Journal of the Korean Society
for Marine Environmental Engineering
Vol. 6, No. 1. pp. 21~29, Feb. 2003

A Regional Approach for Integrated Coastal Management with Scientific and Local Knowledge

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Abstract

Fishing, aquaculture, coastal tourism and port activities in southern coastal seas are important to the Korean economy. Conventional strategies or quick-fixes may not be the best means of addressing coastal issues. Coastal issues in Korean coastal sea include harmful algal blooms (HAB), oxygen depletion, and sea grass disappearance. Regional coastal management plans have been developed during 2001~present after inauguration of Coastal Management Law in 1999. Activities such as eco-pioneer cities, pollution reduction, constitutional rearrangement, environmental regulation, monitoring indicators, and budgeting would be included in regional coastal management planning. The successful implementation of integrated coastal management is largely dependent on the engagement of government and non-government organizations to increase the chorus of concern. The need to involve coastal area residents in restoring activities was addressed with the creation of NGOs'Association for Masan Bay Restoration (NAMR). Several restoration efforts by NAMR are currently underway in Masan Bay coastal zone with scientific and local knowledge. A new level of dialogue was achieved suggesting a sustainable picture of Masan Bay coastal area regarding to a new port construction.

요 약

수산, 항만, 관광 등 남해 연안 바다의 이용은 지역경제의 중요한 부분을 차지하고 있다. 기존의 연안관리와 연안 환경 문제에 관한 일시적인 처방은 더 이상 유동성 적조, 산소결핍, 잘피 서식의 감소 등 연안 문제 해결의 방안이 되지 못하고 있다. 1999년 연안관리법이 통과된 후 2001년부터 현재까지 연안지역관리계획이 수립되고 있다. 연안지역관리계획에는 연안생태도시 구축, 연안오염물질 감소, 제도적 장치 개발, 모니터링 계획, 예산확보 등이 포함되어 있다. 연안역 통합관리의 성공적인 출발은 중앙정부와 지자체의 협조뿐만 아니라 지역의 NGO와의 조화로운 모색이 필요하다. 연안관리의 해역분류 중 특별관리해역으로 지정된 마산만 지역에는 마산만 살리기 시민연합이 조성되어 과학적인 정보의 제공과 지역 특수성에 부합될 수 있는 여러 가지 활동이 진행됨으로써 성공적인 연안통합관리의 실행이 가능해지고 있다.

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Keywords: coastal issues, integrated coastal management, NGOs' association.

1. INTRODUCTION

Activities relating to port, aquaculture, fishing, and coastal tourism are important sectors for Korean economy. The discharges of domestic and industrial wastewater are coming into the coastal seas even though most of wastewaters are treated. Coastal issues are pronounced when urban centers and industries are located along an enclosed bay. There are many islands scattered around southern part of Korean coastal sea, which gives the ideal conditions of natural habitat, aquaculture, and coastal tourism. Integrated coastal management should be an ecologically based, iterative process for identifying, at a regional scale, environmental objectives and cost-effective strategies for achieving them. Management actions need to be developed on the basis of the best scientific knowledge and local knowledge available about ecological functions as well as a comprehensive understanding of institutional framework. The main purpose of this paper is thus to explain the regional activities in various aspects of coordination mechanism by considering environmental issues, ecological characteristics and unique socioeconomic circumstances in the local area.

2. ICM activities within APEC

In most Asian countries, the importance of integrated coastal management (ICM) has been recognized and developed by international agencies or conferences. Within the Asia Pacific Region the use of the marine environment is essential to the economic viability of economies. Exchange of fisheries and aquaculture product is a major trading activity. Tourism is increasing and demands a clean and attractive environment. Recognizing that the marine resources are crucial to the economic and social well-being of the people in the APEC region, APEC established the MarineResource Conservation working group (MRC WG) in 1990. The MRC working group is continuing its effort to implement the Action Plan on Sustainability of Marine Environment to protect this collective resource, and to making dramatic progress toward a sustainable marine environment to ensure continuing socio-economic and environmental benefits. The APEC MRC WG concerns itself with the marine environment throughout the APEC region and the conservation of marine resources through maintenance of environmental quality and resource habitats. Of concern to the Working Group is the identification of sources of pollutants, particularly land-base sources, marine transportation of hazardous goods, degradation of ecosystem, and water quality-related threats to aquatic resources and their habitats. Human health, ecological damage and risk assessment, socioeconomic consequences of loss or damage to natural resources, and the need to maintain fisheries productivity and other natural resource values for the future are important considerations. Information exchange, scientific and technical cooperation and development of integrated coastal zone management approaches can provide mechanisms for APEC members to conserve their marine resources, protect their populations from contaminated seafood products, increase fisheries productivities, enhance trade, and realize their potential in coastal areas.

Agreements in the statement vision adopted by APEC WG on MRC in may 1993 are that: The approach will be to develop initiatives that complement the activities of other

organizations that have related goals, and build cooperative links with such organizations to enhance the effectiveness of activities designed to benefit marine environmental quality in the Region. The MRC WG provides policy guidance to ministers on issues of concern related to the conservation of marine resources and develops practical, action-oriented approaches to maintaining marine environmental quality.

The Objective of the Working Group is to promote initiatives in the APEC region that will protect the marine environment and resources there in, and ensure continuing socioeconomic benefits accrue through maintenance of environmental quality.

The MRC WG currently has projects in three principal areas:

(1) Red tides/harmful algal blooms
(2) Integrated coastal zone management
(3) Development of dialogue among multilateral organizations involved in implementation of the Ocean Chapter of UNCED (United National Conference on Environment and Development) Agenda 21, with a view to improving regional coordination of activities.

APEC member economies with inland seas are facing new problems of silting-in of harbors, decline of water quality, diminution of dissolved oxygen, and decline of aquatic life, because inland seas have been intensively used as ports, harbors and production fishery grounds. APEC member economies develop an ICZM structure that is uniquely suited to the region, to the nature of its coastal areas, to its institutions and their arrangement, and to its traditions, cultural and economic conditions. Thus, the MRC WG has developed projects to address coastal zone management over a range of scale: International Coastal Zone Management Policies and Activities, to address regional issues; and Integrated Coastal Zone Management Strategies, to review the diversity of approaches that APEC economies currently have to the management of their coastal zones. In addition to the above projects, the Workshop on Integrated Management of Semi-Enclosed Bays was conducted for sharing ideas and insights on ICZM approaches to assist in developing cost-efficient and effective policies, goals, and management actions in September 1996. The International Workshop on the development of APEC Mechanism for Integrated Coastal Management to develop a mechanism for coordinating the international activities relevant to integrated coastal management was held in September 2000. Workshop on Integrated Oceans Management in the APEC Region was held in Vancouver from 12 to 15 December 2000.

3. ICM activities in Korea

Korea has a relatively long coastline measuring 11,542 km, due to its intended coastal shape on the west and south coast. Presently coastal zone in Korea accommodates 50 commercial ports, 2,239 fishing harbors, 25 coastal cities, 22 industrial complexes, and about 33 percent of total Korean population (Lee[1999]). It is projected that by the year of 2005, more than 40 percent of total population and 50 percent of GDP will occupy the coastal zone by pursuing coast-oriented development policy.

The Korean government established the Ministry of Maritime Affairs and Fisheries (MOMAF) on 8 August 1996, while combined the ocean-related functions, including port & shipping, fisheries, marine environment, coastal management, and marine science and technology, of ten different government authorities in order to ensure consistent and effective marine policy(Hong and Chang [1997]). The Korean government has also taken a series of national initiatives to

establish an institutional mechanism of integrated coastal management(ICM). The enactment of 'Coastal Management Act (1999)' was one of major outcomes of Korea's efforts for integrated marine and coastal management as a national mechanism of implementing the principles of integrated coastal management. 'Coastal Management Act' stresses the importance of comprehensive and futuristic perspectives pursuing the balance among ecological, cultural and economic values of coastal zone.

Regional coastal management plans have been developed during 2001~present based on Coastal Management Act. Polices such as eco-pioneer cities, pollution reduction, constitutional rearrangement, environmental regulation, monitoring indicators, and budgeting would be included in regional costal management planning.

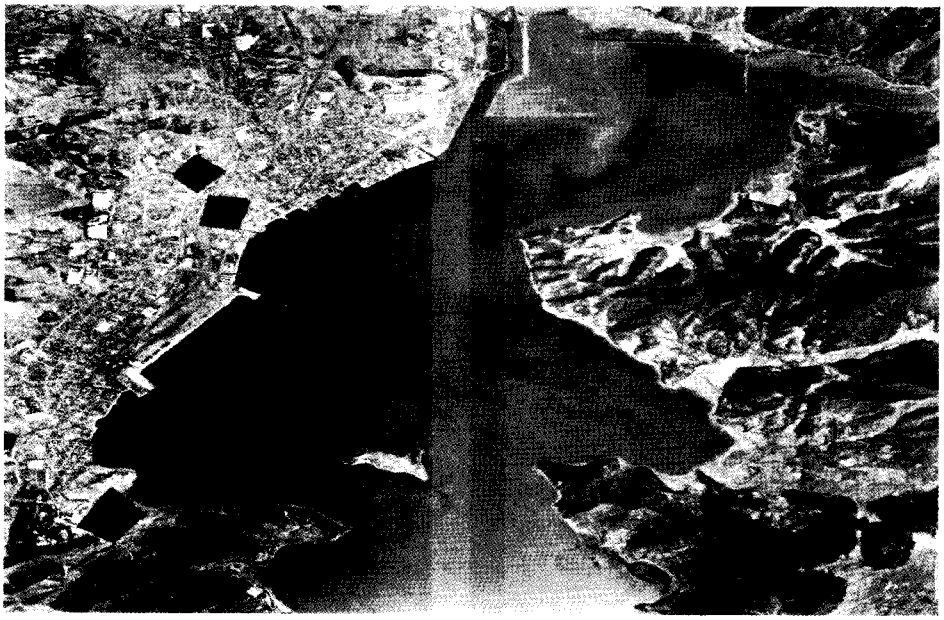
4. Integration between Science and policy

The human activities in the drainage of Masan-Chinhae bay have direct effects on the coastal water quality. The Masan-Chinhae bay was designated as a 'Special Management Area of Coastal Pollution' by the Ministry of Environment in October 1982. The bay is a receiving body for a 1,000 km^2 and a population of 1.2 million (1,200 people/km^2), while the population density of the Seto Inland Sea and the Chesapeake are 637 people/km^2 and 82 people/km^2, respectively. There are strong semi-diurnal currents with speeds of approximately 100 cm/sec along the deep channel at the bay mouth, while very weak currents of less than 10 cm/sec are observed in the inner bay where most pollutants generate. Thus, the physical parameters of this area result in pollutants being flushed only slowly and eventually accumulated. The sediments of the estuary and inner part of Masan Bay have been dredged since August 1990 as a decontaminated process with monitoring of water quality, sediment and biota. The total amount of sediment dredged by the end of 1994 was 2,111,000 m^3. Dredged sludge was used in the infilling of the outer Masan Bay. About $36 million have been invested for this dredging project, of which 70% of the investment was made by the central government and the rest by the local government. Data for the period of 1990~1999 monitored by a local university were used for the purpose of comparison before and after dredging.

An ICM pilot study has been carried out by Korea Ocean Research & Development Institute from 1994 to 1996 in one of the most polluted bodies on the south coast, Masan-Chinhae Bay. The Masan-Chinhae Bay has the area of 650 km^2 with the average depth of 5m in the inner bay and 25 m in the central part.

The reclamation caused a decline in the natural coastlines and shallows as shown in Fig. 1 The history of geographical changes appeared in Fig. 1 clearly depicts how the natural costal lines of Masan Bay have been disappeared. There is no green or park area along the straight coastal line. A total area of 25 km^2 is still used for shellfish culture in Masan-Chinhae Bay. Oysters and clams are major culturing species in this bay, however the productivity was decreased since 1989. In the communities throughout the bay, shellfish-culture related activities are still important components of the local economy.

The continuous influx of sewage and other wastes rich in nutrients like nitrogen and phosphorous to coastal waters have caused a severe and frequent red tide problem. The Masan Bay is surrounded by Masan City and Changwon City in which large industrial complexes have been built since 1970. Over the past two decades, the coastal waters of Masan Bay have been extensively used by



a) before reclamation(1967).

b) after reclamation(2002).

Fig. 1 Masan Bay before and after reclamation.

coastal communities and industries for the disposal of domestic and various industrial wastes. Nitrogen and phosphorous, the main sources of eutrophication had rapidly increased in 1985 and maintained above 1.0 mgL^{-1} as T-N(total nitrogen) and 0.03 mgL^{-1} as PO_4 P until 1995, respectively. The average phosphorus concentration of in the most inner part of Chinhae Bay (Masan Bay) ranged from 0.032 mgL^{-1} up to 0.055 mgL^{-1}. The lowest level of phosphorous in Chinhae Bay was 0.004 mgL^{-1} in winter. Red tides have been observed in Masan Bay through April to October every year since 1984. Pytoplankton density peaks during spring and summer, and decreases to the minimum during December and January. Dominant species varied from diatom to dinoflagellates such as Hetrosigma akshiwo, Prorocentrum spp., Gymnodinium spp., and Protogonyaulax spp., which produce paralytic shellfish poisonings. Though cell numbers have increased, a few species have been dominant with respect to yearly changes in composition of red tide organisms. Prorocentrum species are found during spring and Nitzschia pungens is detected all throughout the year except summer season. Skeletonema costatum peaks from spring to late autumn.

As a consequence of organics over enrichment, the bay's bottom water become depleted of dissolved oxygen(DO) each summer. Masan-ChinhaeBay displays a wide range of DO concentration. It ranges from anoxygen-deficit state in the bottom water to a supersaturating state in the surface water. In July and August, oxygen concentration decreases rapidly along depth and reaches under 1 mg/L in the bottom water. Without oxygen, almost all organisms are driven away or die. Even low DO conditions-hypoxia-severely stress bay animals. Only some members of Gaetice depressus species were caught in December 1994 during biological monitoring. The oxygen-deficit state was not improved in summer season regardless of Masan Bay dredging project. Sediments accumulated on the bottom of Masan Bay was not in condition to support a population of benthos during July and November. This observation indicates a residual effect of low dissolved oxygen formed in early summer season. That is, in the water column, hardly-traceable amount of organims was detected with a lack of diversity.

The runoff into the Masan-Chinhae Bay is an important factor contributing to deterioration in summer because the inflowing loading of suspended solids in the rainy season (it has the two-third of rainfall in summer) was four to fifteen times higher than in dry season (Lee et al.[1996]). When runoff increases, suspended solids concentration and particular form of phosphorus also increase. Phosphorus concentrations in bottom waters were higher than those in surface waters at all the sampling sites in Masan Bay. The analysis of sediments and nutrient-release study indicates that sediments in all areas of Masan Bay are contaminated with organics and these organic pollutants are released into water column, and the summer water does not appear to be mixed vertically and horizontally.

The water quality has been deteriorated as it goes from the mouth of bay to the upper part of bay through the water channel. It was found that the water quality of upper layer was generally bad due to incoming of pollutants through the upper layer of seawater and the occurrence of red tide in upper layer. Red tide was often observed in the field just after raining, which reflects the effect of nutrients input by runoff. A wastewater treatment plant started operation from November 1993 and the effluent from this plant has being discharged to this bay where is located at 15 km distance from inner Masan Bay. Thus the inflow pattern to Masan Bay has been changed. The change of input pattern was evaluated and the effect of a

large discharge (about 200,000 m^3/day) on seawater quality was determined by Lee et al.[1997]. Theaverage data point obtained from the station directly influenced by the discharge of primary effluent moved to lower salinity and higher concentration of contaminants in salinity-contaminant figure. They concluded that the seawater quality has being adversely affected by the discharge of insufficiently treated urban wastewater as shown and the nutrient removal in wastewater treatment was very important and urgent.

Existing wastewater treatment plant is now going through an expansion that is scheduled completed by 2003. A conventional activated sludge system has been designed for the expansion. There is no regulatory tool to apply for the proper control of nutrients. There is not yet water quality level standard or any area specific standards for ecologically sensitive aquatic environment. This causes more cost and deterioration of water quality in this already enriched coastal water until upgrading the treatment. This is a failure by ignoring the ecological characteristics and by no existence of management as a whole system. However, efforts of NGOs and acceptance of local government made a consideration of advanced treatment system in this expansion. The unique features of ICM include the integration of sea-use planning into coastal land-use plans, strengthening of local government capacity, creation of an institutional arrangement for interagency and multi-stakeholders consultation, harmonization of legislative requirements and enforcement, and the application of scientific knowledge and technology for management interventions (Chua[1999]). Critical success factors in establishing coastal management program were identified and assessed for the case of Masan-Chinhae Bay. Under the existing approach, coastal managers can neither link the water quality problem with land-use in the watershed, nor approach the problem of fisheries resources depletion in a comprehensive context of overfishing, pollution, and habitat loss.

Moving toward integrated coastal management requires a continuing effort to press forward on scientific, engineering, regulatory, and management frontiers. However, local governor and city mayor in this region have more concerns about new economic development opportunities. Users and owners of the coastal zone and its resources have tried to get more compensations from the destruction of nature and their resources. The key to success is involvement of all parties and demonstration that ICM is in the long term interest of as large a number of people as possible. Decision makers, coastal stakeholders, and the public should understand the seriousness of coastal problem, because coastal resource systems are valuable natural endowments that need to be managed for present and future generations.

The graduate school at the Kyungnam University currently offers one Master degree (Master of Integrated Coastal Zone Management) as one of interdisciplinary courses to develop human resources for coastal zone management. Kyungnam University is located at Masan City where intense human activities directly affect the most polluted bay (Masan Bay) in Korea. Faculties from six different disciplines teach graduate students. The master program provides high quality professional training for those wishing to enter a career in coastal management. Students participate in community projects as well as regional initiatives. 50% scholarships are provided through the graduate school program.

Local governments have substantial functions and responsibility for the interpretation and implementation of national policies. The successful implementation of integrated coastal zone management is largely dependent upon the engagement of government

and non-government organizations for increasing public's understanding and support of ecosystem restoration activities. The need to involve coastal area residents in restoring activities was addressed with the creation of NGOs' Association for Masan Bay Restoration (NAMR). Several restoration efforts by NAMR are currently underway in Masan Bay coastal zone to cleanse and restore the water bodies. This association mediated by the Coastal Resource and Environment Research Center in Kyungnam University. It secured the participation of delegated elected members of thirteen member NGOs. It is designed to reach the publics to ensure their participation and provide information about critical restoration issues. It gives the potential advantages of routine consultation on current and planned coastal management activities, and on the dissemination of technical knowledge. Co-ordination with central and local government promotes consensus building and delivers strategic management activities over appropriate timescale.

A new dialogue between government and NGO' association was achieved for the remediation or city development plan in this bay area.

5. CONCLUSION

In summary, the following conclusions for regional ICM can be derived from the knowledge of ecological characteristics and socioeconomic conditions in Masan-Chinhae Bay area:

1) ICM in Korea has been recognized and formulated through international conferences and APEC activities. The most important progresses in Korea were establishment of the Ministry of Maritime Affairs and Fisheries in 1996, enactment of Coastal Management Act in 1999, and planning of regional ICM during 2001~2002. 2) Relating to implementation of Masan-Chinhae Bay area ICM, NGOs started to play important roles in citizen involvement, mediating uses conflict, and providing scientific knowledge and local knowledge. 3) There is an ICM operating mechanism at regional level for promoting awareness of the concepts and practices of ICM, providing data and information, mediating and controlling conflicts among people, and enhancing the driving momentum to lead to success considering the unique coastal environment of Masan-Chinhae Bay.

ACKNOWLEDGMENT

The work is supported by the Kyungnam University Research Fund, 2001.

REFERENCES

[1] Chua T. E., 1999, Integrated Coastal Management: "An effective mechanism for local implementation of coastal and marine environment related international conventions", Proceedings of International Conference on Challenges and opportunities in managing pollution in the East Asian Seas, ed. by Chua and Bermas, 3~23.

[2] Hong, S. Y. and Chang, Y. T., 1997, "Integrated coastal management the advent of new ocean governance in Korea: Strategies for increasing the probability of success", The International Journal of Marine and Coastal Law, Vol. 12(2), 141~161.

[3] Lee, C.-W., Y.-T. Kwon, and Yang, K.-S., 1996, "Ecological characteristics of semi-enclosed bays", In Integrated management of semi-enclosed bays, ed. by APEC MRC WG., 151~173.

[4] Lee, C.-W., Y. T. Kwon, K.-S. Yang, P.-G. Jang, B.-J. Kim, and Han, S.-D., 1997. "Loading characteristics and environmental changes in closed coastal water", In Proceedings of the Korean Society of Marine

Environmental Engineering, Korea, 281~311.
[5] Lee, J. H., 1999, "Visioning Korean Coast in the 21st Century by Integrated Coastal Management", Ocean Policy Research. Vol. 14(1): 325~359.