICMP), and came out with the Bataan Sustainable Development Strategy (SDS) and the Bataan Coastal Land and Sea-Use Zoning Plan. The BCCFI, composed of 17 companies located in Bataan, provides counterpart funding for the BICMP and implementation of the Bataan SDS. The replication of the PPP for ICM in Bataan to other provinces and in the National Capital Region (NCR/Metro Manila) is called for, and the BCCFI can lead the way (Erni).

On water pollution, the target of 50 percent reduction of untreated wastewater by 2015 is a tall order. However, the two concessionaires, Manila Water and Maynilad, are making huge investments in sewerage, septage and wastewater management. They may not be able to meet this target in the short term, but significant pollution reduction in major rivers can be expected. Both concessionaires are involved in the San Juan river basin project (**Figure 21**). Long-considered a dead river, San Juan River is a major tributary of the Pasig River. With both concessionaires making this a priority project, this would hopefully result in reviving the San Juan river, and contribute to the long-term rehabilitation of Pasig River.

On habitat, resource and biodiversity conservation, there are already ongoing various resource management projects being implemented by the private sector in partnership with the local governments, NGOs and communities, such as mangrove planting, tree planting, coastal cleanups, river rehabilitation, and management of wild bird sanctuaries and marine turtle sanctuary. For livelihood activities, the private sector has supported the establishment of fish sanctuaries and artificial reefs, setting up of a microenterprise, and the conduct of anti-illegal fishing activities.

Stemming the tide of toxic chemicals

The United Nations Industrial Development Organization (UNIDO) advocates for cleaner production and application of best available techniques (CP/BAT) and best environmental practices (BEP) to reduce/eliminate danger to human health and environment caused by persistent organic pollutants (POPs) and persistent toxic substances (PTS). The organization has a portfolio of projects that support sustainable industrial development while preventing or mitigating pollution. UNIDO also recommends the

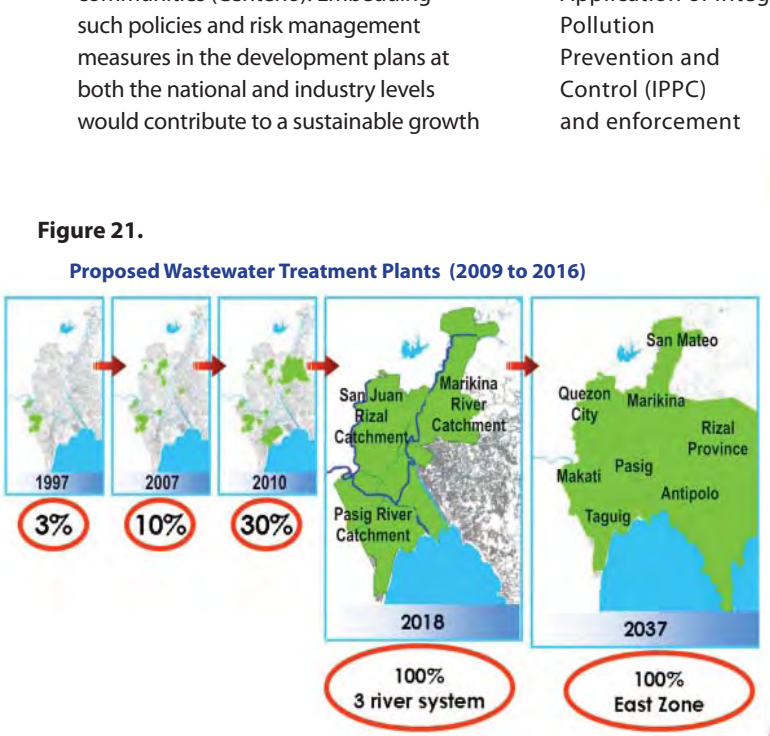
implementation of Industrial Pollution Prevention Policies, such as eco-towns models, zero discharge policies for EDS (endocrine-disrupting substances) in coastal zones, CP/BAT and BEP, regional policies, market-based policies and economic incentives, and participative decisionmaking for coastal zone communities (Centeno). Embedding such policies and risk management measures in the development plans at both the national and industry levels would contribute to a sustainable growth in productivity and, within the proper framework conditions, would result in a sustained and more equitable economic development.

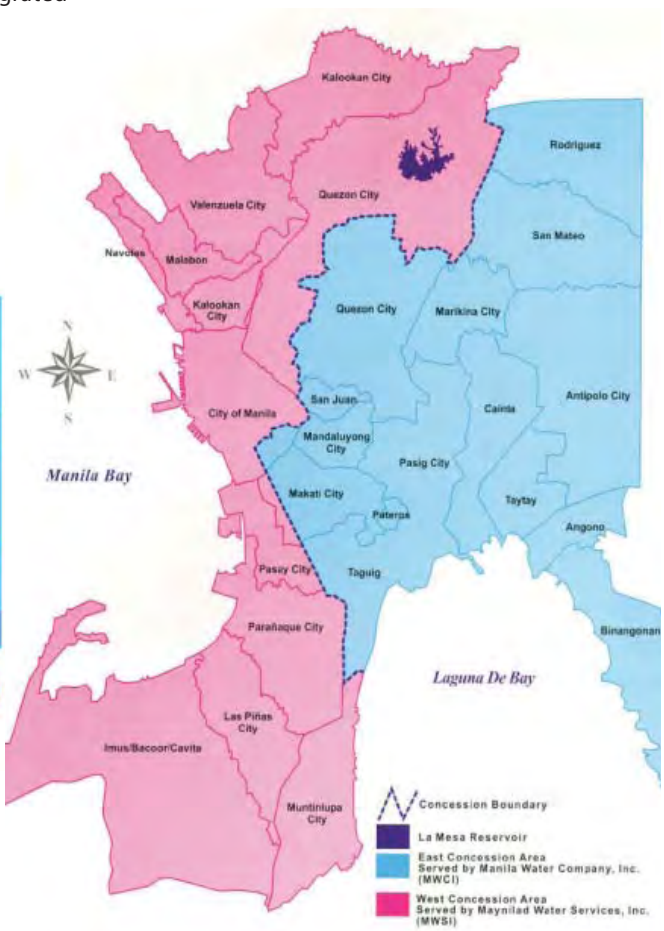
The UNIDO strategy to address POPs and PTS includes the following:

- Application of Integrated Pollution Prevention and Control (IPPC) and enforcement of regulation for toxic and hazardous chemicals;
- Move 'cleaner production' from voluntary to mandatory;
- Encourage effluent trading;
- Introduce direct toxicity assessment techniques;
- Initiate an environmental quality

Figure 21.

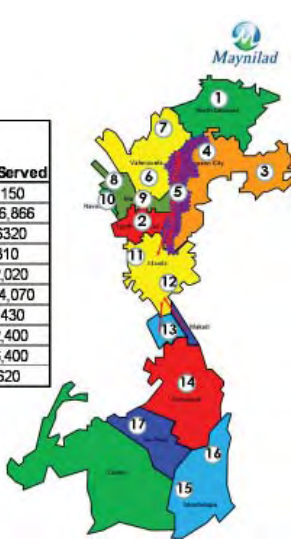
Proposed Wastewater Treatment Plants (2009 to 2016)





Accelerated Wastewater Program

Sites Nos.	Locations	No. Of STPs	Total Capacity (CMD)	Pops Served
1 & 2	Caloocan	15	9,750	72,150
3, 4 & 5	Quezon	92	161,400	1,206,866
6 & 7	Valenzuela	14	46,800	346320
8 & 9	Malabon	1	650	4810
10	Navotas	3	27,300	202,020
11 & 12	Manila	3	232,679	1,504,070
13	Pasay	3	1,950	14,430
14	Paranaque	40	26,000	192,400
15 & 16	Muntinlupa	4	36,000	266,400
17	Las Pinas	2	1,300	9,620



San Juan River Basin Project

- Located in Quezon City
- Total Area: ~ 9,470 ha; ~ 2,490 ha under MWSI
- Some parts are being served by
  - Communal Septic Tanks
  - 1.Hereford, Project 8
  - 2.Legal, Project 8
  - 3.Grant, Project 8
  - 4.Roosevelt, Project 7
  - 5.Road A, Project 7

2009 - 2012:

- Upgrading of 5 communal septic tanks
  - ➢3 implemented from 2009 – 2010
  - ➢2 implemented from 2010 - 2011
- 13 wastewater treatment plants
  - ➢With combined capacity ~ 72,000CMD
  - ➢2009 – Finalize the feasibility study and start with detailed design of proposed facilities; 2010 start of construction

100% Served (2012)
Total population - 570,000

management (EQM) model through R&D institutions;
- Raise public awareness on endocrine-disrupting substances (EDS) in the food chain;
- Initiate partnership to develop initiatives;
- Registration and notification of new chemicals;
- Community "right to know" programs;
- Ensure obligations of industry to disclose chemicals toxicity;
- Support R&D on contaminants and contaminated sites; and
- Establish an effective biomonitoring system.

Mobilizing financing and managing funds

The enormous investment gap undoubtedly creates a significant challenge and will demand innovative thinking and multi-institutional, multisector cooperation. The development of necessary infrastructure and its long-term sustainability will require the identification of additional sources of financing and the introduction of market principles, such as appropriate pricing mechanisms. Policy and regulatory reforms, tariff structuring, cost recovery, and private sector participation remain intractable issues. The failure to stimulate private sector involvement in wastewater management is a cause for concern essentially because of the proven inability of the public sector to finance needed investments and sustain operations and maintenance.

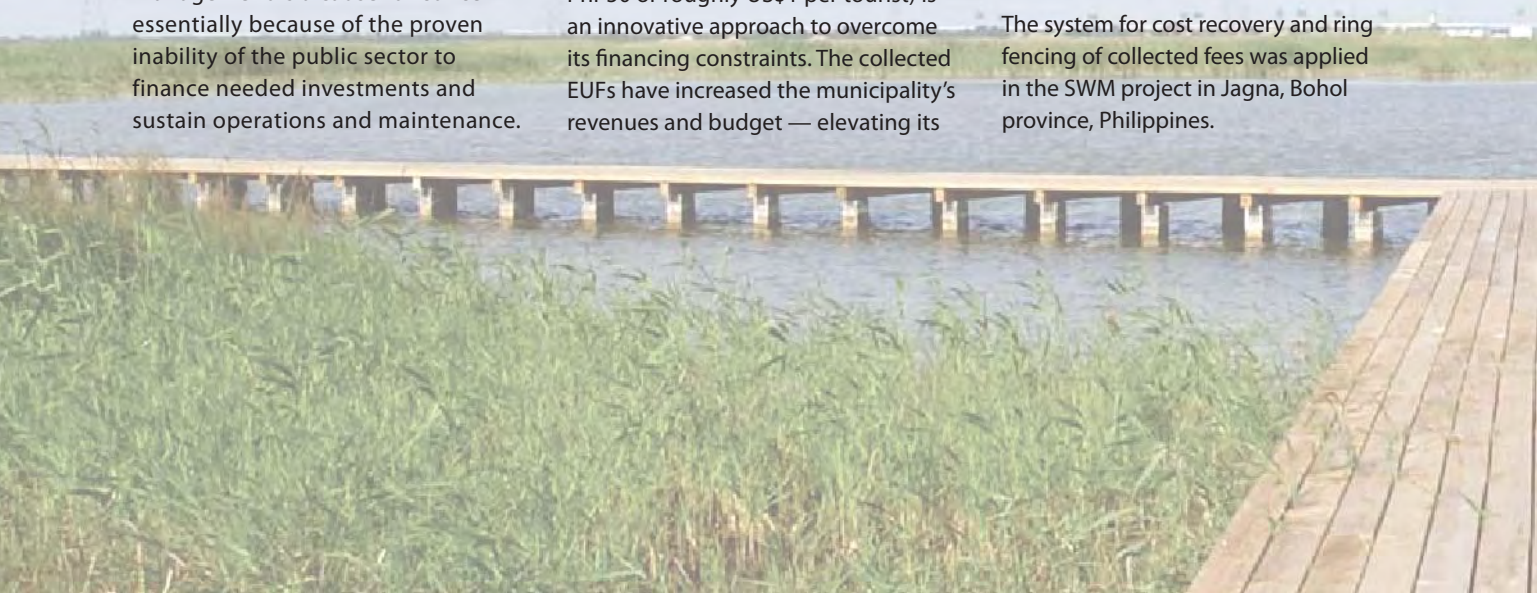
Environmental user fees and public-private partnership: Puerto Galera

Located at the center of marine biodiversity and a major tourism destination, pollution reduction is important to Puerto Galera, a small seaside municipality in Oriental Mindoro, Philippines. The local government has gone a step further in ensuring the protection of its coastal resources and sustaining its tourism industry despite its lack of institutional, technical, and financial capacities. It has prioritized environmental sanitation in its agenda, and taken a risk in implementing a sewerage and wastewater treatment project, which was made a priority project within the coastal resource management plan. The local government has put in place the enabling conditions, including necessary ordinances. It pursued the public-private partnership (PPP) approach and got a private sector partner to provide the viable technology option and financing arrangement for the sewerage project. The municipality also integrated the water supply and wastewater treatment projects, and is executing both projects through partnership with the private sector. It is implementing an Environmental User Fee (EUF) system as a financing mechanism for the sewerage project as well as other coastal resource management projects. The collection of EUF from tourists (at PhP50 or roughly US$1 per tourist) is an innovative approach to overcome its financing constraints. The collected EUFs have increased the municipality's revenues and budget — elevating its class from third to first – allowing it to become more creditworthy (Dolor). Efforts also included exhaustive multistakeholder consultations, capacity-building workshops and public hearings on the project and the ordinance for the establishment of the EUF system. A major challenge is the management of the EUF Fund, particularly earmarking funds to meet the financing requirements of the sewerage project.

Cost recovery and ring fencing

In the Philippines, low compliance by the local governments with the Ecological Solid Waste Management Act can be attributed to: high investment costs; increasing operational and maintenance costs; highly subsidized program and no user fee systems in place; limited access to financing; and low priority given by local government as funds compete with other basic services of government. A key strategy to make SWM financially viable and sustainable is to apply business principles and implement a cost-recovery mechanism. Another strategy and one that complements cost recovery is ring fencing, which involves keeping the resources earmarked for solid waste management (SWM) exclusive within the SWM program, and plowing revenues generated through SWM activities back to the program (Salas).

The system for cost recovery and ring fencing of collected fees was applied in the SWM project in Jagna, Bohol province, Philippines.



The benefits are:

- Performance can be monitored, allowing implementers to do proper budgeting and planning.
- Funds are more wisely used.
- Reliable data is available to determine subsidy levels and for validating tariff rates.
- It keeps the SWM team focused on their performance targets and outcomes.
- SWM becomes financially viable due to increased revenues and controlled expenses.

Demonstrating that Partnership Works

The experience of Puerto Galera and Metro Manila demonstrates that sewerage service can be a profitable business in either small municipalities or mega-cities. Indeed, Public–Private Partnership (PPP) is a solution that works. However, the private sector is prepared to get involved only if risks are manageable and this requires a good regulatory framework that would provide them with incentives, including collection and setting of user fees or tariffs that would allow cost recovery. In Marikina City (one of the cities in Metro Manila), the city government passed ordinances on solid waste and septage management and provided the land where the wastewater treatment facilities were constructed by Manila Water Company, Inc. (MWCI), one of the concessionaires.

Partnerships among the municipalities/cities within a river basin or delta are also crucial for more effective waste management planning and investment. As demonstrated in the Pearl River Delta in PR China, intersectoral planning and information sharing, and interjurisdictional collaboration on water quality monitoring and wastewater treatment are necessary if water quality objectives are to be achieved. Significant savings in both capital expenditures and operating and maintenance costs can also be obtained through clustering of municipalities/cities and sharing of infrastructure within each cluster.

Partnership between public and private sectors: Metro Manila

In 1997, Maynilad Water Services, Inc. (MWSI) and the Manila Water Company, Inc. (MWCI) were awarded concession contracts by the government-owned and –controlled corporation, Metropolitan Waterworks and Sewerage System (MWSS), and split between them the service areas in Metro Manila and adjacent areas (some municipalities in Rizal, Bulacan and Cavite). Twelve years after privatization, the program seems to have paid off, even after a 'false start' of one of the concessionaires (MWSI). Manila Water, which won the bid for the East Zone, was able to meet all 23 performance indicators, and has been profitable since 2003. The company was able to increase coverage of water supply distribution from 26 percent of the population (in the East Zone) in 1997 to 99 percent in 2009 and with 24-hour water supply. Likewise, coverage of the sewerage system increased from 3 percent of the East zone's population in 1997 to 16 percent in 2008, and aims to achieve 30 percent coverage by 2012. Manila Water's wastewater strategy focused on three areas, namely, septic tank desludging and septage treatment, package sewage treatment systems and combined sewer-drainage systems for areas served by individual septic tanks and with no existing sewer networks. It has established 33 sewage treatment plants in various locations treating 90 million L/day with 218 km of sewer network. It has invested PhP 1 billion from 1997 to 2006 and PhP 5 billion from 2007-2010 for wastewater treatment. In terms of its septage management, Manila Water's *Sanitasyon para sa Barangay* (a 'free' septic tank desludging program) has served 455,513 households as of 2008.

Moreover, Manila Water has an investment plan to accelerate coverage of wastewater treatment to 100 percent in the three river systems by 2018 (San Juan River basin, Marikina River basin and Pasig River catchment), and the whole of its concession area by 2037. This is a unique case of financing wastewater treatment projects wherein capital investment is privately sourced, with no government subsidies. Cost recovery is primarily through collection of water tariffs (with cross-subsidy from the water supply distribution) and environmental fees, and enhanced by corporate governance, more efficient operations that reduced non-revenue water, and improved staff capacity and customer relations. In addition to septage and sewage treatment, the company also produces biogas for power generation, reuses treated

Constructed and natural wetlands are used in Ningbo, PR China for municipal and non-point pollution treatment and biodiversity conservation. *Photo: H. Li*

Source: en-wikepedia.org/wiki/filepearl_river_delta_area.png

Figure 22. Pearl River Delta.

wastewater for landscape irrigation and toilet flushing, applies biosolids for agricultural use in lahar-affected areas, and has a Clean Development Mechanism (CDM) project in one of its wastewater treatment facilities.

The other concessionaire for the West Zone, Maynilad or MWSI, has five sewerage systems in place in Central Manila, Dagat-dagatan, Quezon City, Makati and Alabang. For its environmental sanitation services, Maynilad has in place a 450-CMD (cubic meters per day) septage treatment plant, 25 vacuum truck units, and seven mobile dewatering units serving 325,100 households. Its sewerage and sanitation strategy is to maximize utilization of existing network, expand coverage using a combined system, and maintain sanitation facilities outside the sewered areas.

The priority projects of Maynilad from 2009 to 2012 are to maximize the utilization of the existing sewerage system, undertake the San Juan River Basin project and construct a 250-CMD septage treatment plant in the southern portion of the concession area. From 2009 to 2016, it is planning to put up 17 wastewater treatment plants in the West Zone of Metro Manila. To maximize the utilization of this existing sewerage system in Central Manila, Maynilad will enhance treatment capacity to accommodate additional flow. For the San Juan River Basin Project, the concessionaire is planning to upgrade the treatment capability of communal septic tanks in Quezon City and to implement a combined sewerage system by constructing 13 wastewater treatment facilities to intercept and treat flows from drainage and estero (estuaries) before final disposal to San Juan River. Maynilad is also committed to help in the cleanup of Pasig River. To do this, it will connect around 1,800 customers to the existing sewerage system, prioritizing those near the creeks. It will also put up a 550-CMD wastewater treatment facility.
Some of the challenges being faced by Maynilad include inadequate garbage collection, poor drainage maintenance, gaps in drainage, and improperly designed and constructed drainage system, unwillingness of customers to connect or have their septic tanks desludged, failure to secure/acquire septage treatment plant sites/lots within the scheduled timeframe and the presence of informal settlers in estero and creek areas.

Partnership among municipalities: Pearl River Delta

The Pearl River Delta (PRD), also known as the "Golden Delta of Guangdong," is formed by three major rivers, the Xi Jiang, Bei Jiang and Dong Jiang. The term Pearl River Delta also refers to the network of cities that covers nine prefectures of the province of Guangdong, namely, Guangzhou, Shenzhen, Zhuhai, Dongguan, Zhongshan, Foshan, Huizhou, Jiangmen and Zhaoqing, and the Special Administrative Regions (SARs) of Hong Kong and Macau (**Figure 22**).

The following are key issues in the Pearl River Delta in China: (a) financial sustainability (inability to pay operation and maintenance (O&M) of expensive treatment systems); (b) wastewater in small towns/cities (lack of investments in wastewater treatment facilities in smaller townships); (c) agricultural waste; (d) sludge treatment and disposal; and (e) impacts of global warming, e.g., lower base flows, sea level rise, etc. (Cho). To address these issues, a GEF- supported project was developed and implemented to catalyze the following three key innovative aspects:

First, it promoted the planning and construction of shared municipal wastewater treatment and waste management facilities. This integrated

approach to wastewater and waste management was designed to achieve significant capital and operational cost savings, which in turn accelerates investment in wastewater treatment and landfill development, expands the volume of investment and enhances the financial sustainability of the project. These actions achieve faster and larger reductions in pollution loads. There are three pilot wastewater treatment facilities under construction in: (a) Foshan Nanhai (collaboration between Nanhai and Changcheng Districts; (b) Guangzhou Nangang (Collaboration with Guangzhou Economic and Technical Development District); and (c) Guangzhou Luoxi Island (collaboration with Panyu District). The study on constraints, and the review and updating of the Pearl River Delta wastewater master plan have been completed. All municipalities have signed up to the Pearl River Delta Clean Up Campaign.

Second, the project aimed to stimulate greater private sector involvement in waste management and wastewater treatment investment and operation by: (1) encouraging the municipalities to actively seek private sector partners; and (2) assisting potential private sector investor/operators to prepare facility management investment and operational service proposals for consideration by the municipalities and ensuring that such proposals were evaluated solely on their technical and financial merits and implemented when they are both least-cost and financially sustainable options.

Third, additional funding is provided for water quality testing that will improve the collection and dissemination of water quality data, which will enable a collaborative sharing of data with other municipalities and other stakeholders. One of the recommendations that came about was to integrate the results of the improved data collection/monitoring exercises with diagnostic/modeling exercises. Initial simulation models were presented, which showed assessment of impacts of proposed location and schemes for wastewater treatment facilities as well as the impact of sea level rise.

The project has shown that significant savings in both capital expenditures and operating and maintenance costs can be obtained through sharing of infrastructure, and interjurisdictional collaboration on wastewater planning, information sharing, and water quality monitoring. The development of a PRD Water Agency to act as a financing vehicle has been proposed. One key lesson learned concerns the role of the private sector, which was found to be more appropriate for the operation and maintenance of facilities, while government still has a major role to play in ensuring infrastructure capital financing (Cho).

Public-Private Infrastructure Advisory Facility

The Public–Private Infrastructure Advisory Facility (PPIAF) was created in 1999 to act as a catalyst to increase private sector participation in emerging markets. It provides technical assistance to governments to support the creation of a sound enabling environment for private service provision. Based on PPIAF's experience, management contracts and operational efficiency projects proved to be more suitable in capital intensive projects for PPPs in urban water, and stressed the need for tailor-made solutions (Redell). PPP projects that have failed were caused by poor design, and lack of a regulatory framework and cost-recovery mechanism. Overall, performance of PPP projects had been mixed. PPIAF identified major lessons learned from the performance of PPP projects, namely:

- PPP is a viable option to reform water utilities in developing countries;
- A new generation of private operators has now appeared;
- The focus on trying to attract private money (to fund the huge backlog of water investments in developing countries) proved to be a mistake;

Box 2. GEF/World Bank Investment Fund (IF) for Pollution Reduction in the Large Marine Ecosystems of East Asia.

- Launched in 2005
- Mechanism to co-finance innovative projects
- Support to PEMSEA objectives
- World Bank co-finances grant from GEF:
  - Scale: US$80 million of GEF resources leveraging at least US$800 million of World Bank investments
  - Tranche 1: US$35 million (fully committed; 5 projects in implementation, 2 in preparation)
  - Tranche 2: US$30 million
  - Tranche 3: US$15 million
- US$5 million of GEF grant financing per project

Source: Lovei

Photo: H. Li

- The main contribution of private operators lies in improving service quality and operational efficiency; and
- Social considerations need to be incorporated explicitly in the design of PPP reforms.

Sustaining the Momentum: Financing Facilities

GEF/WB East Asia Land-based Pollution Reduction Investment Fund (Partnership Fund)

The GEF/World Bank East Asia Land-based Pollution Reduction Investment Fund Project (Partnership Fund) is a financing and technical assistance facility to accelerate pollution reduction initiatives in the East Asian Seas region. The objective of the Fund is to reduce local, national and transboundary degradation of East Asia's marine ecosystems due to land-based pollution. It focuses on the countries involved in the GEF-supported planning efforts for the South China Sea and the Yellow Sea Large Marine Ecosystems, and the national and local commitments facilitated by PEMSEA. Its strategic objective is to help address major gaps in regional land-based pollution control efforts. The Fund's development goal is to promote sustainable development of the coastal areas of the East Asia region by reducing land-based pollution of its rivers and seas. There are five projects in implementation (discussed in this paper): Livestock Waste Management in East Asia, Ningbo Water and Environment; Yantai, Pearl River Delta, and Manila Third Sewerage Project.

Carbon Finance for Pollution Reduction Investment Projects

Gaining access to the Clean Development Mechanism (CDM) to recover costs for pollution management projects is one of the innovative financing mechanisms that link waste management, pollution reduction, alternative energy generation and climate change mitigation (Villaluz). Carbon Finance projects can help scale up implementation of the Sustainable Development Strategy for the Seas of East Asia (SDS-SEA) objectives and actions.

The following are some examples of pollution reduction projects where CDM was applied: (a) replacing aerobic with anaerobic treatment, and biogas recovery in wastewater treatment projects (Shanghai Sludge Carbon Finance project); (b) converting organic wastes into renewable energy; (c) converting manure to energy (Livestock Waste Management Project, Thailand); (d) methane recovery in landfill (Payatas, Quezon City, Philippines); (e) excavating and composting of partially decayed municipal solid waste (Kota Kinabalu, Malaysia); (f) methane recovery in agricultural activities at household/small farm level (Laguna de Bay Community Waste Management project, Philippines); and (g) avoid deforestation by improving charcoal production (Plantar sequestration and biomass reuse, Brazil).

With the end of the Kyoto funds approaching, new facilities are being developed, such as the Carbon Partnership Facility (CPF): Carbon Asset Development Fund (CADF) which is operational at €7 million, and the Carbon Fund, which is currently at €100 million (operational target at €200 million).

Conclusion and Recommendations: Averting the pollution conundrum

Pollution — from a range of sources from municipalities to industries and agriculture — is a major threat to sustainable development in the region. Impacts on health, quality of life, and ecosystems impose large economic and social costs. Climate change adds an additional dimension — a threat of increased pollution, the need for climate-proofed infrastructure, and the risk of increasing vulnerability. In general, averting the onset of pollution in any area, i.e., be it on air, water or land, could be the start, the simplest and the most rational solution to the problem. This calls for conscientious efforts to adopt good practices or the conscious practice of good habits by the people, the enactment, passage and the proper implementation of appropriate laws and the strict compliance and enforcement. Yet, this is easier said than done. Certain bad habits are entrenched and rapid urbanization, uncontrolled development, industrialization and intensive agriculture somehow carry with them the concomitant burden of pollution. Moreover, the cost to business and its commercial ramifications make this rather simple preventive approach quite complicated and more difficult to implement. Major constraints include lack of: awareness on the issue and impacts; political will; law enforcement; access to innovative and affordable technologies; capacity to access financing and engage private sector.

A crucial step in providing solutions to water sustainability is to acknowledge that managing a resource, such as water, is not just about providing technical or engineering solutions, but considering the social, political and environmental complexities attached to it as well.
We need to collectively deal with the increasing pollution as population and economies grow, and look for ways on how each sector can respond to address the various environmental challenges affecting our coasts and seas, including:

- Nutrients: excess nitrogen and phosphorus from homes, cities and farms can promote algal growth and eutrophication; cause fish kills, dead zones, red tides (toxic algal bloom); and obstruct navigation;
- Oil pollution (from both land-based and sea-based sources): impacts marine life; kills mangroves, seagrass and corals; and fouls fishing gear;
- Plastic waste: kills seabirds, marine

mammals and sea turtles and releases toxins;
- Industrial waste: toxic, non-toxic, hazardous and non-hazardous wastes affect water quality, ecosystems and public health.

In addition to pollution reduction, other benefits from waste management must be promoted, such as improved public health conditions, more efficient production in industrial companies, reversal of economic losses (e.g., attract more investments and tourists, lower cleanup cost), biodiversity conservation (constructed wetlands), and energy generation from biogas. Moreover, the application of treated sludge as soil conditioner/organic fertilizer and treated wastewater for agricultural use may be promoted as ways to contribute to addressing various issues like the use of energy-intensive chemical fertilizers, food security, water scarcity and climate change mitigation.

In addition to pollution reduction, other benefits from waste management must be promoted, such as improved public health conditions, more efficient industrial production, reversal of economic losses (e.g., attract more investments and tourists, lower cleanup costs), biodiversity conservation (constructed wetlands), and energy generation from biogas. Moreover, the application of treated sludge as a soil conditioner/organic fertilizer and treated wastewater for agricultural use may be promoted as ways to contribute to addressing various issues like the use of energy-intensive chemical fertilizers, food security, water scarcity and climate change mitigation.

Success depends in part on having a solid scientific understanding of the causes of the problem and the full range of possible management alternatives, and more so, on the political will to undertake necessary policy and institutional reforms and investments in needed infrastructure, and cooperation of various governments (at different levels — international, national, local), institutions, sectors and all stakeholders. Regions, countries or localities can learn from success and failure in particular situations.

The major lessons and points arising from the workshops was:

- **Political will**
  - Political will, commitment and leadership are needed to address pollution problems and transboundary issues.

- **Institutional arrangements**
  - Interagency and multisector cooperation is essential in the management of river basins and coastal areas, including water management authorities, ocean management agencies, environmental protection agencies, academe, civil society and other concerned sectors

  - It is also important to enhance coordination and develop areas of collaboration among related programs and initiatives, and to improve the level of cooperation in on-the-ground actions.

  - Establishment of institutional arrangements, including appropriate bodies as required to oversee transboundary pollution reduction, such as the international commissions for the Mekong River, the Yellow Sea and the Danube-Black Sea for cross-country pollution reduction.

  - Establishment of a national river basin agency and national or sub-national commissions and alliances between levels of government and other stakeholders can also be forged for in-country pollution reduction (e.g., River Basin Control Office in the Philippines' Department of Environment and Natural Resources).

- **Strategic integrated planning**
  - Application of strategic environment assessment is being recognized as a useful tool in designing plans, programs and projects.

  - Optimization of infrastructure planning, linking investment with expected environmental outcomes and targeting investments can achieve highest impact.

  - Ecosystem-based planning and management approaches ensure integrated methods.

  - Pollution load monitoring and modeling are key tools to develop effective pollution reduction targets, plans and strategies, and support investments in cleaner production technologies and pollution abatement facilities.

  - Good coordination is required in monitoring, quality assurance and quality control and standardization of data.

- **Regulatory/policy/ institutional framework**
  - Environmental laws (passage and enforcement) provide the basis for actions on pollution reduction and waste management.

  - Economic regulation/market-based instruments: tariffs (e.g., Metro Manila concession) and user fees (e.g., Laguna de Bay, Puerto Galera) ensure funding for operation and maintenance and sustainability of facilities and services, and provide incentive for private sector involvement.

Theme 6: Pollution Reduction and Waste Management Recommendations

Presented by Theme Chair: Prof. Rudolf Wu

Workshop 1: Transboundary Pollution Reduction in River Basins and Coastal Areas

Through the analysis of best practices from the Northwest Pacific, East Asia, Europe and North America, workshop participants agreed that the following actions are deemed necessary for transboundary pollution reduction in river basins and coastal areas:

- Close cooperation of neighboring countries in economic policies, including coordinated use of natural resources, environment protection and ensuring sustainable development of river basins and coastal areas.
- Political leadership; legislation and enforcement; financial resources; political agreement (commitment); bringing together academics and decision makers.
- National laws and regulations aiming at coordinated economic, investment and social policies related to environmental protection and sustainable development.
- More active role of civil society in conservation of natural resources and wildlife.
- Establishment of international commissions to manage transboundary river basins and coastal areas (such as Mekong River Commission, Yellow Sea Commission, etc.).
- Establishment of joint monitoring systems (including water quality standards and criteria) for transboundary river basins and coastal areas.

Workshop 2: Innovative Policies and Practices in Water Supply, Sanitation and Waste Management

The workshop discussed the applications of strategic integrated planning, regulatory/ policy/ institutional framework, innovative approaches and technologies, and financing mechanisms for water supply, sanitation and pollution reduction, and recommended to:

- Use strategic planning approaches and strategic environmental assessment more systematically, to optimize investments;
- Focus on a small number of demonstration projects that can deliver development outcomes;
- Provide incentives for innovation and systematic learning from their implementation;
- Replicate and scale up successful examples/pilots through programmatic financing;
- Build capacity for engaging the private sector to improve efficiency;
- Develop capacity of local governments to develop bankable projects and implement cost recovery mechanisms; and
- Need champions for sustained implementation.

CSR Workshop: PPP in the Rehabilitation of Manila Bay

The workshop highlighted the importance of public-private partnerships in addressing pollution and other issues, particularly the application of CSR in the rehabilitation of the Manila Bay, and recommended:

- The corporate sector to confirm commitments, set specific targets, and take an active part in initiating programs to support the implementation of the Operational Plan for the Manila Bay Coastal Strategy.
- More active participation from the local governments, and closer interactions with the corporate associations and chamber of commerce.

- **Innovative approaches and technologies**
  - There are alternatives and cost-effective approaches to wastewater treatment (e.g., artificial and natural wetlands in Ningbo; bioremediation in Pasig River; combined sewer systems in Metro Manila, etc.).
  - Piloting technologies/ techniques can build capacity and understanding to help address issues such as water scarcity, water allocation rights, alternative energy, and food security while dealing with the wastewater treatment issue (e.g., use of less energy-intensive wastewater treatment technologies; use biogas digesters in livestock waste management for waste-to-energy; wastewater reuse and biosolids application in agricultural areas).
- **Financing**
  - Cost recovery, through tariffs and user fees, is essential to ensure financial viability.
  - Special financing instruments (e.g., CDM/carbon financing) can further help.
  - Targeted subsidies and output-based aid can assist in improving coverage and access by poor communities to the environmental facilities and services.
  - Combination of targeted and conditional subsidies and tariffs/ user fees can ensure investments and capital financing as well as O&M funding and sustainability of service.
  - Technical assistance is important to help local governments in accessing financing and

developing bankable projects (e.g., PPIAF).

- **Private sector participation and PPP**
  - Private sector is particularly efficient in operation and management, but less effective in filling the financing gap for capital investments.
  - PPP works if enabling conditions (policies, regulations, user fees, institutions) are in place and implemented.
  - The corporate sector is actively implementing CSR programs that are relevant to pollution reduction, habitat restoration and resource protection.
- **Learning and capacity building**
  - There are many successful experiences in the countries of the East Asian Seas region to learn from, replicate, and scale up.
  - Learning across countries by practitioners (e.g., twinning network) can promote adoption of key policies, institutional arrangements, cost-effective technologies and financing mechanisms.
  - Knowledge management — documentation of good practices and lessons, sharing of success stories and sharing of benefits — is essential to increase public awareness and ensure support for policies and initiatives on pollution reduction.

Key Recommendations

Given the political, technical and financial complexity of the problem and the myriad players who have a role in addressing it, as well as working models, there are a number of solution options.

The key recommendations arising from the workshops are:

- Facilitate close cooperation among neighboring jurisdictions (e.g., national governments; local governments) sharing a water body (i.e., large marine ecosystem or LME, bays, rivers), including economic policies, coordinated use of natural resources, environment protection and sustainable development of river basins and coastal areas.
- Use strategic and integrated planning approaches (e.g., SEA), ecosystem-based management and scientific support (adaptive management, pollution load assessments, environmental carrying capacity, GIS, etc.) more systematically to optimize environmental investments.
- Adopt and enforce national laws and regulations aiming at coordinated economic, investment and social policies related to environmental protection and sustainable development (including tourism-related regulations; wastewater treatment; environmental monitoring and compliance).
- Focus on a small number of demonstration projects that can deliver development outcomes.
- Provide incentives for innovation and systematic learning from their implementation.
- Replicate and scale up successful examples/pilots through programmatic financing.
- Build capacity for engaging the private sector to improve efficiency.
- Develop capacity of local governments to develop bankable projects and implement cost-recovery mechanisms.
- Support champions for policy reforms and sustained implementation.
- Encourage more active participation from the local government.
- Engage civil society in natural resources and wildlife conservation.
- Establish international/ intergovernmental commissions to manage transboundary river basins and coastal areas, such as Mekong River Commission, Yellow Sea Commission, etc., across countries, or similar arrangements across local governments.
- Establish joint monitoring systems (including water quality standards and criteria) for transboundary river basins and coastal areas.

Effective management is site-specific and unique for each river basin, estuary and coastal water body, with no universal 'right answer'. Raising public awareness provides the start to reverse bad practices that result in pollution of water resources. An integrated and adaptive management approach, with the following essential factors — using accessible and emerging tools, knowledge of successful and cost-effective technologies, coupled with supporting policies, regulations and institutional arrangements, and backed up by committed leadership, sustainable financing mechanisms, strong monitoring program, and cooperation of and collaboration of different sectors and stakeholders — appears to provide the highest probability of long-term success.

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T6 W2: The World Bank and Korea Maritime Institute

Prof. Rudolf Wu, The University of Hong Kong, Theme Keynote Speaker

Panel Facilitators:

Mr. Arunkumar Abraham, DAI-EcoGov and Dr. Kim Jong-Deog, KMI

Panelists: Dr. Christophe Crepin, Mr. David Villeneuve, Mr. Paul Reddel, Mr. Juergen orenz, Mr. Mark Tom Mulingbayan

Presentations:

Theme 6 Workshop 1 - Transboundary Pollution Reduction in River Basins and Coastal Areas

Part 1: Case Studies on Transboundary Pollution Reduction in River Basins and Coastal Areas from the Northwest Pacific

Arzamastsev, I. "Integrated Coastal and River Basins Management (ICARM) Approach in the Russia Far East Coastal Zones."

Kachur, A. "International Approaches to the Transboundary Pollution Reduction on Examples of 'Amur GEF' and 'TumenNet' Projects."

Murakami, S. H. Higashi and T. Tsujimoto. "Assessment Framework of Eco-Compatible Integrated Management of River Basin and Coastal Area."

Oh, H.T. "National Program on (ICARM) of the Republic of Korea."

Shulkin, V. "The Significance of the River Input of Nutrients in Relation to Coastal Eutrophication: Spatial Zoning Examples from the Northwest Pacific."

Xie, X.*, Liu, T. and R. Wang. "Chinese Experience in the Reduction of Pollution in the Rivers and Coastal Zones using ICARM Approaches."

Part 2: Case Studies on Transboundary Pollution Reduction in River Basins and Coastal Areas from the East Asian Region

Huang, J., Q. Li, Z. Tu, C. Pan, L. Zhang, P. Nyodoke, J. Lin, H. Hong. "Quantifying Land-based Pollutant Loads in the Coastal Area with Sparse Data: Methodology and Application in China."

Hui, J. "Control of Land-based Pollution in Singapore and Singapore's Experience in the Cleaning up of Singapore River."

Shamsuddin, N.B.* and M. Bin Idrus. "Pollution Reduction in the Selangor and Klang River Systems."

Susanti, P. "Integrated Management of Jakarta Bay and Ciliwung River."

Tablan, D. J. Jr.* and J. M. Mallari. "Targets, Strategies, Good Practices, Achievements and Challenges in Reducing Pollution in Pasig River."

Zhou, Q.*, C. Bin. "Transboundary Pollution Reduction in River Basins and Coastal Areas by Watershed Management in China: The Jiulong River Basin-Xiamen Bay Case Study."

Theme 6 Workshop 2 - Innovative Policies and Practices in Water Supply, Sanitation and Pollution Reduction

Session 1: Knowledge Sharing on Innovative Policies and Practices

a. Optimizing technology to suit local conditions

Centeno, C.R. "Optimizing Technology to Suit Local Conditions Pollution Reduction Applications for Industry in East Asia."

Chaiyakul, A. and S. Chatsanguthai. "Livestock Waste Management in East Asia."

Li Hai Sheng* and Yang Xiao Ming. "Low-cost Wastewater Treatment: Ningbo Constructed Wetlands."

Jin, L.*, J. Zhao, and J. Zhou. "An Integrated Approach for Septic Tank Management: Yantai Demonstration (World Bank Investment Fund project)."

Lovei, M. "Pollution Reduction and Waste Management: Innovative Policies and Practices in Water Supply, Sanitation, and Pollution Reduction."

b. Overcoming financing constraints

Dolor, H.C.A. "Sustainable Development in the World's Center of Marine Biodiversity: Puerto Galera's PPP Experience."

c**. Demonstrating that Partnerships work**

Almendras, J.R. "Experience in the Development of Water and Sewerage Services in Metro Manila."

Cho, T.S. "First Pearl River Delta Urban Environment Project."

d. Using Scientific Support in CLeanung up Rivers and Coasts

Fang, Q.*, L. Zhang, J. Wang, G. Wang, J. Huang and Y. Jiang. "Pollution Load Allocation in Semi-enclosed Bays – A Practical Approach in China."

Jiang, Y. Z. Chen*, F. Zhang, Z. Zhang, E. Liao, W. Song, J. Huang and L. Zhang. "Calculation of Marine Environmental Carrying Capacity in Xiamen, China."

Session 2: Moving Forward – New Initiatives, Challenges and Opportunities

David, C.P. "Pollution Load Assessment in the Meycauayan-Marilao-Obando River System-WQMA."

Radiansyah, A. D. "Jakarta Bay: Ciliwang River Pollution Reduction Project."

Wen, Q. "Bohai Sea: River Basin Pollution Reduction Project."

Session 3: Sustaining the Momentum – Developments in Financing and Investments

Philippine Environmental Governance Project (DAI-EcoGov). "Cost-recovery and Ring Fencing of Special Accounts: Promoting Sustainability in Solid Waste Management for Local Governments."

Reddel, P. "Public–Private Infrastructure Advisory Facility."

Villaluz, M. "Clean Development Mechanism."

SPECIAL EVENT: Public-Private Partnerships (PPP) for the Rehabilitation of Manila Bay: A Corporate Social Responsility Forum

Dela Torre. "A Corporate Social Responsibility (CSR) Forum."

Erni, M. "Public-Private Partnership for the Rehabilitation of Manila Bay: A CSR Forum."

Erni, M. Partnerships and Governance: Facilitating 100% ICM Coverage of the Coastline through Public-Private Partnership - Marilou G. Erni

Jara, R. "Scaling Up ICM in Manila Bay."

Maynilad. "Maynilad's Program for Pollution Reduction of Manila Bay."

Tuddao, V. B. "Operational Plan for Manila Bay Coastal Strategy (OPMCBS)."

Other Documents

Corporate Community Statement of Support for the Manila Bay Rehabilitation

Corporate Social Responsibility Opportunities for the Rehabilitation of Manila Bay

References:

Center for Strategic and International Studies (CSIS). 2005. Addressing Our Global Water Future.

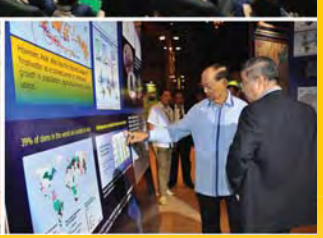
Danube/Black Sea Basin Strategic Partnership on Nutrient Reduction, Phase I. www.iwlearn.net/iw-projects/Fsp_112799468982/view

Danube Pollution Reduction Program. Danube Program Coordination Unit, Vienna, Austria. www.oieau.fr/ciedd/contributions/atriob/contribution/danube.htm.

National Research Council. 2001. Assessing the TMDL Approach to Water Quality Management. National Academy of Sciences. (Downloaded from: www.nap.edu/catalog/10146.html).

Sadoff, Claudia W. and David Grey. 2002. Beyond the River: The Benefits of Cooperation on International Rivers. Water Policy (4): 389-403.

Side Events



eas Congress 2009

Partnerships at Work:
Local Implementation and Good Practices

Philippine International Convention Center
Manila, Philippines

23-27 November 2009

Corporate Social Responsibility (CSR) Forum for Manila Bay Rehabilitation:

Finding Opportunities for Public-Private Partnerships in the Manila Bay Area

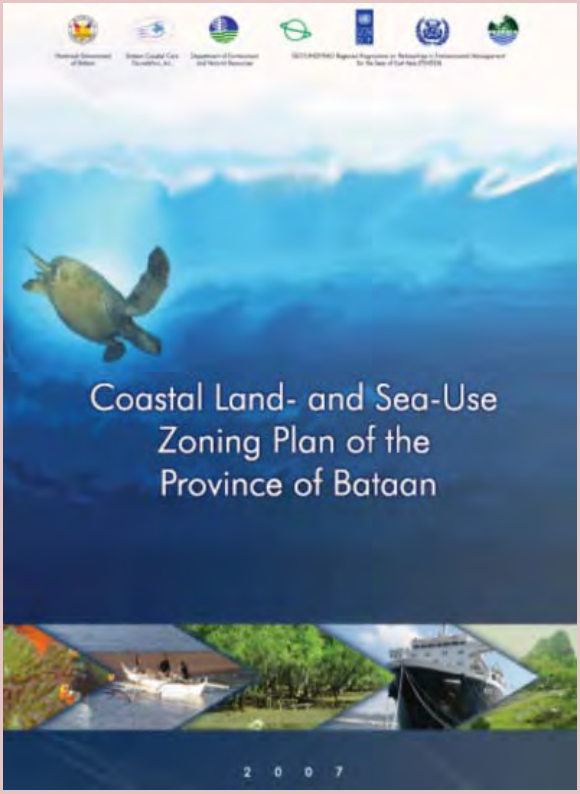
For the first time in the history of the East Asian Seas Congress, the corporate sector was invited to a CSR Forum for Public-Private Partnerships in the Rehabilitation of Manila Bay. The special event attracted more than 80 CSR practitioners from companies and banking institutions located in the provinces of Bataan, Batangas, Laguna, and Pampanga and the National Capital Region of the Philippines. Collectively, the CSR programs of these individual companies, most of which are members of the League of Corporate Foundations (LCF) and the Bataan Coastal Care Foundation (BCCF) was seen to be contributing considerably to the achievement of the objectives set forth in the Operational Plan for the Manila Bay Coastal Strategy (OPMBCS).

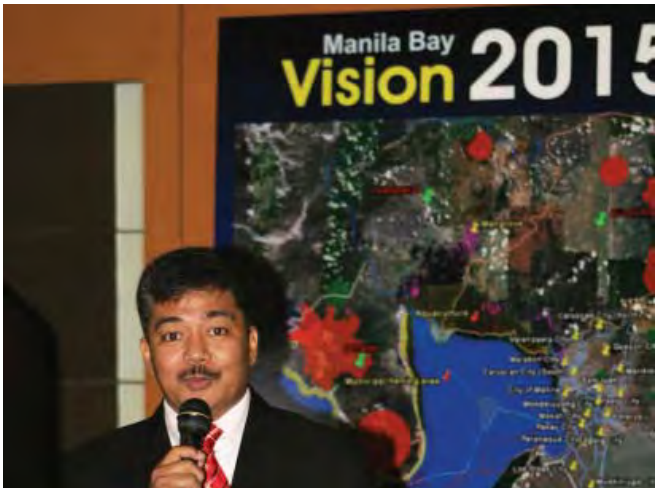
Ms. Malu Erni, Executive Director of Petron Foundation and President of the BCCF, chaired the CSR Forum while Mr. Rogelio Singson,

President of Maynilad Water Services, Inc., served as co-chair. Focusing on the three main areas of concern of the OPMBCS, namely, Partnerships and Governance; Water Pollution; and Habitats and Resources, case studies of successful CSR initiatives demonstrated that the corporate sector was undertaking smart CSR programs that provided both business and social benefits, exerted positive influence in coastal communities and generated impacts on the ground.

For Partnerships and Governance, Ms. Erni highlighted the experience of the Bataan Coastal Care Foundation in supporting the development and implementation of the Bataan ICM program, clearly demonstrating that Public-Private Partnerships (PPP) can indeed work, provided there are strong champions from both sides. The 23 founding members of the BCCF have shown inspiring solidarity in taking care of the coastal environment of Bataan by undertaking CSR initiatives, such as annual coastal cleanups, solid waste management programs, establishment of sewage treatment facilities, disaster response and rebuilding operations, mangrove and upland reforestation, support to livelihood programs and turtle sanctuaries and other relevant environmental activities. The BCCF has also actively contributed to the development and implementation of the Bataan Sustainable Development Strategy and the formulation and enforcement of the Coastal Land and Sea-Use Zoning Plan of the Province of Bataan. The Bataan experience is a shining example that could provide the impetus to facilitate 100 percent integrated coastal management (ICM) coverage of the Manila Bay coastline through PPP.

For water pollution, Mr. Frankie Arellano (Maynilad), showcased the achievements of Maynilad and Manila Water in providing water supply and wastewater treatment services in the West and East Zones of Metro Manila. The experience of the water concessionaires showed that CSR can be both





a case of performing well in your business operations that impact on the lives and welfare of customers and doing good, in a philantrophic sense, that could elevate the business of providing water and treating wastewater into a socially meaningful corporate mission. By providing free desludging services and improving access to water and sanitation to the urban poor, Maynilad and Manila Water have improved the lives of their customers.

Equally important, the past and planned investments in sewerage network of the two water concessionaires have strategically positioned them to move closer to the target of 50 percent reduction in untreated or inadequately treated wastewater by 2015.

The last case study presentation was on accomplishing food security and creating alternative livelihood opportunities through habitat rehabilitation and management. Mr. Eric de la Torre (Team Energy) described their CSR programs on carbon sequestration and biodiversity conservation.
Team Energy's Carbon Sink Initiative was designed to protect existing watersheds from degradation (upland reforestation), preserve life forms in the marine environment (coastal resource management), and rehabilitate degraded mangrove forests (mangrove amelioration). Its initiative with the Wild Bird Club of the Philippines involves habitat rehabilitation and management of the Las Piñas-Parañaque critical habitat. Located in Metro Manila, this critical habitat is part of the migration path of migratory birds that serves as a haven and a sanctuary for more than 8,000 birds of different species during the height of bird migration. The major activities are mangrove restoration and provision of the necessary infrastructure for bird watching as part of the ecotourism project being undertaken by the government in the area.

Several other companies from the BCCF and LCF are also undertaking habitat rehabilitation and management programs, including:

- **Mangrove and tree planting activities** - Liquigaz, Maritime Academy of Asia and the Pacific, Oilink International, Orica Philippines, Petron Foundation, PNOC-Alternative Fuels Corporation, Philippine Resins Industries, Inc. and Total Philippines Corporation;

- **Coastal and river cleanups** - Core Maritime Corporation, Liquigaz, Maritime Academy of Asia and the Pacific, Oilink International, Orica Philippines, Petron Corporation, Petron Foundation, PNOC-Alternative Fuels Corporation, Philippine Resins Industries, Inc., and Total Philippines Corporation; and

- **Providing support to bird and marine turtles sanctuary** – Petron Corporation, Petron Foundation, Philippine Resins Industries, Inc. and Total Philippines Corporation.

The CSR Forum likewise provided an opportunity for the corporate and public sectors to spur ideas for potential PPP arrangements that could further improve the environmental conditions in the Manila Bay area. After a presentation on ICM scaling up, opportunities were presented to the corporate sector by Mr. Robert Jara (PEMSEA/DENR), an open forum facilitated by Mr. Mark Mulingbayan (Manila Water) and Mr. Rox Peña (TIPCO), rekindled interests from the corporate sector in partnering with communities and local governments to undertake projects for the coastal and marine environment and resources of the Manila Bay.

As a culminating activity, the CSR Forum participants expressed their commitment as one community of CSR practitioners to

work towards a stronger partnership with local government and civil society groups in the rehabilitation of Manila Bay by signifying their interests to start up or continue their CSR programs in the various provinces, cities and municipalities in the Manila Bay area. Individual representatives of various companies posted stickers on a Manila Bay map indicating the commitment to continue or start a new CSR project in a particular province or municipality in the Manila Bay area.

Prepared by Rainier Requinala.

The following are the list of CSR activities that have been initially committed by the different CSR participants in the Forum:

BATAAN

1. Bataan Coastal Care Foundation (BCCF): Continuing support to Bataan ICM
2. Petron Bataan Refinery/Petron Foundation: Reforestation Program (330 ha); Fish Sanctuary/Artificial Reef Program; Active participation in the BCCF programs/activities (coastal cleanup, tree planting, mangrove rehabilitation, alternative livelihood programs); waste and water management program
3. Petron Marine: Double Hull Ships and Ballast Management
4. MAAP : Establishment of artificial reefs, coastal cleanup and tree planting
5. Philippine Resin: Coastal cleanup and mangrove planting

PAMPANGA

1. TIPCO: Solid Waste Management, IEC Campaign and Waste Water Reduction
2. Coca-Cola: Undertake waste minimization, carbon dioxide emission reduction; Solid waste management and watershed rehabilitation

BULACAN

1. Nestle Philippines: River rehabilitation and support to information awareness activities
2. Coca-Cola: MMO partnership particularly in watershed protection
3. San Miguel: Rehabilitation of Tullahan River in Valenzuela

CAVITE

1. Coca-Cola Foundation: Solid waste management
2. Cavite Corporate Social Responsibility Council : Coastal cleanup and waste water management
3. Caylabne Resort: Coastal cleanup and mangrove habitat rehabilitation and protection.

LAGUNA

1. Coca-Cola Foundation: Watershed protection and undertake waste minimization, carbon dioxide emission reduction and to solid waste management

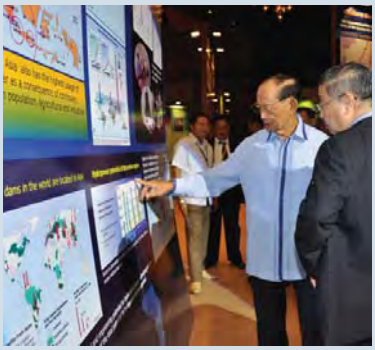
National Capital Region

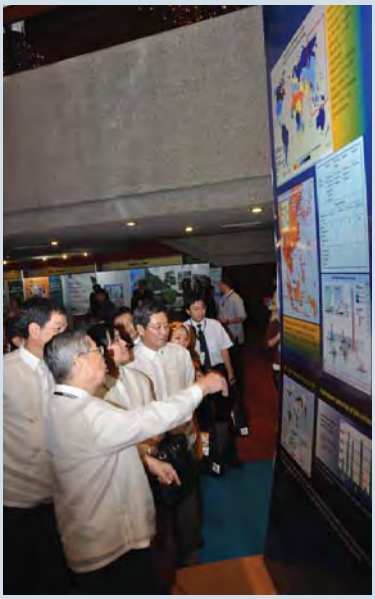
1. Energy Development Corporation: Mangrove rehabilitation and monitoring
2. Team Energy: Mangrove rehabilitation and development of the Parañaque Critical Habitat
3. Maynilad: Expansion of sewage coverage and promotion of community-based sewage and sanitation program
4. League of Corporate Foundations: Building awareness, reforestation activities and other environmental advocacies/ programs
5. Coca-Cola Foundation: Green Kalinga Program
6. Manila Water: Implementation of the wastewater treatment development program; support to watershed management and awareness program
7. TOTAL: Control of leacheate contribution from Payatas dump site
8. UCPB-CIIF: Reforestation project in the Marikina Watershed
9. PETRON: Pasig River Rehabilitation Program; implementation of programs promoting environmental sustainability
10. ABS-CBN: Pasig River Rehabilitation Program and management of the La Mesa Watershed
11. Ayala Foundation: Solid waste management and wastewater management

Innovative Technologies and Good Practices at the SEAnergies Exhibition

Manila, Philippines — The environmental Exhibition titled SEAnergies was showcased from 23-26 November 2009 at the Reception Hall of the Philippine International Convention Center (PICC) in Manila, Philippines, during the EAS Congress 2009.

Sixty-seven exhibitors from around the world showcased innovative technologies and good practices which promote linkages among people, organizations and sectors working on coastal and ocean management at local, national, regional and global levels. PEMSEA Country and non-Country Partners, PEMSEA ICM Sites, international, regional and national organizations, NGOs and the private sector exhibited state-of-the-art technologies and on-the-ground actions which address coastal and ocean environmental and ecological threats such as natural and man-made hazards, habitat degradation, water and energy scarcity, food security, water pollution, and climate change.





The SEAnergies exhibit was opened with the Ribbon-Cutting Ceremony by President Fidel V. Ramos, Former President of the Government of the Philippines; Ambassador A. Selverajah of Singapore; Dr. Chua Thia-Eng, EAS Partnership Council Chair; Hon. Jose L. Atienza, Jr., Secretary of the Department of Environment and Natural Resources (DENR) of the Philippines; and Prof. Raphael P.M. Lotilla, Executive Director of the PEMSEA Resource Facility.

The centerpiece of the exhibition featured the coastal and marine initiatives in the East Asian Seas region, including those of PEMSEA Country and non-Country Partners. The PEMSEA exhibit highlighted the interconnectivity of the East Asian Seas region in 12 colorful and large panels, showing the issues, challenges and values focusing on: (1) Biogeochemical Richness and Natural and Man-made Hazards; (2) Harnessing Freshwater Potentials: Impacts of Catchments on Coastal Seas; (3) Losing Biodiversity; (4) Fishing Down the Web and Upcoming Assault of Climate Change; and (5) Sustainable Development in an Uncertain Climate: Trade, Tourism and Economy. PEMSEA showcased its contributions and progress in addressing

these issues and challenges and in achieving the international and regional targets through the local implementation by various stakeholders, such as PEMSEA Country and non-Country Partners, partner organizations, etc.

The exhibit of DENR highlighted major programs and projects contributing to sustainable development as good examples of the local actions on the ground. The projects on Manila Bay, Laguna de Bay and Pasig River and ICM programs in Bataan, Batangas and Cavite were highlighted as national and local actions, and the Coral Triangle Initiative as a sub-regional initiative.

The SEAnergies Exhibition also marked the first active participation of various private companies in the EAS Congress Exhibition. These companies showcased Corporate Social Responsibility (CSR) efforts to protect and conserve the environment and to achieve sustainable development in the coastal areas and the oceans.

Through the efforts of the DENR Exhibition Team, colleges and universities in Manila were invited to the environmental exhibition as part of their field studies. More than 800 college students visited the Exhibition to learn new technologies, environmental facts and various local actions being taken by the exhibitors.

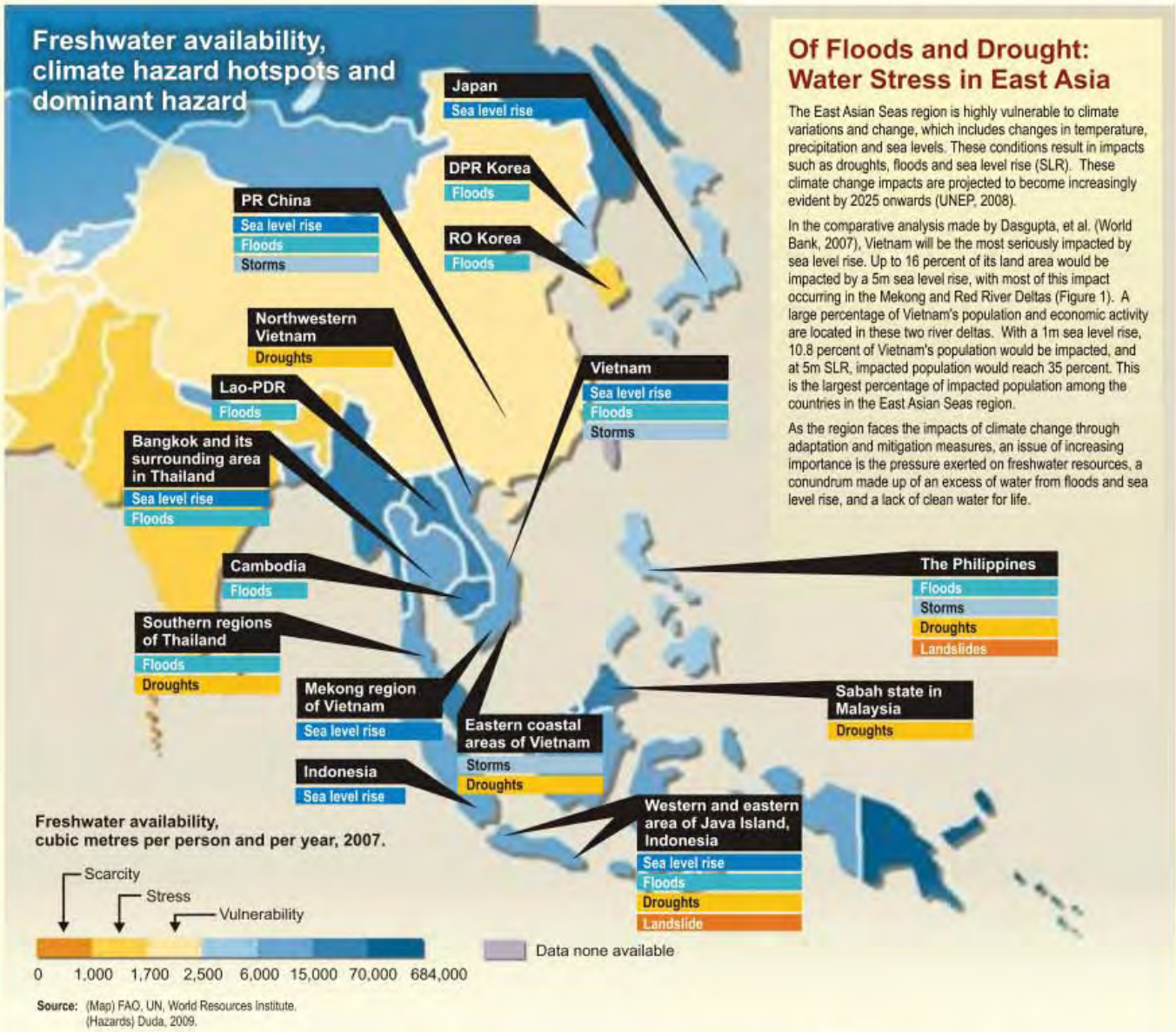
On 26 November 2009, during the Ministerial Forum, the Ministers and representatives of the PEMSEA Country Partners toured the exhibition and interacted with the exhibitors. Mr. Takehiko Fujita, Deputy Minister for Technical Affairs, Ministry of Land, Infrastructure, Transport and Tourism of Japan, said of the exhibition, "The PEMSEA centerpiece exhibition captures the environmental status, challenges and emerging issues on coastal and ocean environment in the region very well and is quite informative."

Mr. Lotilla adds that the "exhibition is a brilliant example of what can be achieved when the private and public sectors, the scientific community and people's organizations work together in pursuit of a common purpose – to lessen the impact of the current environmental damages to secure a sustainable future."

The exhibition also served as an ideal venue to meet and interact with over 1,500 policymakers, national and local government officials, professionals, experts, private sector, academe, NGOs, and regional and international organizations on coastal and ocean development that attended the East Asian Seas Congress 2009.

List of Exhibitors

1. 2nd EAS Youth Forum
2. ASEAN Centre for Biodiversity(ACB)
3. ASEAN Foundation
4. Asia Regional Office of the International Union for the Conservation of Nature (IUCN-ARO/MFF)
5. Bali, Indonesia
6. Bataan Provincial Government/Bataan Coastal Care Foundation, Philippines
7. Bureau of Fisheries and Aquatic Resources (BFAR), Philippines
8. Cambodia
9. Cavite Provincial Government, Philippines
10. Chonburi ICM (Thailand)
11. Chonburi Provincial Administrative Organization
12. Conservation International Philippines (CI-Philippines)
13. Danang, Quangnam, Thua Thien-Hue, Vietnam
14. Democratic People's Republic of Korea
15. Department of Environment and Natural Resources, National Economic Development Administration and Department of Tourism (DENR-Region 1)
16. Dongying City, People's Republic of China
17. East China Sea UMIGOMI Project - The University of Tokyo, JEAN/Japan Environmental Action Network
18. Foreign Assisted and Special Project Office (FASPO), Department of Environment and Natural Resources, Philippines
19. Foundation for the Philippine Environment
20. Gulf of Thailand
21. Haribon Foundation
22. Indonesia
23. International EMECS Center
24. Japan Federation of Ocean Engineering Societies (JFOES)
25. Japan International Marine Science & Technology Federation (JIMSTEF)
26. Korea Environment Institute (KEI)
27. Korea Marine Environment Management Corporation (KOEM)
28. Korea Maritime Institute (KMI)
29. Korea National Park Service
30. Korea Ocean Research & Development Institute (KORDI)
31. Korea Water Resource Corporation
32. Kyungnam University
33. Laem Chabang Port, Thailand
34. Land Bank of the Philippines
35. Lao People's Democratic Republic
36. Magsaysay Mitsui OSK Marine, Inc.
37. Manila Bay - River Basin Control Office (DENR)
38. Manila Water Company, Inc.
39. Ministry of Land, Infrastructure, Transport and Tourism (MLIT), Japan
40. Ministry of Land, Transportation and Maritime Affairs (MLTM), Republic of Korea
41. Municipality of Puerto Galera, Oriental Mindoro & Puerto Galera Infrastructure Organization
42. National Parks Board, Singapore
43. Northwest Pacific Action Plan (NOWPAP)
44. Northwest Pacific Action Plan Special Monitoring & Coastal Environmental Assessment Regional Activity Centre (NOWPAP/CEARAC)
45. Ocean Construction Co. Ltd.
46. Ocean Policy Research Foundation(OPRF)
47. Oil Spill Response Limited
48. PEMSEA Resource Facility
49. Philippine Airlines, Tanyankee Foundation
50. Philippine Business for Social Progress (PBSP)
51. Plymouth Marine Laboratory (PML)
52. Port of Tanjung Pelepas
53. Pusan National University/Marine Research Institute
54. RCA Regional Office
55. Republic Democratic Timor-Leste
56. RO Korea Secretariat
57. Shima City, Japan
58. Sukabumi, Indonesia
59. Team Energy Foundation
60. Thailand
61. The Organizing Committee for Expo 2012 Yeosu Korea (Yeosu Expo)
62. The Philippines Environmental Governance Project, Development Alternative Inc. (DAI-EcoGov)
63. The WorldFish Center
64. UNEP/Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (UNEP/GPA)
65. United Nations Development Programme, Philippines
66. United Nations Industrial Development Organization (UNIDO)
67. University of the Philippines-Marine Science Institute (UP-MSI)
68. Xiamen City, People's Republic of China



Source: (Map) FAO, UN, World Resources Institute. (Hazards) Duda, 2009.

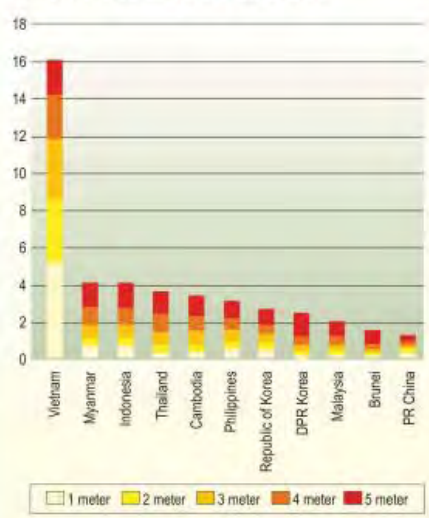
Of Floods and Drought: Water Stress in East Asia

The East Asian Seas region is highly vulnerable to climate variations and change, which includes changes in temperature, precipitation and sea levels. These conditions result in impacts such as droughts, floods and sea level rise (SLR). These climate change impacts are projected to become increasingly evident by 2025 onwards (UNEP, 2008).

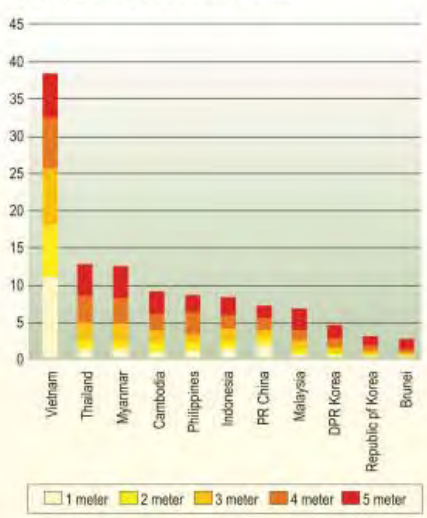
In the comparative analysis made by Dasgupta, et al. (World Bank, 2007), Vietnam will be the most seriously impacted by sea level rise. Up to 16 percent of its land area would be impacted by a 5m sea level rise, with most of this impact occurring in the Mekong and Red River Deltas (Figure 1). A large percentage of Vietnam's population and economic activity are located in these two river deltas. With a 1m sea level rise, 10.8 percent of Vietnam's population would be impacted, and at 5m SLR, impacted population would reach 35 percent. This is the largest percentage of impacted population among the countries in the East Asian Seas region.

As the region faces the impacts of climate change through adaptation and mitigation measures, an issue of increasing importance is the pressure exerted on freshwater resources, a conundrum made up of an excess of water from floods and sea level rise, and a lack of clean water for life.

East Asia: Country area impacted



East Asia: Population impacted



Source: World Bank, 2007.

References:

Duda, A. 2009. GEF International Waters Focal Area (IWC5 Presentation). Global Environment Facility Presentation given during the 5th GEF Biennial International Waters Conference in Cairns, Australia during the opening plenary. "Top 12 countries most at risk climate change. Available at: http://iwlearn.net/abt_iwlearn/events/iwc5/iwc5_presentations/iwc5_plenary_gefiw_duda.ppt/view

UNEP. 2008, Vital Water Graphics - An Overview of the State of the World's Fresh and Marine Waters. 2nd Edition. UNEP, Nairobi, Kenya. ISBN: 92-807-2236-0. Philippe Rekacewicz, Geographer and cartographer. http://www.unep.org/dewa/vitalwater/jpg/0221-waterstress-EN.jpg

UNEP/GRID-Arendal. 2010. Vital Climate Graphics. Available at: http://www.grida.no/publications/vg/; http://www.grida.no/publications/vg/climate/page/3091.aspx; http://maps.grida.no/go/graphic/the-contribution-of-climate-change-to-declining-water-availability

World Bank. 2007. "The Impact of Sea Level Rise on Developing Countries: A Comparative Analysis." Dasgupta, S., B. Laplante, C. Meisner, D. Wheeler and J. Yan. World Bank Policy Research Working Paper 4136, February 2007. Available at: http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2007/02/09/000016406_20070209161430/Rendered/PDF/wps4136.pdf

Yusof, A.A. and H. Francisco. 2009. Climate Change Vulnerability Mapping for Southeast Asia. Economy and Environment Program for Southeast Asia (EEPSEA), International Development Research Centre (IDRC); the Swedish International Development Cooperation Agency (Sida); and the Canadian International Development Agency (CIDA). Available at: http://www.idrc.ca/uploads/user-S/12483270391Mapping_Reportv02.pdf