eas Congress 2009

Theme 6

Pollution Reduction and Waste Management

WORKSHOP 1: TRANSBOUNDARY POLLUTION REDUCTION IN RIVER BASINS AND COASTAL AREAS

25 November 2009

NOWPAP POMRAC UNEP

Northwest Pacific Action Plan (NOWPAP) — Pollution Monitoring Regional Activity (POMRAC)

Chair: **Dr. Alexander Tkalin**
Coordinator, NOWPAP of UNEP

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The East Asian Seas Congress 2009

"Partnerships at Work: Local Implementation and Good Practices"

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Co-Convening Agencies:
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BACKGROUND

Transboundary transport of pollutants through rivers is recognized as one of the main causes of ecological problems in coastal and marine areas. Reduction of pollution inputs from rivers is hence a prerequisite in addressing downstream pollution impacts in receiving coastal and marine waters.

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.

This workshop aimed to present and take lessons from case studies in the Northwest Pacific, East Asia and other regions on transboundary pollution reduction in rivers and coastal areas through integrated management approaches. It also aimed to share good practices and experiences on integrating pollution reduction measures and tools in river basin management among established river basin management programs and areas that are starting the process.

TRANSBOUNDARY POLLUTION REDUCTION IN RIVER BASINS AND COASTAL AREAS FROM THE NORTHWEST PACIFIC

Session 1 of the workshop focused on sharing case studies on transboundary pollution reduction in river basins and coastal areas from the Northwest Pacific, including experiences from the implementation of two UNDP/GEF projects in strategic river basins in the northeastern Asia, and experiences in development and implementation of integrated coastal area and river basin management (ICARM) in Russia, Republic of Korea, PR China and Japan. A model that can be used to distinguish sea areas where ICARM approach is strongly recommended from areas where influence of land-based point sources of nutrients is less probable was also presented.

International approaches to the transboundary pollution reduction through GEF "Amur River" and "TumenNet" Projects

In the northeastern Asia, rapid economic development of PR China, Russia and Republic of Korea are causing environmental and natural resource degradation in the Amur and Tumen River Basins (**Figures 1 and 2**). Three key problems confront the coastal areas and river basins: (1) habitat degradation; (2) pollution of transboundary ground and river waters; and (3) non-optimal utilization of resources. These are further compounded by inadequate institutional and management systems to address these problems in an integrated manner. To address these problems, the UNDP/GEF projects "Tumen River Strategic Action Program" and "Integrated Management of the Amur/Heilong River Basin" aimed to develop an overarching regional strategic action programme 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. Taking into account the experiences from these projects, the following courses of actions were recommended in order 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 plan in case of environmental emergences and joint ecological monitoring system; (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 the Yellow sea Commission.

Figure 1. Tumen River Basin.

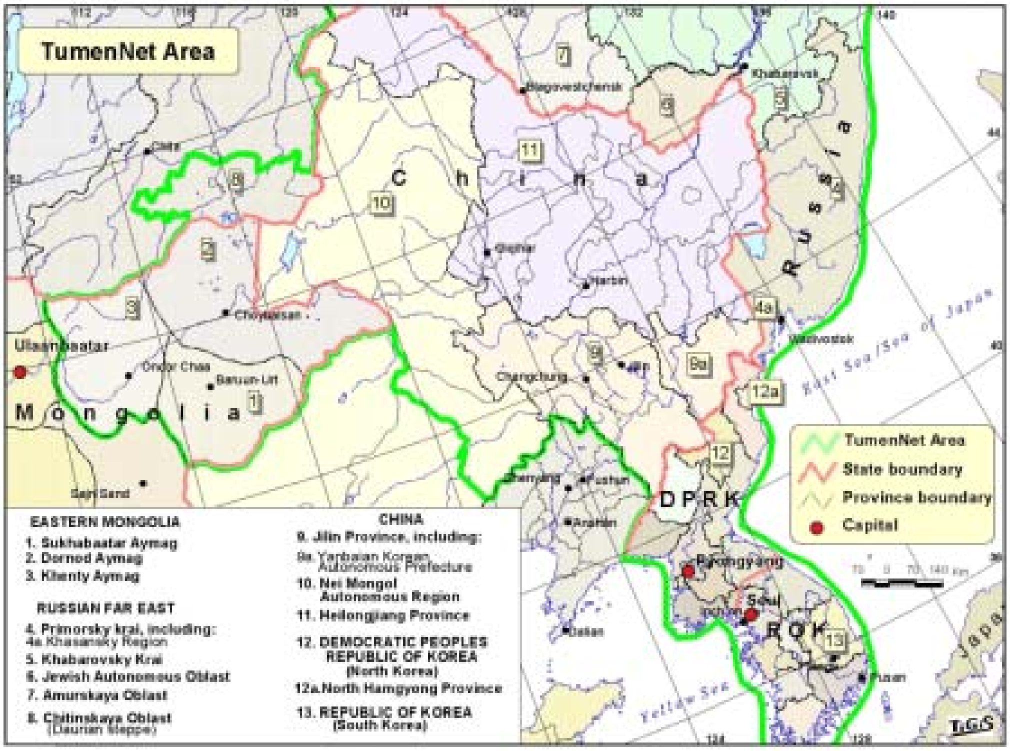


Figure 2. Amur River Basin.

ICARM Approach in the Russian Far East

For the organization of an integrated and sustainable management of natural resources in the Far Eastern coastal zones of Russia, a hierarchical structure of delimitation of coastal areas and recommendations for their development on the basis of natural resource and socioeconomic zoning was developed as follows. First, 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. Second, the zoning for coastal areas was defined in terms of the quality of conditions that can support life and human activity. Third, 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. Lastly, 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 continental shelf. Regional responsibility (of coastal Krais and Oblasts) would cover their land borders and inner waters and territorial sea from the marine side. And Municipal responsibility would include territories of municipal subjects located in river basins and parts of the sea (2 nautical miles 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. **Figure 3** shows the proposed delimitation scheme, which considers the coastal zone as a whole physical-geographical natural system, takes into account the interests of federal and regional structures, the needs of municipalities and the population of the coasts, and corresponds to existing Russian and international legislation. **Figure 4** shows the delimitation of coastal zones in the Peter the Great Bay near Vladivostok.

Figure 3. Proposed hierarchical structure of delimitation of coastal areas.

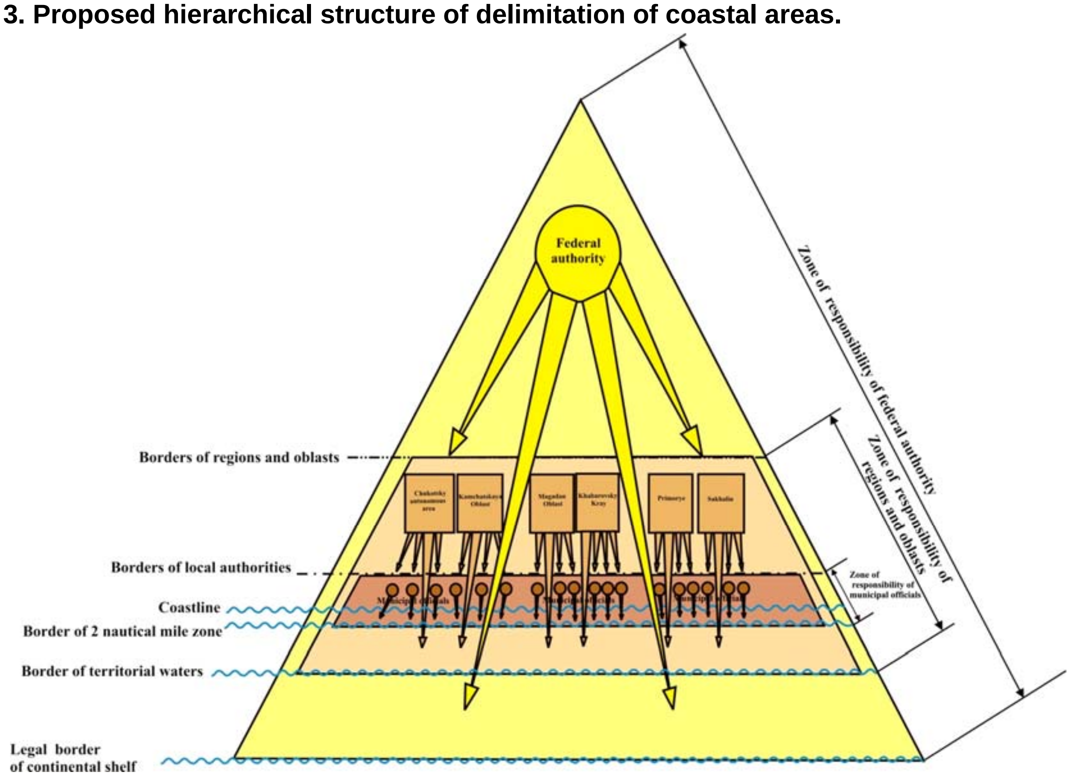
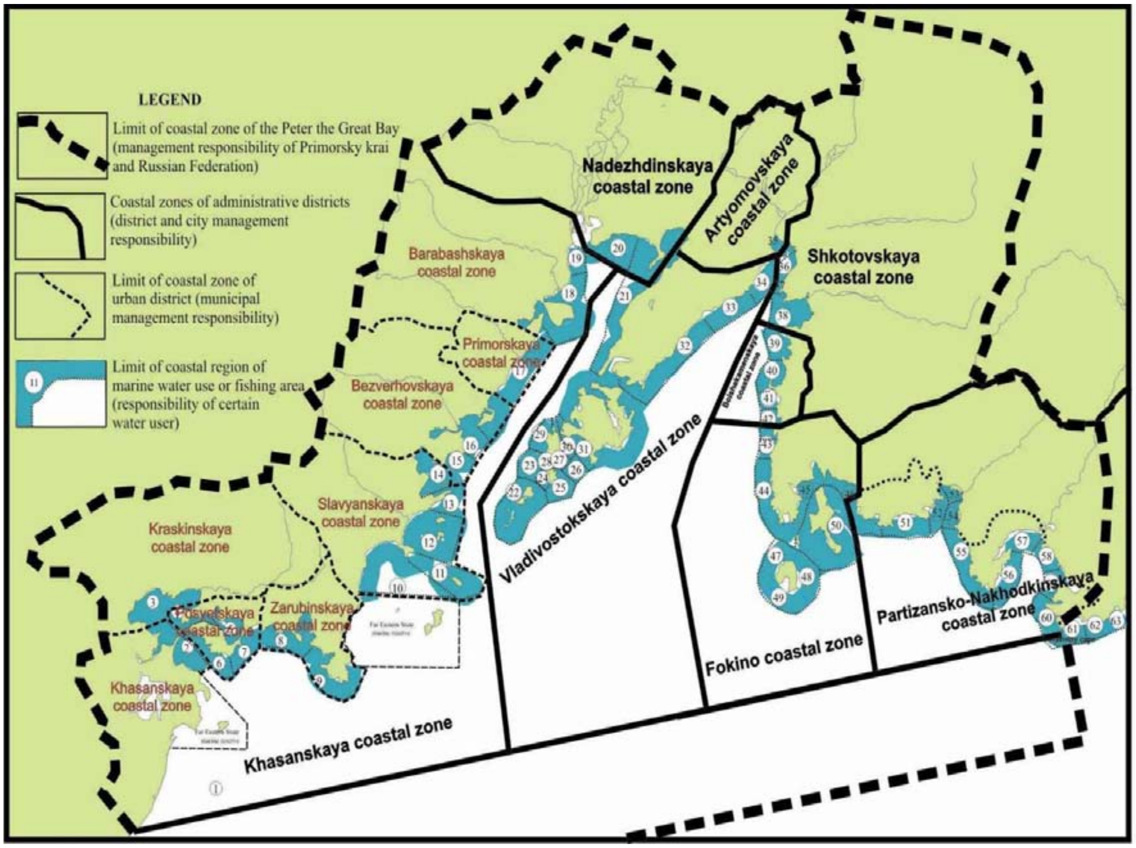


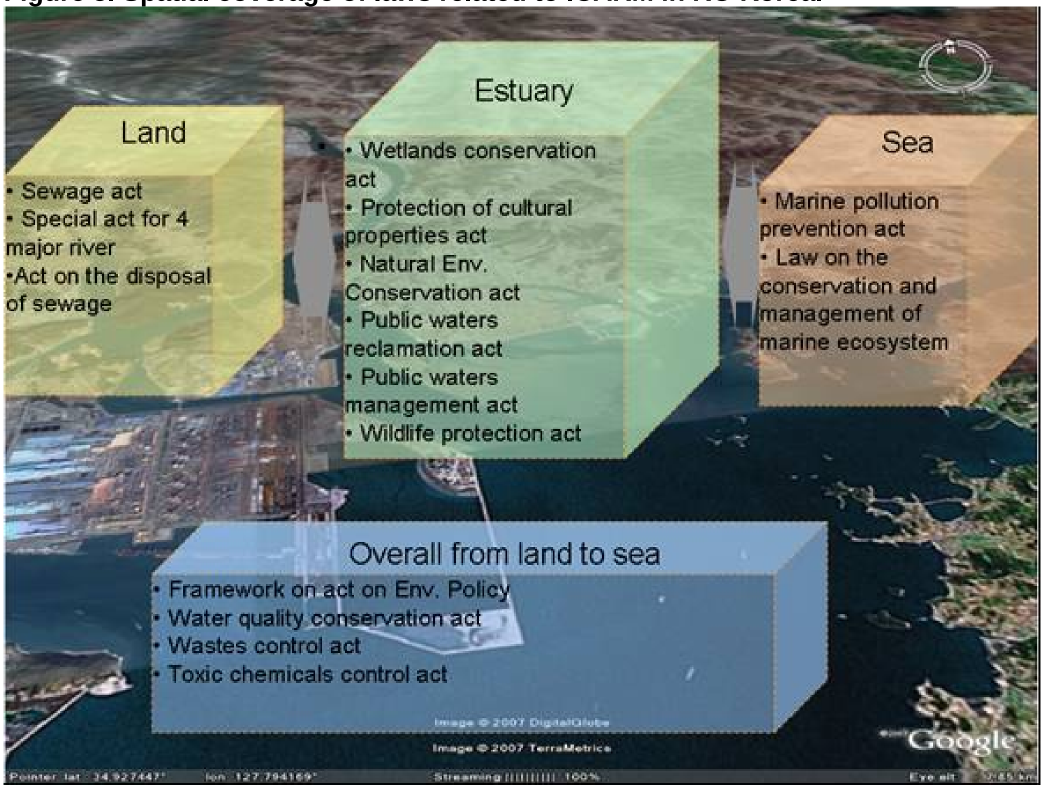
Figure 4. Delimitation of coastal zones in the Peter the Great Bay near Vladivostok.



National Program on the Integrated Coastal and River Basin Management (ICARM) of RO Korea

In RO Korea, intensive coastal development since the 1970s has led to degradation of coastal habitats, rapid increase in pollutants input from land-based sources into coastal waters, about 40 percent increase in BOD during the last decade, and 20 percent decrease in wetlands 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 consolidation of coastal watershed management regime, applying a site-specific and issue-dependent approach, strengthening decisionmaking support system, public involvement, revision of legal and institutional framework, and cooperation between countries and local communities. Significant proportion of national budget has been allocated for pollution prevention from land-based activities, with sewage, POPs, heavy metals, and physical alteration and destruction of habitats as high priorities. Several policies and laws covering the land, estuary and sea areas also set policy directions and standards for environmental management (**Figure 5**). 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).

Figure 5. Spatial coverage of laws related to ICARM in RO Korea.



China's experience in the reduction of pollution in the rivers and coastal zone using ICARM approach

The main target of ICARM in the Yellow Sea in China is to control land-based pollution through the river systems, which was identified as the key factor contributing to the pollution of the coastal zone. In 2007, the State Council promulgated the “China National Environmental Protection Plan in the Eleventh Five-Years (2006-2010)”, which proposed five targets to reduce marine pollution. These targets include: (1) reducing land-based pollution load; (2) quickening the steps of important marine environmental protection; (3) protecting the sea from port and watercrafts pollution; (4) strengthening marine ecology conservation and environmental protection including establishment of marine conservation areas; and (5) avoiding marine environmental disasters. Between 2006 and 2008, China adopted several measures to reduce pollution and improve water quality namely: (1) land-based pollution control through the delegation of responsibilities in improving water quality to provinces and regular monitoring of results; (2) establishment of national aquatic resources conservation areas and periodic closing of some fishing areas; and (3) adoption and implementation of ships pollution reduction and mitigation measures at the national and local levels.

Eco-Compatible Integrated Management of River Basin and Coastal Area: ICARM Experience in Japan

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 continuously have supplied the pollutant loads, and sometimes resulted in water pollution and degradation of marine ecosystems. Hence, the Japanese Government has been aggressively implementing environmental protection countermeasures directed at controlling and reducing land-based pollution at source in the river basin, through the Total Pollution Load Control System (TPLCS). The purpose of TPLCS is to reduce the pollutant loads entering into the enclosed seas, especially specified water bodies of Tokyo Bay, Ise Bay and Seto Inland Sea. Every five years, the Minister of the 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 plan generally consists of concrete measures to reduce pollutants from households, industries, and agricultural lands. These measures significantly reduced the COD and TN load in Tokyo Bay, Ise Bay and Seto Inland Sea between 1979 and 2009 (**Figure 6**). However, further environmental improvement from the forest to the sea areas was targeted, for which ICARM is a comprehensive approach. 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 basin. For the development of ICARM in Ise Bay, an assessment framework for eco-compatible integrated management of river basin and coastal area was applied, which consists of three tool boxes to evaluate natural and man-made flux network (e.g., water, sediment, pollutant load), evaluate ecosystem service for each categorized landscape which forms the river basin, coastal area and bay, and for integrated evaluation (**Figure 7**).

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

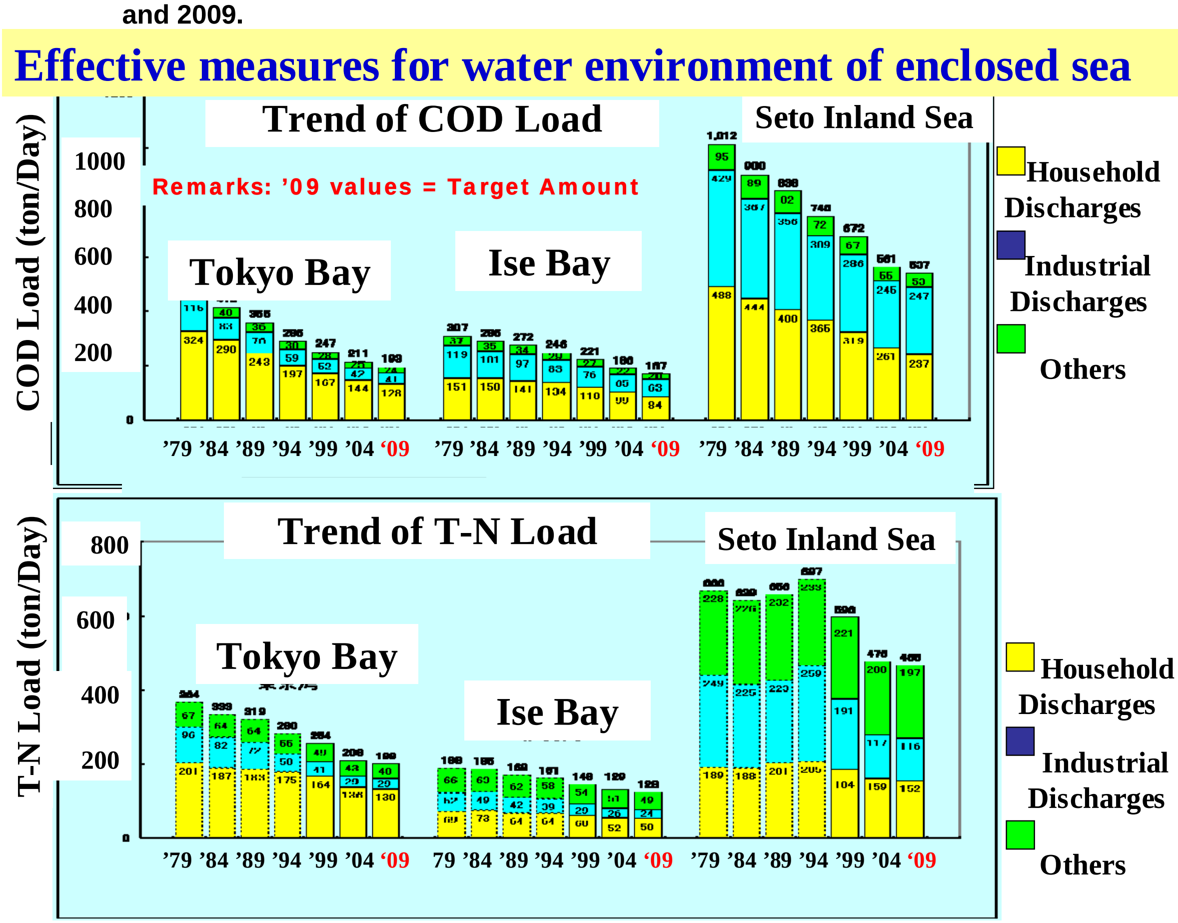
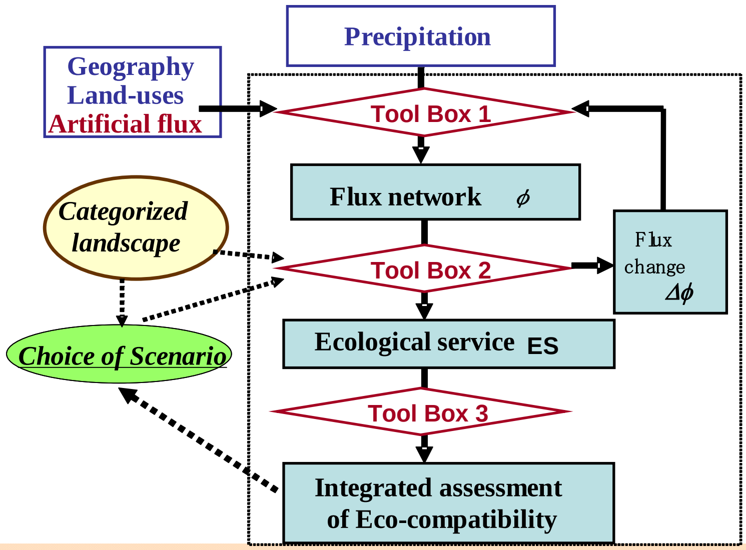


Figure 7. Schematic diagram of eco-compatible assessment.



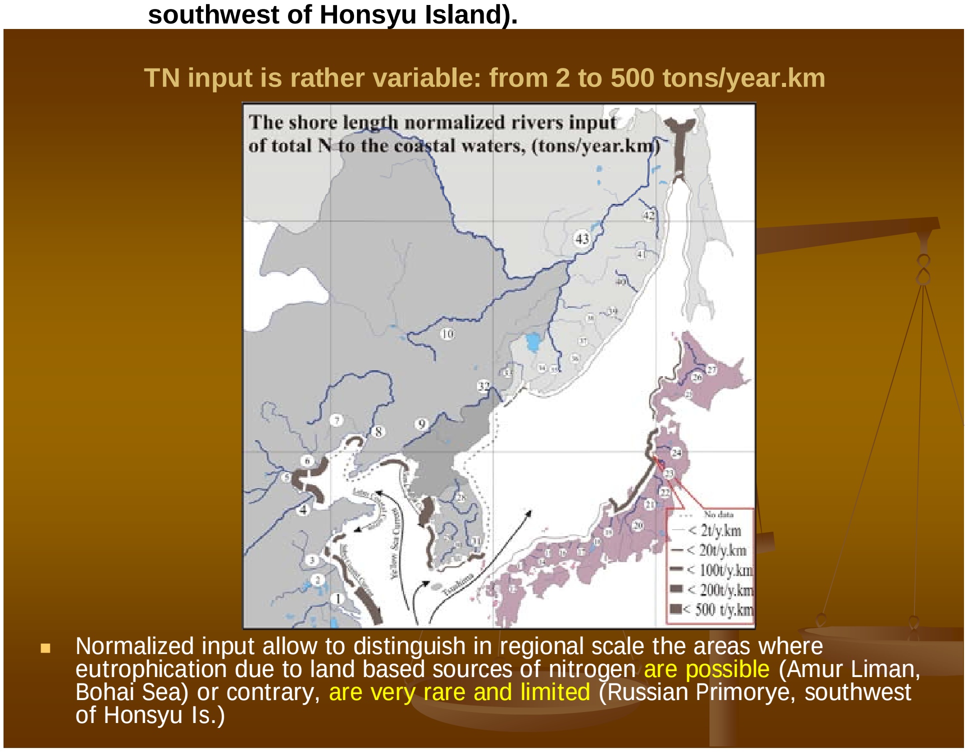
Tool Box 1 Flux network analyzing model : land and coast
Tool Box 2 Ecosystem service modeling : Categorized landscape
Tool Box 3 Integrated eco-compatibility assessment model

Significance of the River Input of Nutrients in relation to Coastal Eutrophication: Spatial Zoning examples from the Northwest Pacific

The assessment of the sea area where land-based sources determine the characteristics and ecological problems is a prerequisite necessary for the proper spatial zoning and success of the ICARM approach. In the NOWPAP region, which combines 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 influencing on the sea areas for proper zoning in support of ICARM. In place of the traditional area-normalized discharge (specific discharge, Q/S), which is a characteristic of watersheds and does not reflect comprehensively the influence of river input on the coastal waters, shore length normalization (coastal specific discharge) is proposed as a proxy assessment of the influence of river runoff (or other land-based point sources) on the coastal sea areas at the regional and subregional scale. Coastal specific discharge (Q_L) is equal to the ratio between the volume of discharge and the length of the shoreline of material delivery (QL [tons/year.km] = Q [tons/year]/L [km]). The length of shore between the boundaries of catchment areas was taken as the shoreline length (L). The normalized input allows to distinguish in a regional scale, the areas where eutrophication due to land-based sources of nitrogen are possible (**Figure 8**). The coastal specific discharge, however, is a "first step," rather rough estimate, because it does not account the specific oceanographic features of concrete coastal sea areas. It should also be noted that low value of coastal specific discharge does not mean that ecological problems due to land-based sources are absent, but just that these problems probably do not exceed the local scale. In integrated management, the assessment of land-based fluxes is interesting not in itself, but as a reason of the changes or deterioration of the adjacent marine ecosystems. Hence, as a further step, a simple model was presented for the evaluation of the area of coastal waters — where the existing level of plankton production or eutrophication could be provided by 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 ('river dependent sea area'). The bigger this area means the stronger influence of land-based sources of nutrients in eutrophication in coastal waters. The main disadvantage of this indicator is an ignoring of oceanographic and/or biological features of specified localities. This indicator, however, allows looking at and to compare the situation at the regional and subregional level within big sea areas. Both simplified models ('coastal specific discharge' and 'river dependent sea area') allow distinguishing the sea areas where ICARM approach is strongly recommended from the areas where influence of the land-based point sources of nutrients is less probable.

Figure 8. The normalized input allow to distinguish in a regional scale, the areas where eutrophication events due to land-based sources of nitrogen are possible (Amur Liman, Bohai Sea) or, on the contrary, are very rare and limited (Russian Primorye, southwest of Honsyu Island).



TRANSBOUNDARY POLLUTION REDUCTION IN RIVER BASINS AND COASTAL AREAS FROM THE EAST ASIAN REGION

Session 2 of the workshop focused on case studies of transboundary pollution reduction in river basins and coastal areas from the East Asian region, including Jakarta Bay and Ciliwung River in Indonesia, Pasig River and Manila Bay in the Philippines, Selangor and Klang river systems and the coastal waters of Port Klang in Malaysia, Jiulongjiang River basin and Xiamen Bay in PR China, and the Singapore River and Kallang Basin in Singapore. A model that can estimate pollutant load from various sources even with limited data was also presented.

Integrated management of Jakarta Bay and Ciliwung River

Jakarta, the capital city of Republic 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 also has 10 million people night-time population and 12 million people day-time population due to commuting workers, and the Greater Jakarta area has a total population of around 25 million people. The city's geographical condition is characterized by a low-lying region, with 13 river systems coming from 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 river banks occupied by informal settlers. Large volumes of solid waste and sedimentation due to land erosion upstream have resulted to 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 the 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. With regard to coastal water pollution, the city has signed a letter of declaration for improvement of waste management performance for companies which are located along the coast, and undertaken spatial planning of the coastal area (**Figure 9**), strategic environmental assessment for coastal reclamation and revitalization, and beach clean up campaigns. 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.

Figure 9. Spatial planning in Jakarta Bay.

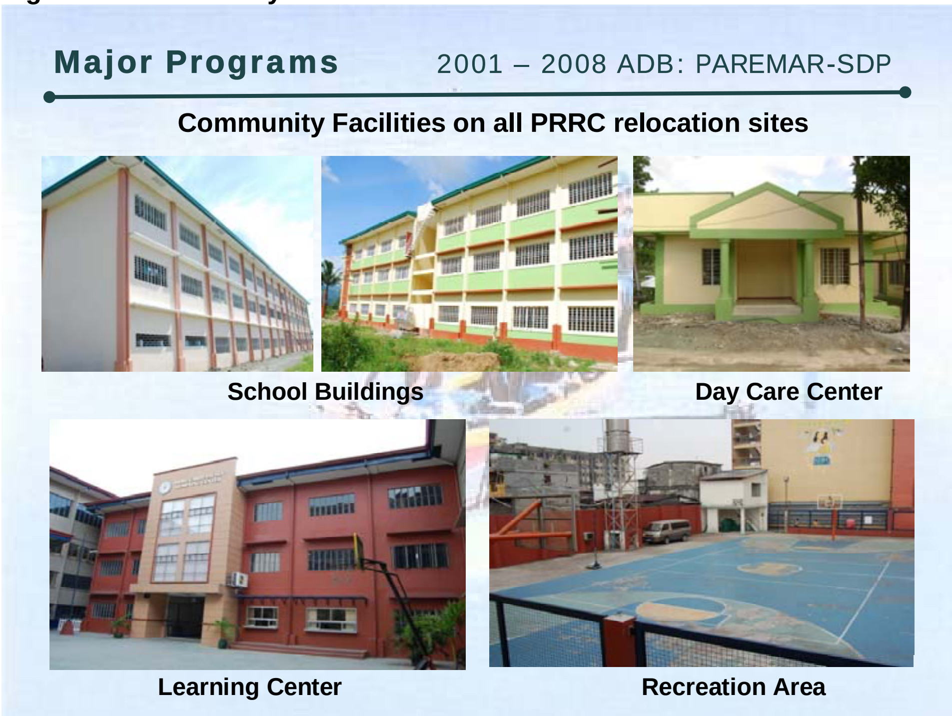
Reducing Pollution in the Pasig River: Targets, Strategies, Good Practices, Achievements and Challenges

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 Bai. The Pasig River also has four major and 43 minor tributaries which are directly and continuously discharging polluted water into it. These tributaries, including the Laguna de Bai had significantly caused the degradation of the water quality of the Pasig River and Manila Bay. Recognizing its role in the sociocultural formation and economic progress of the Philippines and the preservation of Manila Bay, the Philippine government made the rehabilitation of Pasig River a flagship program for the environment. In 1999, the Pasig River Rehabilitation Commission was created through an Executive Order, with the main objective to upgrade the water quality of Pasig River to Class C level, with water quality that is fit for fishery, secondary recreation and water supply for manufacturing processes (after treatment). The Commission has set 12 targets 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. Bioremediation/aeration and filtration; and
12. Phytoremediation.

From 2000 to 2008, the PRRC was able to reduce dumping of garbage and discharging of industrial waste into the river; remove sunken and other materials from the river bed; resettle informal settlers to decent and socialized housing units (**Figure 10**); develop the riverbanks into environmental preservation areas (EPAs); revive the commercial ferry; continuously monitor the water quality of the river; and create public awareness. A river dredging and rehabilitation work was also initiated in 2009. Presently, the commission faces several challenges, such as the: (1) Construction of Septage Treatment Plants (STPs) by the water and sanitation concessionaires; (2) Strengthening involvement of LGUs in the relocation of informal settlers and construction and operation of Material Recovery Facilities (MRFs); and (3) establishment of biological treatment stations for households, commercial and industrial establishments and the 43 minor tributaries of Pasig River.

Figure 10. Community facilities in PRRC relocation sites.

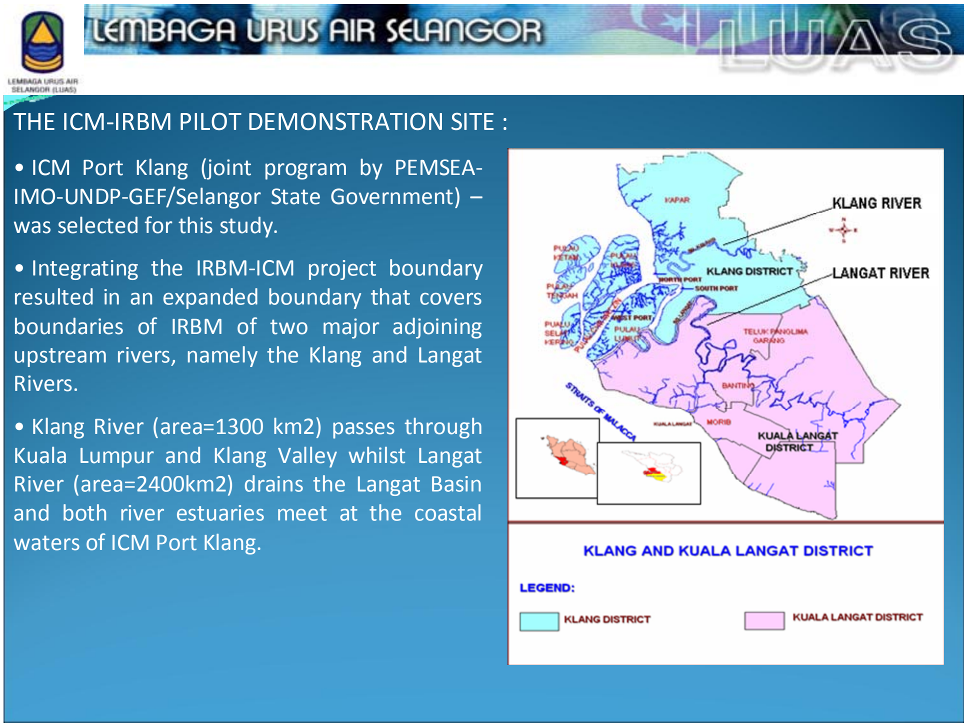


Pollution reduction in Selangor and Klang River System

In the Selangor and Klang River in Malaysia, pollution is one of the largest 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 conditions, the Selangor Waters Management Authority — a one-stop agency for the management of water resources, river basin, ground water, 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 2400 km^2, drains the Langat Basin and both river estuaries meet at the coastal waters of the ICM area in Port Klang (**Figure 11**). 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 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.

Figure 11. The IRBC-ICM demonstration area covering the coastal waters of Port Klang and Klang and Langat River Basins.



Control of Land-Based Pollution in Singapore and Experience in Cleaning up the Singapore River

In Singapore, major marine sources of pollution include ship-borne pollution and land-based pollution. Land-based pollutants originate from municipal, agricultural and industrial activities. Many studies have indicated that land-based sources are the major contributors of the marine pollution. Being a city-state, the main sources of land-based pollution in Singapore are domestic wastewater, both sewage and industrial effluent. There are also some commercial farms in the suburban areas, which generate pollutive wastes, which if not properly managed, will also pollute inland and coastal waters. With proper planning control, provision of environmental infrastructure and pollution control facilities, stringent enforcement of pollution control legislation and an effective monitoring programme, Singapore has controlled the land-based pollution sources effectively and kept the inland and coastal waters clean and healthy. A big challenge that Singapore faced in the late 1970s is the serious pollution of the Singapore River such that in 1977, then Prime Minister Lee Kuan Yew issued a challenge to have the Singapore River cleaned up in ten years. This resulted into a 10-year master plan aimed at cleaning up Singapore River and Kallang Basin. The goals were to remove sources of pollution and to ensure quality that can 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 squatters along river banks; (5) develop action programs and implement them; and (6) river rehabilitation and beautification. After just 10 years, the quality of river has 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 12**). The success of the program was attributed to political will, clear mandate for agencies to carry out the tasks and close coordination among government agencies and partnership with stakeholders.

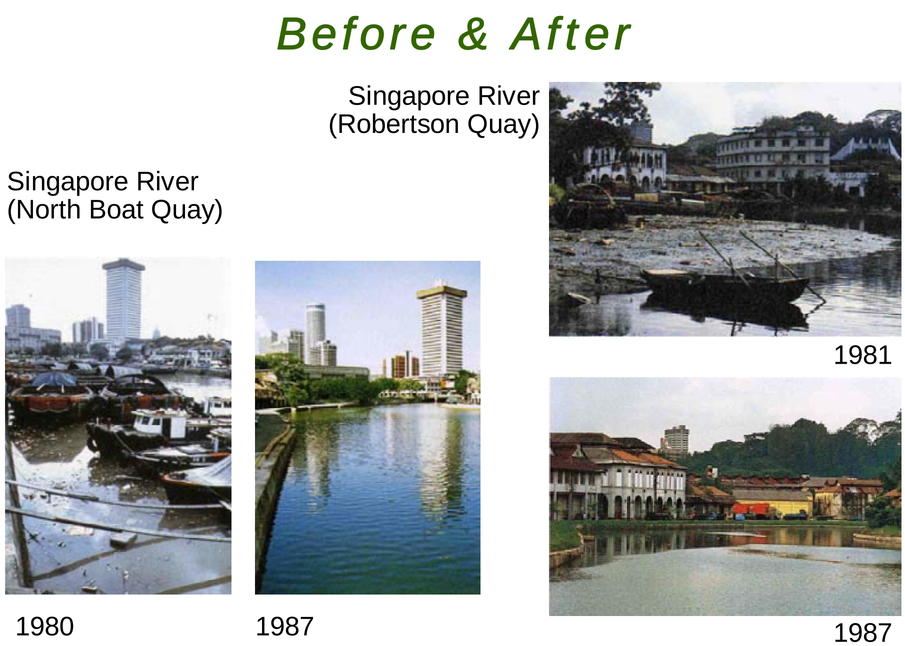
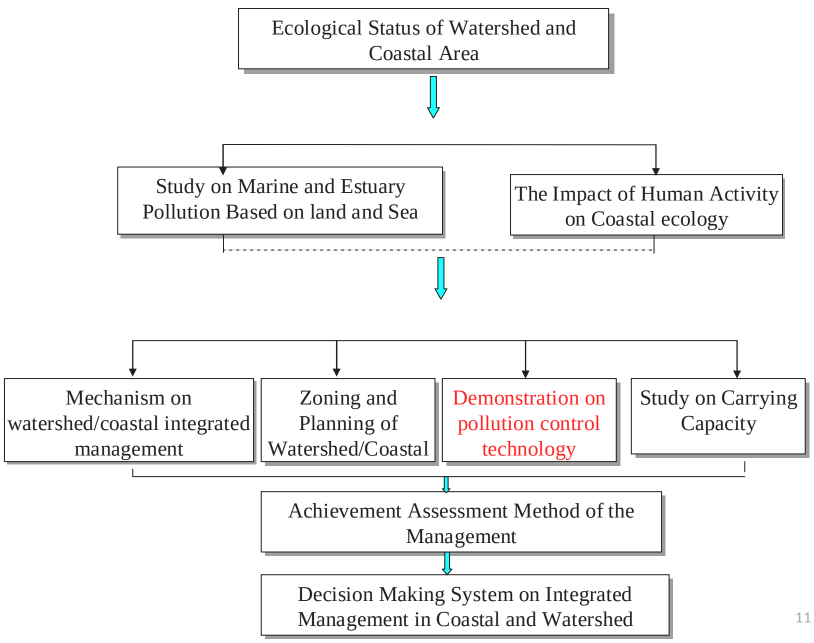


Figure 12. Selected areas along Singapore River before and after the rehabilitation.

Transboundary Pollution Reduction in River Basins and Coastal Areas by Watershed Management in China: The Jiulongjiang River Basin-Xiamen Bay Case Study

The Jiulongjiang River, 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 River. However, after a decade of ICM practices in Xiamen, the managers and stakeholders in Xiamen came to realize that the Jiulongjiang Basin still has a great impact on ecosystem health and marine biodiversity conservation in Xiamen Bay as the Jiulongjiang River accounts for 50 percent of the non-point source pollution in the Bay. Therefore, the Strategic Management Plan of Xiamen ICM developed in 2004 made the control of transboundary pollution from the Jiulongjiang Basin as one of its priority objectives. Since 2004, the Xiamen Government initiated a comprehensive program for transboundary pollution reduction in the Jiulongjiang River through institutional, technical and financial arrangements with the upstream and downstream cities. In terms of institutional arrangements, several actions were made such as the setting up of a Xiamen, Zhangzhou and Longyan City-Alliance in 2004 which 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 where lessons were exchanged. 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. In the financial area, the Fujian Government invested in water pollution control and ecological management. Moreover, since 2004, the Xiamen Municipal Government has been providing finance for the upper reaches of the watershed for pollution reduction activities. Arrangements were also set up in order to relocate, move or shut down activities and industries that significantly pollute the watersheds. The basis for decisionmaking for the integrated management of coastal and watershed areas in Jiulongjiang Riverbasin and Xiamen Bay is presented in **Figure 13**.

Figure 13. Decisionmaking framework for the integrated management of coastal and watershed areas in Jiulongjiang Riverbasin and Xiamen Bay.



Quantifying Land-based Pollutant Loads in the Coastal Area with Sparse Data: Methodology and Application in PR 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 stormwater runoff, stream flow, climate variables, and so on, in the coastal area are insufficient or inappropriate for the purpose of modeling or accurate direct estimation of land-based pollutant loads. This is especially a big challenge in PR China. A systematic approach for quantifying the land-based pollutants loads in coastal bays with limited data was developed with the integration of Raster GIS, USLE, SDR, and empirical export coefficient method (**Figure 14**). This approach can quantify the source apportionment of land-based 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 visualize and identify the critical areas of land-based pollution in coastal areas. The application of the said approach in two studies on the Bays with different natural conditions and levels of urbanization resulted in clear identification of the source apportionment of land-based pollutant loads in the coastal area with sparse data in China. In Xiamen Bay, which suffered from more intensive urbanization process, the main results show that over 55 percent of land-based pollutant COD, TN and TP emission are caused by non-point source pollution (**Figure 15**). On the other hand, the main results obtained in Luoyuan Bay show that land-based pollutant COD is mainly from rural domestic wastewater pollution (63%) and soil erosion (22%) whereas point source only contributes 4 percent. The results also showed good implications for river basin and coastal management in the study regions. Nonetheless, there are still some uncertainties and limitations for such proposed 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.

Figure 14. A proposed approach for quantifying land-based pollutants loads in coastal bays with limited data.

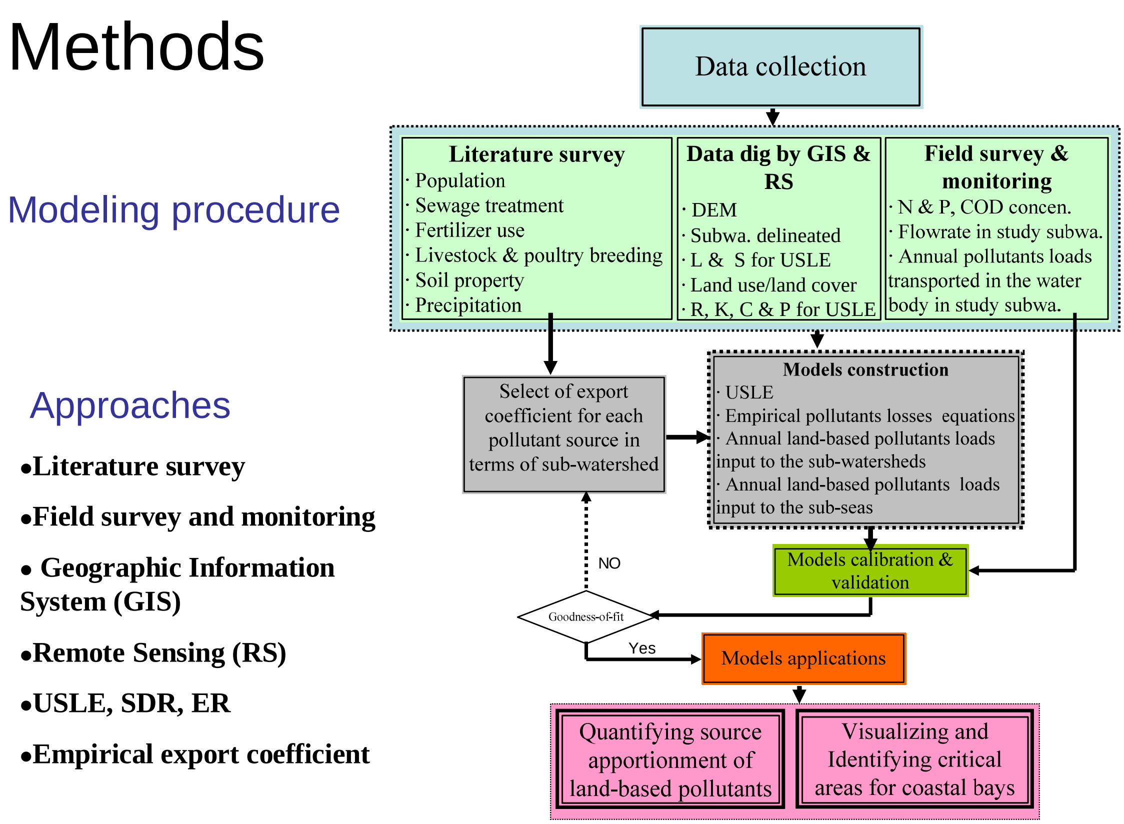
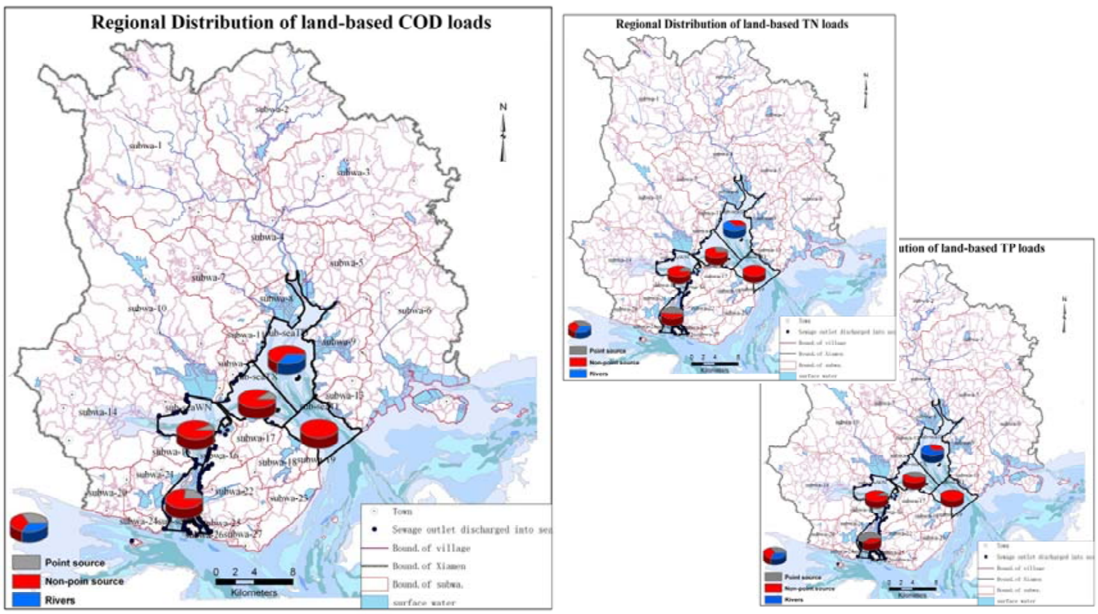


Figure 15. **Application of the proposed approach in Xiamen Bay showed that non-point source is the main source for COD_{Mn} in all sub-seas, accounting for over 60 percent. Non-point source also contributes largely TN and TP for most sub-seas. Interestingly, river discharge and point source are responsible for considerable TN and TP load in sub-seaTD (northernmost) and sub-seaWS (southernmost), respectively.**

Source Apportionment of Land-Based Pollution in Xiamen Bay



EXPERIENCE ON TRANSBOUNDARY POLLUTION REDUCTION IN RIVER BASINS AND COASTAL AREAS FROM OTHER REGIONS

In Session 3 of the workshop, in-country experiences in Chesapeake Bay, USA, and cross-country experiences in the Danube River and Black Sea in Europe, areas with established river basin management programs, were shared.

Comprehensive Multi-sector Pollution Reduction Strategies to Restore Chesapeake Bay

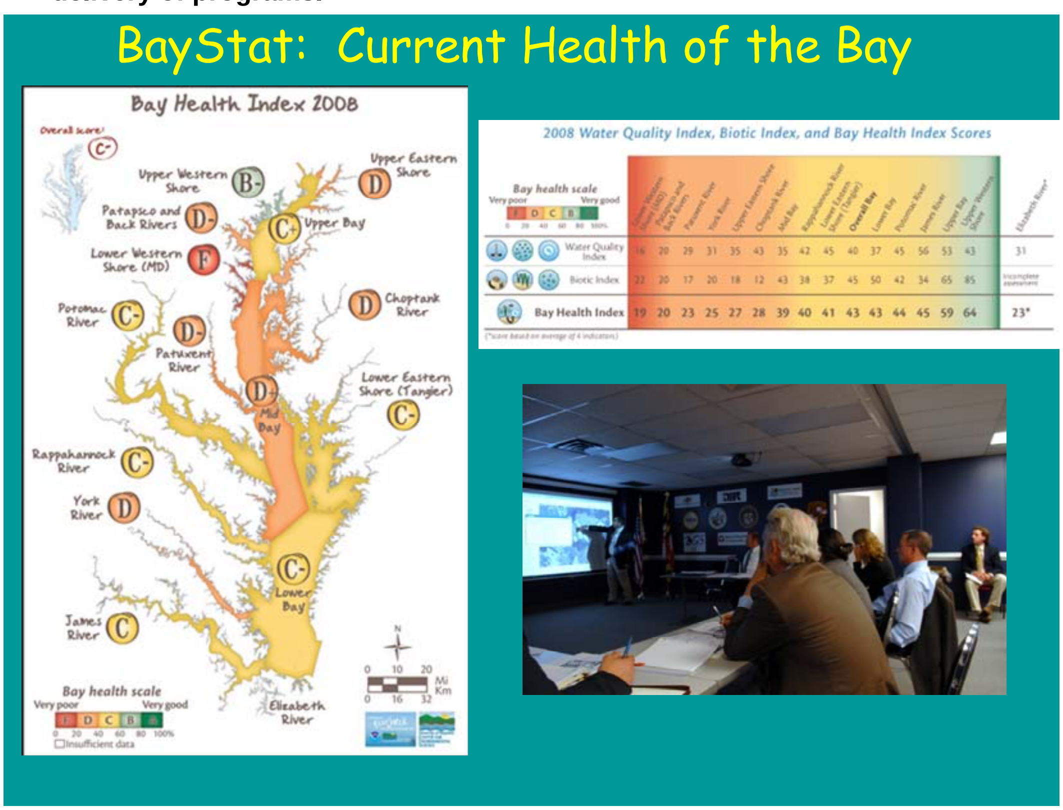
Chesapeake Bay is a shallow bay with an average depth of 6 m, but with a large watershed area of 160,000 km^2 and population of 16 million. The bay has been degraded in the last 100 years due to pollution as shown by the decline in aquatic life. Nutrient enrichment from all sectors has caused fundamental and pervasive alteration of the bay ecosystem. Seagrasses have declined by 8-10 folds while oysters are at now only at 1 percent of historic populations. Given its shallowness, a rise in water level due to climate change will have big impact on the area. 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 the Chesapeake

Bay by the year 2000 and capping nutrient levels thereafter. Although the goal was not met, significant nutrient reductions were achieved. Various laws and measures applied to reduce nutrient pollution, include:

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 addressing nutrient management on farms;
4. Bay Restoration Fund of 2005 primarily to support waste water treatment plant upgrades and also cover crops and septic 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 current Governor also established BayStat in 2007 to review monthly progress and assess the effectiveness of nutrient reduction programs from all sectors and consider changes to increase their efficiency (Figure 16). The BayStat team is composed of the Secretaries of the Maryland Departments of Agriculture, Environment, Natural Resources and Planning, and scientists from the University of Maryland. Two-year goals were also formulated to hold politicians accountable. Total maximum daily load (TMDL) allocations will also be enforced beginning 2011. For all these measures to effectively lead to full recovery of Cheasapeake Bay, nutrient reduction actions from all sectors must be undertaken. Restoring the Bay must also be considered in the context of climate change, and adaptive management must also be employed based on the improvements made on ecosystem health.

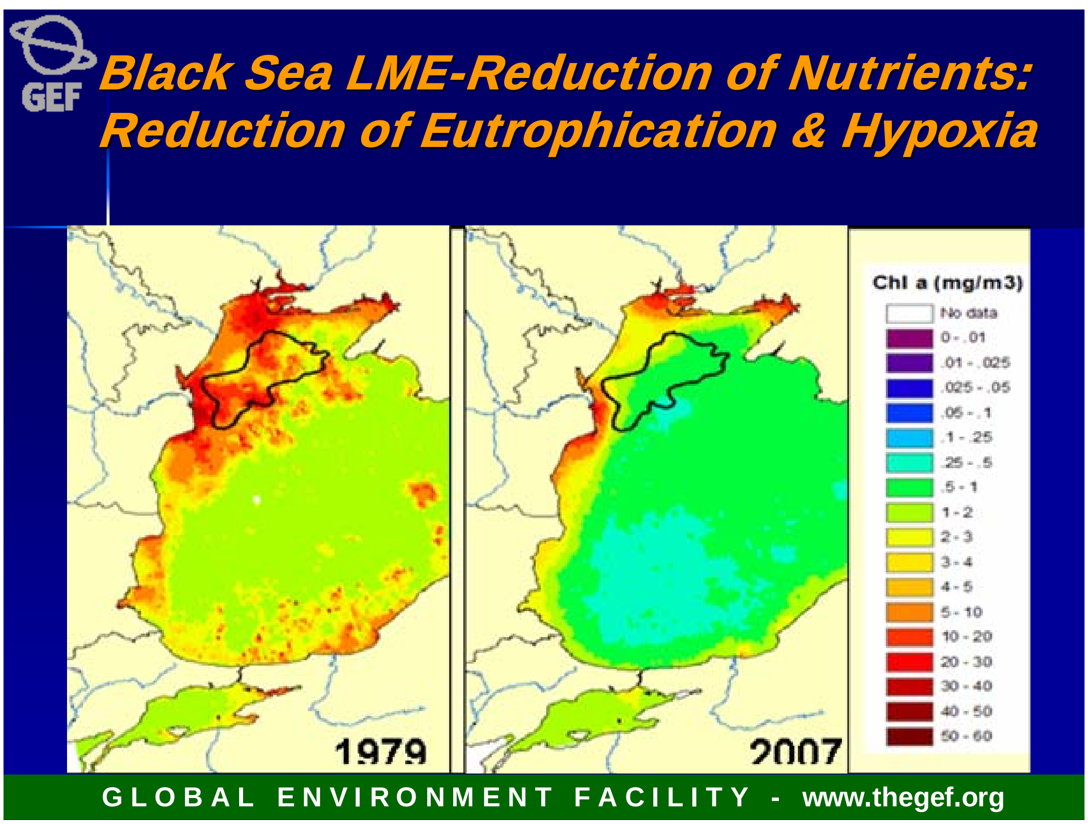
Figure 16. The BayStat is a powerful statewide tool designed to assess, coordinate and direct Maryland's Bay restoration programs, and to inform the citizens on progress. The Governor of Maryland chairs monthly meetings to review and track progress in the delivery of programs.



Danube/Black Sea Strategic Partnership for Nutrient Pollution Reduction

To address pollution from excess nutrients, and the associated eutrophication in the lower Danube and the Black Sea, the GEF Strategic Partnership on nutrient reduction was launched in 2001 in the GEF International Waters focal area with an initial commitment of US$95 million in GEF grants. 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 with the assistance of UNDP. The Partnership was composed of three components: The Danube River Basin Regional Project, the Black Sea Ecosystem Recovery Project, and a Partnership Investment Fund. The GEF-WB Investment Fund provides a focused regional framework for country-level investments aimed at a common goal of reducing nutrient pollution in the Black Sea and helping to jump-start and further accelerate key investments in sectors such as municipal wastewater, agricultural runoff, and industrial pollution. The intervention has yielded positive outcome for the region. For instance, in 2007, eutrophication has been reduced and the "Dead Zone" in the Western Black Sea has been virtually eliminated (**Figure 17**). Oxygen Levels were at near saturation in most areas. Moreover, the number of Benthic Species increased 1.5-2 times with respect to 1980 while invasive alien species (Mnemiopsis) has been significantly curtailed. Upper reaches of the Danube Basin is no longer considered at risk.

Figure 17. Efforts to reduce nutrient pollution in the Black Sea has resulted in the reduction of eutrophication and hypoxia.



OPEN FORUM

The Open Forum that followed the presentations highlighted the challenges in transboundary pollution reduction and the need for the following:

1. Political will, commitment and leadership to address pollution problems.

2. Interagency and multisectoral cooperation in the management of the river basin and coastal areas, including water management authorities, ocean management agencies, environmental protection agencies, the academe, the civil society and other concerned sectors are involved in the management of the bay. 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 real actions.

3. Appropriate legislation, regulatory framework and strong enforcement.

4. Establishment of environmental infrastructure, considering cost-effective technologies.

5. Long-term investments in environmental infrastructure, with strong institutional support. For transboundary pollution reduction, financial agreement, in addition to political agreement, is also important since participating countries or local jurisdictions may have different capacities.

6. Establishment of institutional arrangements, including appropriate bodies to oversee transboundary pollution reduction, such as the international commissions for the Mekong River Commission, Yellow Sea and Danube-Black Sea for cross-country pollution reduction. National or subnational commissions and alliances between levels of government and other stakeholders can also be forged for in-country pollution reduction.

7. Good coordination in monitoring, quality assurance and quality control and standardization of data.

8. Documentation of good practices and lessons, sharing of success stories and sharing of benefits.

RECOMMENDATIONS

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 or local governments 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 decisionmakers.

- 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).

- More active role of civil society in natural resources and wildlife conservation.

- Establishment of 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.

- Establishment of joint monitoring systems (including water quality standards and criteria) for transboundary river basins and coastal areas.