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ICZM for Coastal Megacity: An Overview

Feril Hariati and Idi Namara
Civil Engineering Department, Enginnering Faculty, Ibn Khaldun Bogor University
K.H. Sholeh Iskandar Street Km. 2, Bogor, West Java, Indonesia

Abstract: The development of coastal zone can't be avoided today due to rapid urbanization from inland area to coast. Changing of land use from mangroves or coastal forest and wetland to human settlement had already happened in this recent year. Beach is the most preferable place for live and recreation, that provided sun, sea, and sand. It leads to the increasing of physical change of coastal zone. The life of origin coastal dwellers are become harder. In Indonesia, these community's life are depend on coastal natural resources as fisherman, salt farmer, and farm worker, but most of them had not had their own land. The development of coastal area might lead to the migrating and occupation changing of coastal dweller. The capitalist is taking over the managing of coastal natural resources. Climate change which associated with sea level rise, tidal wave and storm surge will lead their life more miserable A literate study was done to find out impact of coastal development to coastal environment, while field study in Muara Baru was done to find out the impact of coastal flooding. Fact finding shows that natural resources of Jakarta coast is being degraded and has an impact to 12,000 traditional fishers. ICZM should be implemented so as the development of Jakarta as Megacity will be in line with the goal of sustainable development of Indonesia. .

Key words: *ICZM, climate change, sea level rise, Muara Baru*

INTRODUCTION

Indonesia is an archipelago country, which consists 17,508 islands, more than 81,000 km coastline, and 62% from total territory (3.7 million km2) are sea. Upon recommendation of United Nations Convention on The Law of Seas (UNCLOS), Indonesia acquired jurisdiction over an Economic Exclusive Zone of some 2.7 million km2. With all these condition, the Indonesian coastline is potentially to be the largest and most important coastline in the world in terms of economic activity. Jakarta, which is located in north coast of Java Island, is the densest city in Indonesia and predicted became the 7th coastal megacity in the world in 2010 [**1**]. At present, Jakarta is the largest urban concentration in Indonesia and seventh largest urban agglomeration in the world [**2**]. The massive demographic and economic growth had led to environmental destruction and poverty concentration, especially along the north coast. According to Jakarta Province Government [**3**], thirty two percent from 16.24 million of coastal communities are the poor communities with income is less than USD 2 per day. They live in semi-permanent house; have limited access to health, education and social welfare system; and had to prepared themselves to be move out from their occupation as the land is over handled by the government at any time. To survive, they usually do the easiest way to find and collect coastal natural resources such as fish, coral, and firewood or timber by destructive fishing (poisoned), coral dynamite, and cutting off mangrove forest, and all these thing lead to environment degradation. Facing this situation, Jakarta's Province Government stated that poverty alleviation and preservation of the coastal environments are becoming critical issue for sustainable development. ICZM is becoming an effective tool to overcome this multi dimension problem. This paper will give brief explanation how ICZM can be applied to solve the problem of coastal megacities.

RESEARCH RATIONALE

Human population is the greatest threat facing the world's coastal zones. More people live along the coasts, the demand for land and recreation opportunities (including fishing) increase, and it will lead to coastal ecosystem degradation, such as damage of coral reef due to scuba diving, boat, pollution, and waste disposal. Coastal regions are also often exploited for transportation, energy, commercial fishing ventures, and offshore mineral extraction. Economics and population

Corresponding Author: Idi Namara, Civil Engineering Departement, Ibn Khaldun University, Sholeh Iskandar Street Km 2 Bogor Indonesia, +6281225135292

pressures have pushed such activities, especially as land alternatives have become scarce [**4**]. In most countries, coastal resources (coastal waters and beaches) are considered common property available equally to all citizens, with the government as 'trustee' [**5**]. This common property nature makes it impossible to exclude those who do not pay for using them, and as a result there is no incentive to conserve resources, and over-use and exhaustion can occur when utilization or harvest rates exceed the population growth rates of species or the ability of ecosystems to recover from disturbances. This condition will exacerbate already severe coastal-use conflict, in terms of land and water space and resource utilization. The negative impact of increased human settlement and industrial development are also more acutely felt in the coastal zone since it is receiving end of land-and water-based pollution.

Too often, traditional controls over the allocation and use of coastal space and coastal resources disintegrate when privatization and/or markets and associated societal behaviors contrary to traditional controls become prevalent [**6**]. Coastal zone also become subject of local, provincial and central government policy overlapping.

REVIEW OF RELATED LITERATURE

Coastal zone is the area within 100 km from coastline. It is an area where the lands meet ocean. Coastal zones, throughout the world, have historically been among the most exploited areas because of their rich resources. It had been estimated that half of total population in coastal country is live in coastal zones due to the increasing of migration from inland area to coast. Population densities in coastal region are about three times higher than a global average [**7**]. The average population density in the coastal zone has increased from 77 people per km2 in 1990 to 87 people per km2 in 2000. Current projection put this figure at 99, 115 and 134 people per km2 in 2010, 2025 and 2050 respectively. Nine of the world's 10 most densely populated cities are located in the global coastal zone. Five of these cities (Tokyo, Seoul, Shanghai, Calcutta and Bombay) are in Asia, while two (Sao Paulo and Buenos Aires) are in South America. Seven of the 10 most densely populated coastal cities are in developing countries. In some developing countries in Africa, coastal towns are by far the most developed urban areas and by implication, have high concentration of residential, industrial, commercial, educational and military facilities [**8**]. Not surprisingly, there is sharp conflict between the need for immediate consumption or use of coastal resources and the need to ensure the long term supply of those resources. In many countries this conflict had already reached critical stage with large part of coastal zone polluted from local or upland source, fishery degradation both of quantity and quality, wetland drained, coral reef dynamite, and reclamation to make a new beach for human enjoyment. To maintain and restore coastal resources, management system of coastal zone should be implemented plan

Jakarta: Toward Coastal Megacities

Jakarta is one of capital city in the world which is located in coastal zone area. With its coastline stretch along 32 km, Jakarta's coastline is becoming the most preferred place to live, to recreation, and to do a business. As a result, the development had already led to coastal degradation. According to spatial and zoning plan of Jakarta in 1995 to 2010, North Coast of Jakarta is destined as industrial, commercial and housing area. From total 154.01 km2, only 3.27 km2 or 2% from total area is provided as conservation area. The north coast of Jakarta itself stretched along 32 km from west to east and its part of North Jakarta City. There are five sub-district along The North Coast, Penjaringan, Pademangan, Tanjung Priok, Koja, and Cilincing, and population density reach 10,494 people per km^2.

Environmental problems along Jakarta's coast are various, such as salinity intrusion which had been reach 10 km landward, water pollution, and the most annoying is coastal flooding. Coastal and marine water in Jakarta had already polluted due to industrial waste and reclamation [**9**] and making of 12,000 traditional fisher's life become more miserable. Temperature measurement of coastal water surface in Harbour of Sunda Kelapa, Port of Tanjung Priok, Thermal Power of Muara Karang, and along of estuary, were reach 37^{o}C, which is as a result of hot water waste from boat and ship, industrial, and thermal water process [**10**]. Impact of hot water waste is thermal shock for marine biota. Not only from industrial waste, garbage also become source of coastal and sea water pollution (Fig. 1)

Figure 1. Garbage pile in Muara Angke (Source: ©2012 Merdeka.com/imam buhori)

Research in Muara Baru, one area in Penjaringan, was done to find out economic loss due to coastal flooding event. Since 2007 to 2010, it had been fifteen coastal flooding events in Penjaringan Sub-District (Table 1). Even though Jakarta's Province Government had already built a revetment along the Muara Baru coast,

but this coastal defense structure seems failed to protect the area behind. Table 2 shown economic loss of trading and manufacturing company in Muara Baru due to coastal flooding [**11**]

Table 1. Coastal flooding event in North Jakarta Coast **(**Source: Hudaya, 2012)

No	Date	Location	Depth of Puddle (cm)
1	August, 23 2007	Muara Baru	70 - 80
2	December, 23 2007	Muara Baru	50 - 80
3	June, 04 2008	Muara Baru	50 - 80
4	December, 01 2008	Muara Baru	60
5	December, 15 2008	Muara Baru	10 - 20
6	January, 11 2009	Muara Baru	20
		Marunda	40
		Penjaringan	10 - 15
7	January, 14 2009	Kapuk Muara	30 - 40
		Jalan Kapuk Raya	10-20
8	May, 14 2009	Muara Baru	10-20
9	October, 22 2009	Muara Baru	10 - 100
10	November, 05 2009	Marunda	60 - 80
11	December, 04 2009	Jalan RE Martadinata	20 - 40
12	January, 30 2010	Jalan RE Martadinata	5-10
13	March, 13 2010	Muara Baru	197 cm
14	June, 16 2010	Jalan RE Martadinata	40-50
15	June, 25 2010	Muara Baru	40 - 50

Table 2. Economic loss due coastal flooding (Source: Hudaya, 2012)

No.	Company Name	Main Production	Flood Duration (days)	Puddle Depth (cm)	Distance from coast (m)	Amount of Loss (in million Rupiahs)
1	PT. Kemasan Jaya Makmur	Machinery	5	50	300	150
2	PT. Inti Sumber Lestari	Warehouse	5	50	300	30
3	PT. Indochemical	Chemical manufacture	5	50	200	130
4	PT. Maju Selaras	Packaging	5	50	200	10
5	PT. Adi Guna	Machinery	5	50	200	100
6	CV. Ciheng	Workshop	5	50	150	20
7	PT. Nindya	Shoes factory	7	50	100	200
8	PT. Angka Niaga	Warehouse	7	100	100	20
9	PT. Perikanan (persero)	Fish packaging	5	100	100	30
10	PT. Multi Karya	Ceramic warehouse	5	50	100	20
11	PT. Sumber Makmur	Fodder Manufacturing	10	100	50	200
12	PT. Alam Jaya	Spare part	6	50	100	100
13	CV. Sinar Bahari	Machine packaging	7	50	200	50
14	CV. Agung Perdana	Shipment	7	50	150	100
15	PT. Nirwana Alam Jaya	Printing	5	30	300	30
16	PT. Subur	Textile manufacturing	5	30	300	200
17	PT. Dexta	Warehouse	6	50	150	50
					Total	1,440

Integrated Coastal Zone Management

Those are various definition of ICZM. From literate study, the definition of ICZM is as follows:

1. ICZM is a resource management system which employs an integrative, holistic approach and an interactive planning process in addressing the complex management issues in the coastal area [**12**]. Planning is usually included in the concept of management in ICZM

2. Integrated Coastal Zone Management (ICZM) is a process of governance and consists of the legal and institutional framework necessary to ensure that development and management plans for coastal zones are integrated with environmental (including social) goals and are made with the participation of those affected. The purpose of ICZM is to maximize the benefits provided by the coastal zone and to minimize the benefits provided by the coastal zone and to minimize the conflicts and harmful effects of activities upon each other, on resources and on environment [**13**]
3. The OECD stated that the overall purpose of ICZM is to maximize the benefits provided by the coastal zone and to minimize the conflicts and harmful effects of activities upon each other. Its goal has been defined as the production of the optimal mix of products and services from a coastal system, with 'optimal' being the mix that results in maximum social benefit (OECD, 1993). ICZM focuses on the interactions between activities that take place within the coastal zone and activities in other regions. It can guide the sustainable development of coastal areas by reducing the degradation of coastal ecosystems, providing a common framework for the management of multi-sectoral activities, and maintaining options for future uses of coastal resources [**14**]
4. Integrated coastal (area) management can be defined as a continuous and dynamic process by which decisions are taken for the sustainable use, development, and protection of coastal and marine areas and resources. ICZM acknowledges the interrelationships that exist among coastal and ocean uses and the environments they potentially affect, and is designed to overcome the fragmentation inherent in the sectoral management approach. ICM is multi-purpose oriented, it analyzes and addresses implications of development, conflicting uses, and interrelationships between physical processes and human activities, and it promotes linkages and harmonization among sectoral coastal and ocean activities [**15**]

From definition above, we could say that ICZM is multi sectoral activities. Hence, theoretically, in Integrated Coastal Zone Management a wide number of sciences are involved, including Law, Oceanography, Sociology, Economy, Regional Planning, Traffic Planning, Geology, Geography, Physics, Biology, Ecology, Chemistry and Coastal Engineering [**16**]. As coastal engineer, writers would like to criticism how ICZM should be implemented for Jakarta's coast from the point of view coastal engineering as important issues of Jakarta in this recent year are giant sea wall and reclamation. The purpose of the giant sea wall development is to overcome coastal flooding problem and the reclamation is to provide extra land to developed Jakarta Waterfront City (Fig. 2)

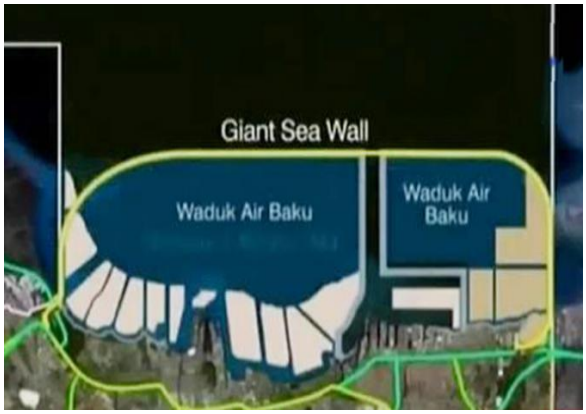

Figure 2. Reclamation plan of Jakarta Coast for Waterfront City and construction of Giant Sea Wall (source : http://news.liputan6.com/read/2494970/ video-tanggul-raksasa-jakarta-diintegrasikan-dengan-reklamasi)

The questions are:

1. Are giant sea wall and reclamation the only answer in dealing with coastal flooding and land limitation for Jakarta?
2. Does the plan to build giant sea wall and reclamation become part of programs which are recommended in the ICZM framework?

Principally, coastal nation should have ICZM structure which is uniquely to that nation, to the nature of coastal area, its institutional and governmental arrangement, and its tradition, culture and economic condition. In Indonesia, ICZM concept is stated in Act No. 27, 2007; Coastal Zone and Small Island Management, Ministry Regulation No. 16, 2008; PWP-3K Plan ((Pengelolaan Wilayah Pesisir dan Pulau-Pulau Kecil), and Ministry Regulation No. 17, 2009; Conservation Zone in Coastal and Small Islands.

In Act No.27, 2007, reclamation is legal action. It stated that reclamation in coastal zone and small islands can be done in purpose to increasing the utilization of the area from technical, environmental, and economic aspect. Reclamation has to maintain and concern to livelihood sustainability of community, balancing between utilization benefit with environment conservation concern, and should follows technical specification for reclamation work. But, if we review Spatial Planning of Jakarta City in 2030 (Fig. 3), the reclamation area will be used as housing, office, trading, service, industry, and warehouse area.

In Act No. 27, 2007, local government also had to define the demarcation line of coastal area. The demarcation line has function as coastal zone protection from:

a. Earthquake and/or tsunami
b. Erosion or abrasion
c. Storm, flooding, and other natural disaster
d. Gives protection to coastal ecosystem
e. Manages public access
f. Manage water and waste water channel

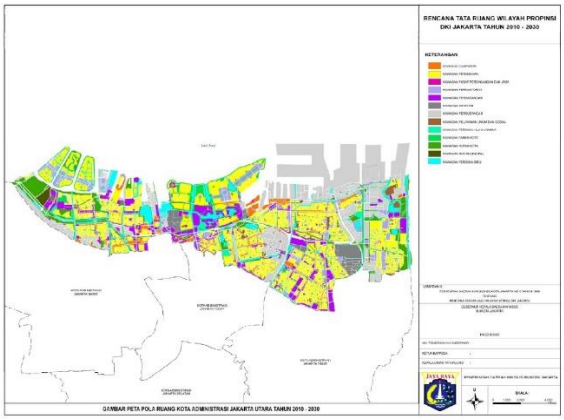

Figure 3. Spatial zone planning of North of Jakarta in 2030 (Source: Pemerintah Daerah Khusus Ibu Kota Jakarta)

From this statement, the development of sea wall is not feasible. The construction will change the wave propagation and impact the adjacent beaches. Since littoral system is interconnected, what is done on one stretch of beach can have significant impacts on nearby beaches. The impact is related to the coastal processes of the area, in particular the long-shore sand transport rate. Long-shore sand transport along beaches can extend for many miles. Inlet shoals are part of the same littoral system as the adjacent beaches if sand can move from the beaches to the shoals and vice versa.

Coastal structures by themselves can only function to redistribute the sand that is in the littoral systems. They do not create sand. Seawalls, bulkheads, and revetments protect the land behind the wall, not the beach in front of the wall. There is little clear evidence that seawalls actually cause erosion, except for the impact of the reduction in sediment available for the littoral system if the shoreline erodes to the seawall. However, a seawall constructed on a beach that is receding for other reasons, the usual site for a seawall, will contribute to loss of beach. So to solve a coastal flooding problem, Local Government of Jakarta should be considering in utilizing the demarcation line to protect the coastline.

In the other hand, Act No.27, 2007 also mention a right to undertake coastal water for Indonesia citizen, corporation, and local community. This will change the regime of coastal and sea resources management from common property right to private property right.

DISCUSSION

Managing coastal in coastal megacities is facing various obstacle. Conflict of interest between conservation and economic development is becoming a boundary in implementing ICZM, even though the legal framework in managing coastal had been issued. Indeed, the legal-jurisdictional boundaries are often proposed by politicians and decision-makers who, in most cases, adapt legislation to their own interests [**17**]. And this not only happen in Indonesia, but mostly coastal megacities. Climate change which is associated with sea level rise and increasing of extreme climate disaster related, such as storm, heavy rain that can caused coastal flooding will make life of coastal dwellers more difficult. The need of protection is the most important to do. In ICZM framework, coastal management is managing a coastline in such a way that the policy of ICZM can be executed. Thus: maintaining the coastline at those points where it is necessary, but also a (controlled) retreat of the coastline in those places where maintaining the coastline position is not absolutely necessary. The technical means to maintain a coastline vary considerably. Both of soft measures (artificial beach nourishment) or hard measures (beach walls and revetments) can be considered. There are many type of coastal protection structure. Each had its own function. According to SPM [**18**], there are four major coastal problems and each has a type of coastal protection measure to be implemented. Detail of coastal problem is shown in Figure 4.

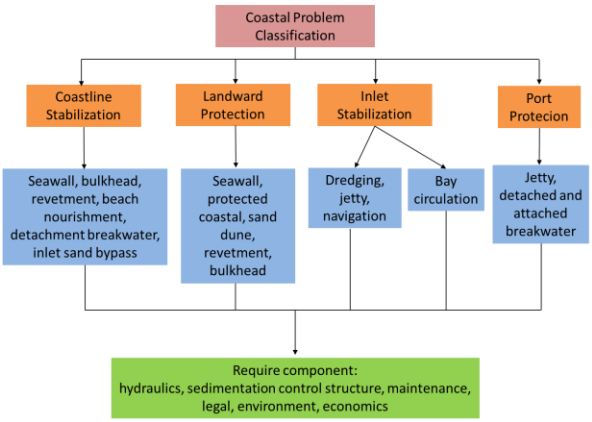

Figure 4 Coastal problem classification

Considering the climate change, adaptation scheme should be considered the worst condition base on the condition of the rise of sea level due to climate change, wind set up, wave set up/run down and tidal fluctuation. To avoid maladaptation, height of coastal protection structure should be accomodate the sea water level in the future. The component of sea water level for current and future condition is shown in Table 3.

Table 3. Component of sea level for current and future condition

Current	Future	
	Source	Result
Mean Sea Level	Sea Level Rise Scenario	Future Mean Sea Level
Mean High Water Level (MHWL)	Increasing of cyclone intensity (assumed 20%)	Wind Set-Up
Highest High Water Level (HHWL)		
Significant Wave Height (Hs)		

Significant wave height is important parameter to determine of wave run-up value, which is the rise of water level when wave approaching the beach or structure. Meanwhile, wind set-up is the rise of water level during cyclone event. In determining the adaptation scheme, each sea level component should be take into consideration.

Table 4. Adaptation scheme base on sea water level

Adaptation Scheme	Sea Level Component					
	Mean Sea Level	Mean High Water Level (MHWL)	Highest High water Level (HHWL)	Significant Wave Height (Hs)	Future Mean Sea Level	Wind Set Up
Permanently Innundation Area	x				x	
Demarcation Line of Coastal Zone	x		x		x	
Coastal Protection Structure	x	x		x	x	
Coastal Hazard Protection	x	x		x	x	x

CONCLUSION

In coastal megacity, conflict of interest in coastal zone utilization cannot be avoided. Within ICZM framework, economic value and environmental value of coastal should be regulated in balancing to meet the goal of sustainability development. Case study in Jakarta, the need to expand the land for house and economic activity zone in seaward direction is become the Jakarta's Province intention to increase its local income. Mostly coastal dweller is protest against this plan, especially the fisher and the community who depend their life from coastal resources. But the development should be obtained and according to regulation it is legally. Role of ICZM in this case is how to minimize the impact of reclamation and construction of coastal structure as giant sea wall. Detail engineering design, which is include Environmental Impact Assessment, should be conduct, within the ICZM framework, where multi discipline of science, multi sectoral, and stakeholder, involved in making the decision.

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