Asian Journal of Scientific Research

ISSN 1992-1454

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OPEN ACCESS Asian Journal of Scientific Research

ISSN 1992-1454
DOI: 10.3923/ajsr.2016.13.23

Research Article
Jakarta North Coast Development Impact on Fishery Activities

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Abstract

Jakarta is the most important megapolitan city for Indonesia with northern part facing to the Jakarta bay as fishing ground for small-scale fishermen coast so that could provide real added value to the economy and local communities. Now-a-days, Northern coast of Jakarta has undergone some of the most drastic changes over the last in few decades. The Jakarta waters in state threatening for the sustainability of the marine environment. It is crucial to apply a research which arms the impact of coastal development to the fishery activity, to optimize the fishery resources that have been found and to arrange the follow up strategic of coastal resources management. This study has been conducted utilizing environment monitoring result in Jakarta Bay. The methodology applies Driver Pressure State Impact Response (DPSIR) approach to analyze the factors which can cause the pressure to the coastal ecosystem and representing the analysis and identification of the environment data using Geographic Information System (SIG). The results show that in terms of demography and socio-economics indicator in Jakarta, there is significant increase in population from 1,137,211 in 1998 to be 1,182,749 in 2004. The density of 7,486 km^{-2} in 1998 increases to 8,475 km^{-2} in 2004. The rate is the highest in Jakarta (2.09% per year). Those increasing changes bring implications for the environment, such as conversion of land use, increased water consumption and environmental pollution. In terms of environment indicator, there has been a change in land use during the period 1998-2004, from total area 16,529,0 in 1998 become 16.579,3 in 2004 deteoriting function of many fields and shrunk the extent of the reservoir. Applying six chemical parameters used in this study: pH, DO, PO_4, NO_3, NH_3 and salinity infers the condition of marine environment unsuitable for marine life. The area classified as suitable fishery category is 36,256,4 ha in 1998 and in the contrary it falls significantly into 23,993,2 ha in 2004 but 21,277,0 ha remain is in the category of unsuitable. Using DPSIR methods, the study recommends: (a) Designing programs that encourage the creation of power employment and reduce migration, community of understanding for important coastal ecosystems, and regulation of residential land, (b) Regulation to expanding industrial at outside and industry-environmental friendly and (c) Regulation on domestic and industrial waste, development in environmentally bases and allocation protection area as buffer pollution.

Key words: Jakarta North-coast, fishery activity, threatening marine environment, driver pressure state impact response, sustainable

Received: October 22, 2014 **Accepted:** October 17, 2015 **Published:** December 15, 2015

Citation: Supartono, J. Haluan, M.F.A. Sondita and Manuwoto, 2016. Jakarta North Coast Development Impact on Fishery Activities. Asian J. Sci. Res., 9: 13-23.

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Jakarta is the most important city for Indonesia as the state capital and economically very valuable because it can provide real added value to the economy and local communities. Jakarta has the largest concentration of urban population in the country with approximately 9 million residents living in an area of 662 km^2 (Hosono *et al*., 2011).

The Jakarta Bay is located in the northern of Jakarta. It is a shallow bay, with an average depth of about 15 m, an area of 514 km^2 and a shoreline about 72 km long. In the Eastern and Western sides, the bay is bounded by two capes: Tanjung Karawang and Tanjung Pasir, respectively.

Jakarta Bay is important for a number of human activities which contribute significantly to the economic development of the region. However, the high population growth rate, together with the expansion of Jakarta during the second half of the 20th century, have led to the serious pollution and over-exploitation of coastal and marine resources, thus threatening the sustainability of the marine environment. Within Indonesian coastal waters, Jakarta Bay has undergone some of the most drastic changes over the last in few decades (UNESCO., 2000).

The Jakarta Bay also serves as fishing ground for small-scale fishermen with some particular fishing gears operating in the area, such as stationary liftnet, gillnet, traps and hook and line. The fishery production in the Jakarta Bay was primarily dominated by demersal fish caught by gears described above. The demersal landings account for more than 50% of the total landings of the Jakarta areas. The demersal fish such as groupers and red snapper are considered as highly economic fish in the market (Suzy and Fauzi, 2007).

North Jakarta is the only area which has a beach, therefore, most of this area is coastal ecosystem. This ecosystem bears a heavy burden, as well a variety of economic activities, development and community activities in the upstream region lead to the beach area. Along that waterways, land uses are dominated by anthropogenic activities, for instance industry and housing. As a consequence, the river systems receive numerous influx, include heavy metal. Thus, the North Jakarta accommodates the pollution load from the Jakarta area and the upstream areas such as Puncak, Bogor, Depok ends up in Jakarta Bay. Several major coastal rivers transporting sediments, sewage, agricultural and industrial effluents and solid waste flow also into Jakarta Bay. Those have resulted in increasing nutrient levels and eutrophication of coastal waters extending over a considerable distance as far as the Java Sea. Takarina *et al*. (2008) reported Cr, Cu, Pb and Zn in sediments of river Angke, Ciliwung, Sunter, Cakung and Bekasi values have exceeded the Canadian standard for contaminated sediments. The recorded values were 24-290, 63-157, 28-198 and 150-910 ppm, respectively.

Nutrient concentrations have increased in Jakarta Bay since 1969 (UNESCO., 2000). High nutrient concentrations have been identified as the main cause of increased primary productivity in the surface waters as well as reported by Nontji (1997) that chlorophyll a concentrations ranged from 5.41-12.3 mg m^{-3}. Jakarta's Office of Urban Environmental Study reported in 1997 that the heavy metal content (copper, lead and mercury) in Jakarta Bay waters had been increasing since 1983. Otherside, the water drainage system in the Jakarta Area is degraded. A third of Northern Jakarta is flooded on average twice in a year. This situation, which seriously affects 5% of the city, is exacerbated in some areas by subsidence Jakarta Bay can be considered as one of threatened marine ecosystems (UNESCO., 2000).

Noronha *et al*. (2002) suggested that the pressure on coastal ecosystems is an outcome of population growth, the main activity of society (economic and social), macro and sectoral policies and globalization. In their model, Noronha *et al*. (2002) suggested that the greater the growth in population, more active and varies public activities, macro policies are less in favor of the preservation of the environment and also the impact of globalization will increase the pressure on coastal ecosystems.

Currently, the Northern coast of Jakarta accommodates a variety of economic activities that directly or indirectly provide significant pressure on the degradation of ecosystems and biophysical. The activities vary from industry, ports, tourism, fisheries and settlements. In addition to biological effects, such activity also has economic impact on some people, especially fishermen who depend on the availability of fish resources in the waters of the northern coast of Jakarta. Decreasing in support of fishery resources causes most fishermen can not obtain adequate catches. At the end, these communities are gradually forced to switch and seek another livelihood.

This study aims to analyze the factors which can cause the pressure to the coastal ecosystem from the perspectives of environmental and socio-economic indicators to revitalize the fishery threatening resources; and to set up the follow up strategy to coastal resources management in the future.

MATERIALS AND METHODS

Research on the environmental impact is complex because it must take into account many contributed variables

Table 1: Indicator type of development impact against the Jakarta coastal resource conditions

Focus evaluations	Indicators
Characteristics of coastal zone	Percentage of population living in coastal areas, density and growth
	Coastal habitats: coastal area, mangrove forests, coral reefs, sea grass
	Changes in coastal land use
	Total area of protected beaches
Biodiversity	Percentage of area of land vegetation cover
	Surviving species in coastal habitats
	Changes in the composition and number of benthos
	Endangered species composition
	Pressure habitat and ecosystem structure
Number of tourists visiting	Travelers density per kilometer
Fishery	Total fishery catch per year, either for commercial or tourist
	Number of by catch
	Changes in the composition of tropic
	over fishing status
	Seafood quality (contamination)
Water quality	Physical parameters: salinity, turbidity, sedimentation and pH
	Solid waste parameters: accumulation at the beach, in the sea discharges
	Eutrofikasi parameters, nutrient conditions, dissolved oxygen
Shipping	Total shipping vessel traffic
	Ratio of equipment in the port
Oil and gas	Tanker traffic
	Frequency of oil spills
Global process	Changes in seawater temperature
	Changes in sea level

Source: Fauzi and Bachary (2002)

or factors. Therefore, efficient and sophisticated instruments are required to manage a lot of data in order to see the impacts on the condition of natural resources can be quantified (Fedra and Feoli, 1998). Impacts occurring in coastal environments can be studied by applying Geographic Information System (GIS), Image Processing System (IPS) and Remote Sensing (RS). Geographic Information System (GIS) is a set of computer system capable of capturing, manipulating, processing and imaging of data or geographic spatial. By using GIS technology, it is possible to integrate all methods and equipments that can be used as a tool for decision-making (Decision Support System/DSS) to problems spatially related. As the DSS for the management of natural resources, the GIS can be used also as a tool to improve planning and decision-making by providing useful and scientific information for all parties involved in the management of natural resources.

Analysis performed includes: (1) Analysis of land use on the northern coastal of Jakarta for the port designation, industry, tourism, residential and conservation and (2) Analysis of the characteristics of demography and socio-economics.

Types of indicators used to assess the impact of development on coastal resource refers to Integrated Coastal Management (ICM). Changes in the condition of coastal resources include environmental parameters and socio-economics. Environmental characteristics is portrayed by the condition of coastal land planning, biodiversity, tourism, fisheries, environmental quality fisheries, vessel traffic activities, exploration oil and activities and global processes (Table 1). The impact of development on the socio-economics condition of the community represents the living conditions of the population of the shore, the quality of life in the coastal zone, needs and provision of services, tourism and recreation and economic opportunities (Table 2).

Analysis of the various indicators mentioned above focus on assessing the contribution of the construction of the coastal areas of Jakarta on society and the impact of development on the fisheries resources and ecosystems.

The data was collected into two groups, namely the statistical data at the end of the year 1998 and 2004. Two data were chosen as reference in accordance with the layout plan which have been made by the city government in 1999 that compiled spatial plan for the period 2000-2005. Thus, comparison of the two datasets will produce pictures of the changes that occur in the coastal ecosystems and Jakarta socio-economic coastal communities.

Aquatic environment biophysical parameter data are obtained by sampling at 30 stations elected representatively (Fig. 1). Environmental conditions are evaluated by comparing the results of measurements of environmental parameters on environmental quality mentioned in the Environment Ministerial Decree number 51/2004 (Ministry of Environment Republic of Indonesia, 2004).

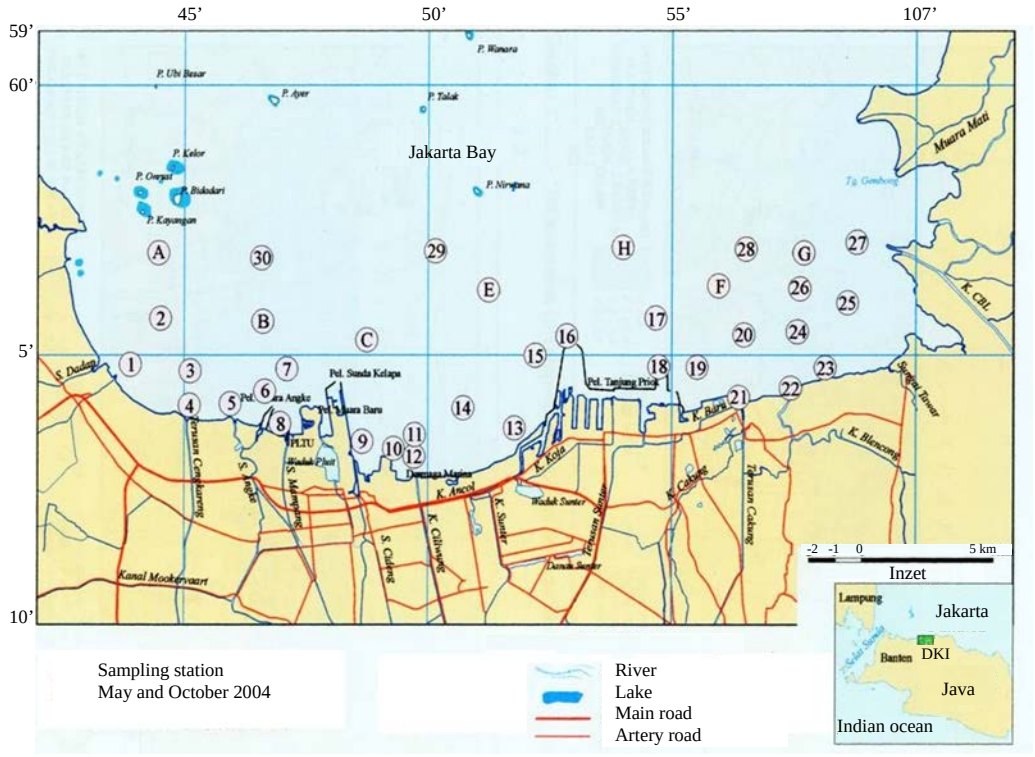

Fig. 1: Field study and sampling stations in May and October 2004. Characters refer to turbidity, visibility and surface temperature and numbers for chemical parameters such as pH, DO, PO_4, NO_3, NH_3 and salinity

Table 2: Indicators used to assess the development impact on social and economic conditions of Jakarta

Focus evaluations	Indicators
Population	Density and population growth
Quality of life in the coastal area	Unemployment rate
	Public perception of the quality of the coastal environment
	Population age structure
Public information and awareness	Public awareness of the issues in coastal areas
	Public awareness of sustainable development issues
Facilities and infrastructure	Education
	Health
	Housing
	Clean water and sanitation
	Electricity/energy
	Roads
	Telecommunications facilities
Tourism	Number of people working in the tourism sector
	Role of the tourism's economy
	Number of tourists
Fishery	Total catch by type of fish
	Percentage of household income sources of fisheries
Coastal communities development	Environment and land use
Public participation	Growing diversity of economic activity
	Public investment and infrastructure
	Number of people participate in Integrated Coastal Management (ICM)
	Industrial involvement in ICM

Source: Fauzi and Anna (2002)

This study uses the analytical framework of integrated social and ecological as has been done by Noronha *et al*. (2002) with Driver Pressure State Impact Response (DPSIR) approach to analyze a number of factors contributing to the pressure on coastal ecosystems in the region of Goa, India.

RESULTS AND DISCUSSION

This study uses two main indicators to assess the impact of development and community activities on the condition of coastal ecosystems North of Jakarta. The major indicators include demography and socio-economics and the environment quality.

In terms of demography and socio-economics parameters, population growth has occurred in the period 1998-2004 (Table 3). The population of North Jakarta for the period 1998-2004, growth of 0.67% per year, namely the 1,137,211 people in 1998 increase to 1,182,749 people in 2004. The population density increased from 7,486 people km^{-2} in 1998 to be 8,475 people km^{-2} or growing about 2.2% per year. It is higher than the population growth at other areas in Jakarta (2.09% per year). However, the population density of North Jakarta is the lowest compared to other regions. The trend indicates that the North Jakarta become increasingly attractive region for migrants. This shows the increase in the proportion of migration to North Jakarta in 1998 (7.35% of the total migration to Jakarta) then multiply into 17.25% in 1999 (CAS., 1999).

Like most urban areas, the structure of livelihoods in Northern Jakarta also dominated by industry, trade and services. More than half of the workforce in North Jakarta work in the manufacturing sector (29%), trade (34%), services (18%) and transport and communications (10%). Agriculture and fisheries are a small contribution in the sector of employment. In the period 1998-2004 (Table 4), the contribution of agricultural employment fell from 4-0.66% (CAS., 1999, 2005).

Livelihood structure is in line with its contribution to Gross Domestic Product (GDP). For the period 1998-2004, North Jakarta Municipality GDP is dominated by the processing industry (51%), trade (15%), transportation and communication (14%). In the same period the agricultural sector's contribution turns decreased from 0.27-0.35% (CAS., 2005).

Population growth and industrial development along the coast have greatly influenced pollution loads into coastal marine environment. Land-based activities are major source of pollution in the coastal waters in Indonesia (Arifin *et al*., 2012). The contaminant from anthropogenic and natural source flows through the river run off and its accumulate in coastal waters. The pollution has contributed significantly to the falling catches of the coastal fishing (Suzy and Fauzi, 2007). Jakarta Bay a semi-enclose bay, in the present can be considered as one of threatened marine ecosystems (Takarina and Adiwibowo, 2011).

The rate of population growth in North Jakarta municipality implies the attraction for migrants to settle in North Jakarta, as well as for other cities. Population growth in North Jakarta is triggered by a variety of factors, including the growth of economic opportunities in trade, industrial development, new residential developments in various locations, as well as the seasonal migration patterns of fishermen. The rapid population growth in residential building carries implications for the environment, including the

Table 3: Demographic conditions in North Jakarta

	Demographic conditions	
Variables	1998	2004
Population	1,137,211	1,182,749
Population density	7,486	8,475
Number of households	293,071	315,238
Migration out	1,041	No data
Migration log	No data	No data

Source: CAS (1999, 2005)

Table 4: Total population in North Jakarta municipality based on livelihoods

	Total population				
	1998		2004		
Business field	Total	Percentage	Total	Percentage	Exchange (%)
Agricultural	10,843	4.00	4,079	0.66	-3.34
Industry	42,452	15.67	182,351	29.72	14.05
Building	15,389	5.68	16,111	2.63	-3.06
Trading	57,790	21.34	213,529	34.80	13.47
Transportation and communication	14,240	5.26	62,052	10.11	4.86
Finance dan banking	7,065	2.61	17,833	2.91	0.30
Government	56,551	20.88	6,296	1.03	-19.85
Services	60,202	22.23	108,479	17.68	-4.55
Others	6,306	2.33	2,803	0.46	-1.87
Amount	270,838	100.00	613,533	100.00	

conversion of land use, increased water consumption and environmental pollution as a result of the increase in domestic waste. Thus, the condition of housing is one factor will trigger a negative impact on the quality of fishery resources (Jakarta Regional Government, 1998).

This shift indicates that agriculture and fisheries activities are highly dependent on the availability of natural resources considered no longer economically viable, hence, the transition of land uses were originally used for agriculture and aquaculture (ponds) into buildings or industry.

The high contribution of manufacturing sector to the economic conditions of North Jakarta municipality carries various implications on the environment, including the pollution of the environment as a result of the increase in industrial waste. Then the economy becomes one of the triggering factors that will have a negative impact on the quality of fishery resources.

The decrease in water quality and coastal ecosystem is directly or indirectly a result of development in land area and population activities. Population growth has been pressed ecosystem function through land requirements and the buildup of waste, both industrial waste and domestic waste.

The negative impacts can occur due to coastal development in Jakarta Bay more oriented to the interest of land, than in the appellate of waters. Then the development undertaken is in the form of reclamation for buildings, expansion port or Ancol tourist beach and not to improve water quality. Annihilation of coastal plant that is very influential in aquatic ecosystems such as mangroves are unavoidable in the land-oriented development. Though the existence of mangrove vegetation is not only important for the breeding of fish but will also affect the dissolved oxygen content and control of chemical compounds that determine as ammonia, nitrate, nitrite and phosphate.

Nitrogen compounds such as ammonia and nitrate and phosphate compounds is a necessary nutrient in the water. However, the absence of buffer zones in coastal/beach such as mangrove forests, makes the nutrients entering the water body intensively through the river until it reaches levels more than necessary. Excessive enrichment of nutrients required by phytoplankton can cause eutrophication that cause algae bloom. Sudden death of fish in large quantities which sometimes occur in the Bay of Jakarta, is caused by the algae blooming phenomenon. With coastal development that does not take into account the interests of the waters, the possibility eutrofikasi will be more frequent.

In terms of environment indicators, there has been a change in land use during the period 1998-2004 (Table 5). These changes occurred in the form of land for port expansion, settlement and others.

This change has pressed the function fields and shrunk the extent of the reservoir. In the period above, there is no change of land for conservation (296 ha). This is related to the city's regional government policy that maintains the function of conservation as embodied in the Jakarta Regulation No. 9 of 1999 on the Jakarta Spatial Plan (Jakarta Regional Government, 1999).

Conditions in the coastal waters of northern Jakarta showed a decline in quality, viewed from 3 physics parameters namely turbidity, visibility and surface temperature (Table 6).

The parameters turbidity and surface temperature shows are near limits. High turbidity concentrations indicate the existing particles in the waters which led to the low penetration light gets into the waters. While the intensity of light affect fish in the breeding and on larvae stadium. The light also available for affecting time ripeness fish.

Turbidity high also show a level brightness low waters connected with the ecosystem photosynthesis on a waters. Cloudiness waters growth could hinder fish cultivation either directly or indirectly. On the darkly water, radiation sunlight it takes for a process photosynthesis plant will is less than to sea clear. Productivity plankton in waters will increase with the increase the intensity of the sun into waters, so abundance biota another which is growth of plankton prey.

Table 5: Land use changes in coastal regions of North Jakarta municipality

	Land use		
Designations	1998 (ha)	2004 (ha)	Change
Port facilities	1,027	1,487	460.0
Rice field	5,122	4,555	-567.0
Settlement	8,431	8,573	142.0
Reservoir	151	116	-35.0
Holidays	361	361	0.0
Industry	1,141	1,141	0.0
Conservation	296	296	0.0
Reclamation	-	50.3	50.3
Total area	16,529	16,579,3	50.3

Source: CAS (1999, 2005)

Table 6: Water quality status mean some quality standard station and marine life

Parameters	Quality standard to tourism	Quality standard to marine life	2004	Note
Turbidity (NTU)	<5	<5	26.08	Unsuitable
Visibility (m)	Coral >6	Coral >5	12.81	Suitable
Surface temperature (°C)	Natural	Coral 28-30	30.68	Unsuitable

Table 7: Water quality status mean some quality standard station and marine life

Parameters	Standard quality of marine life (Decree No.51/2004)	Status		Remarks
		1998	2004	
pH	7.00-8.50	7.75	8.07	Suitable
DO (mg L^{-1})	>5	4.15	3.46	Unsuitable
PO_4 (mg L^{-1})	0.015	0.09	0.84	Unsuitable
NO_3 (mg L^{-1})	0.008	0.13	1.48	Unsuitable
NH_3 (mg L^{-1})	0.300	0.09	4.18	Unsuitable
Salinity (PSU)	<33.0-34.0	25.05	32.46	Suitable

DO: Dissolve oxygen

Table 8: Results of the analysis parameter heavy metal dissolved compared with of quality standard

Chemical elements (mg L^{-1})	Standard quality of marine life(Decree No. 51/2004)	State (average)		Keterangan
		1998	2004	
Pb	0.008	0.00300	0.0060	Unsuitable
Cd	0.001	0.00085	<0.0012	Unsuitable
Cu	0.008	0.00230	<0.0028	Suitable
Zn	0.050	0.00350	<0.0038	Suitable
Ni	0.050	-	<0.0150	Suitable

Likewise temperature parameters shows a higher than tolerance fish in general .The majority of marine biota is poikilometric (body temperature influenced the temperature) that is one of the very important in regulating life processes and the spread of organisms. The marine organism as fish and shrimp able to live either on the temperature range 20-30°C. Changes in temperature under 20°C or over than 30°C cause fish subjected to stress that usually followed by indigestion.

Meanwhile, 6 chemical parameters used in this study: pH, DO, PO_4, NO_3, NH_3 and salinity (Table 7), generally in the condition unsuitable for marine life.

Based on these criteria, it is less suitable water quality for the benefit of marine tourism and marine life. On the physical parameters, the indicators of turbidity, visibility and temperature showed threshold exceeded. On chemical parameters, four parameters (DO, PO_4, NO_3 and NH_3) have turned out to be above the quality standards set by The Environment Ministerial Decree number 51/2004 (Ministry of Environment Republic of Indonesia, 2004).

The Jakarta Bay also be a subject of accumulation for various kinds of heavy metals in the marine sediment like Pb, Cd, Cu, Zn and Ni which carried by river flow from industry and housing waste. Table 8 showed the results of the analysis parameter heavy metals solute form in two period, in 1998 and 2004.

Considering the parameters in Table 8, concentration of Pb and Cd elements were sitting on the threshold allowed while the Cu, Zn and N elements still in conditions of allowed. Despite, availability of the solute form, heavy metal dissolved in water is not stable. Measuring heavy metal in solute form which was commonly found to be very low in concentration comparing in sediment form Arifin *et al*. (2012) noticed the heavy metal in solute form Jakarta Bay waters in July 2003 for Pb, Cu, Ni and Zn elements are 0.0005, 0.0004, 0.0002 and 0.0033 ppm, respectively and less than 0.001 ppm for Cd element. The heavy metal concentration increases in 2004 namely Pb, Cu, Ni and Zn elements to be 0.002, 0.001, 0.003, 0.003 and 0.006 ppm, respectively and less than 0.001 ppm for Cd element.

Putri *et al*. (2012) found that the concentration of Hg, Cd and Pb in sea water around Kamal Estuary Jakarta Bay were 0.0001-0.0002, 0.00001-0.00002 and 0.0013-0.004 mg L^{-1}, respectively, which were still lower than threshold standard issued by Indonesian government. Nevertheless, it was much higher concentration of heavy metals in green mussel which were 0.0017-0.012, 0.46-0.743 and 0.92-1.485 mg L^{-1}.

Riyadi *et al*. (2012) studied the spatial and temporal variations of trace elements contamination in the Jakarta Bay by analyzing surface sediment samples from Jakarta Bay. They point out that degree of heavy metals contamination such as Zn, Cu and Pb were generally higher in coastal sites than offshore. Ferianita-Fachrul *et al*. (2011) assessed the effect of water quality disturbances on macrozoobenthos communities in Jakarta Bay and found that abundance and diversity analysis indicated that benthic community within estuaria and 5 km from shore line were affected by the water quality disturbances that caused by pollution. Various of these research strengthen evidence that Jakarta Bay are under threat seriously.

The incorporation of chemical compound as noted in the Table 8 shows reduction on the catching area for fishing activities. Figure 2 presents two map of suitability for fisheries

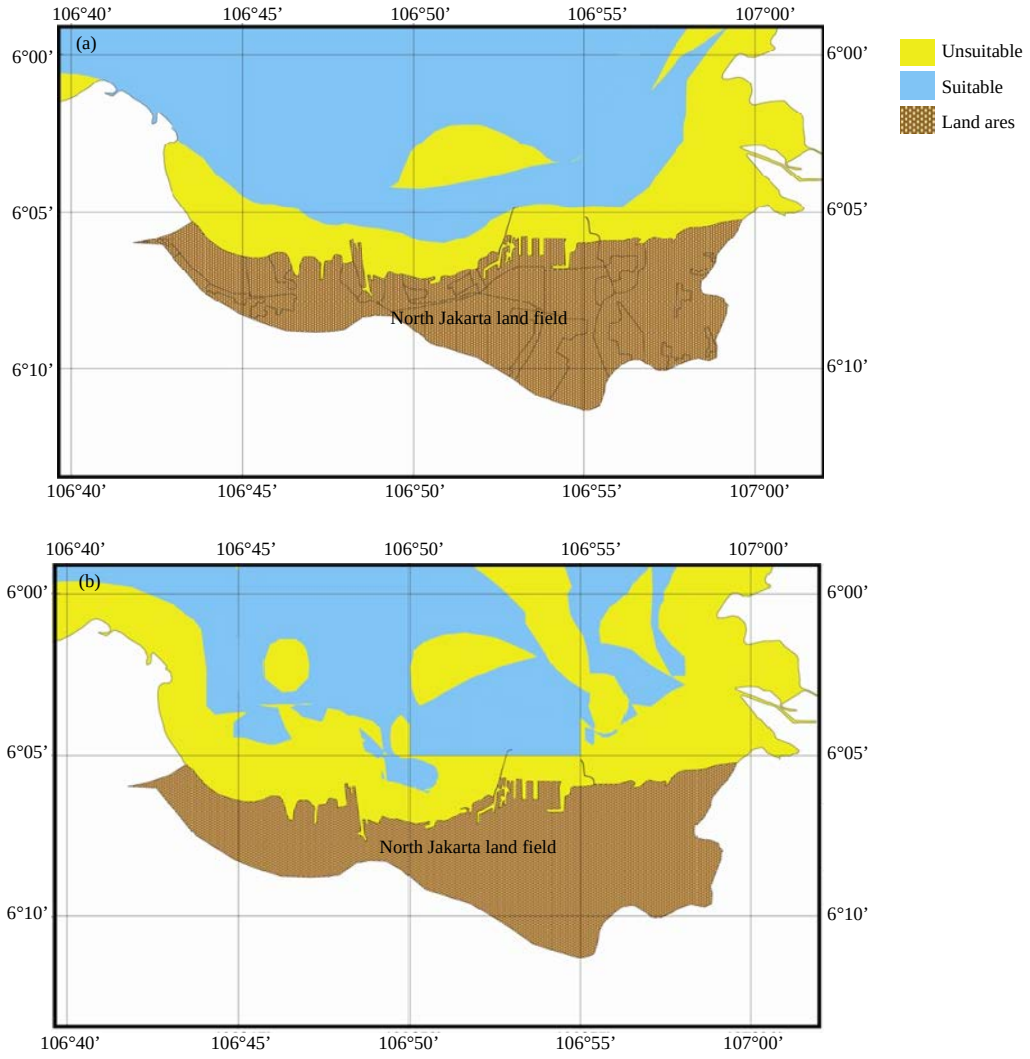

Fig. 2(a-b): Area for each category of suitability for fishing activities based on the content of the combined chemical compounds important in the Bay of Jakarta in (a) 1998 and (b) 2004

Table 9: Size of water category suitability of fishing activity based chemical compounds content

	Aquatic area (ha)		
Suitability categories	1998	2004	Change
Unsuitable	9,046	21,277	12,212,9
Suitable	36,256	23,993,2	-12,263,2
Total area	45,322	45,270,2	-50,3

activities catch based on the quality of four chemical compound in Jakarta Bay waters in the year of 1998 (Fig. 2a) and 2004 (Fig. 2b). In 1998, areas of waters that classified as suitable fishery category are 36,256,4 ha but in the contrary in 2004, it fell significantly into 23,993,2 ha and the remain of 21,277,0 ha are in the category of unsuitable (Table 9).

Figure 2 captures the impact of the development and activity of the population of the coastal ecosystem. In addition, the decrease for the quality of coastal ecosystems and its development have not succeeded in lifting the entire population of North Jakarta from the poverty trap.

Considered by physical parameters, turbidity levels showed that exceed the standards were allegedly caused by the high amount of dissolved material derived from domestic waste dumped into the river and carried down to the water. High turbidity levels that would interfere with the penetration of sunlight into the water, so that the process of photosynthesis and respiration will be disturbed which could result in the decrease of dissolved oxygen levels in the water.

Table 10: Results of analysis of social change based on coastal resource against DPSIR framework

Issues	Indicator type	Analysis results	Policy results	Functional relations of the vulnerability of ecosystems
Population growth	Driver	Population growth is higher than the population growth of the city of Jakarta	Need to design various programs that encourage the creation of power employment and reduce migration	Vulnerability increases with the number population increase as well
Population density	Driver	Population density is on average more lower than other regions. North Jakarta attracts more immigrants to enter	Availability of employment	Vulnerability employment increased in line with employment limitation
Residential	Driver	Increase in demand for residential housing	Drivers need for residential land	Pressure on ecosystems, vulnerability increases as with the needs of residential land
Industry	Driver	Needs for industrial activity increases along with the increase in the processing industry activity	Competition in line with land use	Vulnerability increase in line with industrial development
Education	State	Average education level is junior high school and senior high school	Community understanding of the importance of coastal ecosystems	Vulnerability increase in line with an average rate of education

DPSIR: Driver pressure state impact response

Table 11: Results of analysis of economic change based on coastal resource against DPSIR framework

Issues	Indicator type	Analysis results	Policy results	Functional relations to the ecosystem vulnerability
Change of lifehood	Driver	Change of proposition of prime sector (fishery) to second sector (trade)	Modern urban rate	Vulnerability increases in line with the ignorance of coastal resources
Revenue per capita	Impact	Per capita income tends to rise and nominated from manufacturing, trade, services and transport and communications	Importance of policy support pro-conservation of coastal resources, due to the high contribution of the industry will have an impact on land requirements	Vulnerability increases or decreases depending on the environmental policy is implemented

DPSIR: Driver pressure state impact response

Table 12: Results of analysis of environmental change against DPSIR framework based coastal resource

Issues	Indicator type	Analysis results	Policy results	Functional relations to ecosystem vulnerability
Change of land use	Impact	Reduction of productive land and conservation	Allocation for the production, protection and speculation	Vulnerability increases if there is no diversification of land use
Waste and pollutant generated	Pressure	Number of domestic and industrial waste generated tends to increase in line with the increasing demand for the settlement and industry	Deterioration of water quality, if domestic and industrial waste is not managed properly	Vulnerability increases with the amount of waste and pollutants increased
Community awareness	Impact	Adequate	Environmentally development	Vulnerability increases with increasing public awareness

DPSIR: Driver pressure state impact response

This in turn will disrupt the fishery resource potential. Jakarta Bay as central area of coastal Northern Jakarta region has experienced a sharp decline. This suggests that the development carried out during the period in coastal areas/coastal Jakarta Bay are not able to maintain or improve water quality, even the opposite occurs where water quality has declined (deteriorate).

Various indicators above if inserted into the DPSIR framework can then be grouped into variable Driver (D) are: Population growth, population density, settlements and changes in livelihoods. This variable individually or interactively will have an impact on the emergence of pressure (P) on the ecosystem. This study found that drivers above variables prompted increasing amount of trash and pollutants that impact on the quality of coastal waters and ecosystems. Variable income per capita and land use change is the impact (I) of the variables, which in turn encourages drivers (P) the need for policies that can withstand a decline in water quality and ecosystem conditions. For all the analysis of the above drivers are put in the Table 10-13 for social, economic, environmental and policy changes based on coastal resource against DPSIR, respectively.

In terms of the case study in the Jakarta Bay area, the economic loss due to pollution is quite significant. The total economic loss in terms of net benefit deriving from the loss in resource rent and producer surplus is approximately Rp 700 million per year (Suzy and Fauzi, 2007).

Table 13: Results of analysis of policy change against DPSIR framework based coastal resource

Issues	Indicator type	Analysis results	Policy results	Relations functional of the ecosystems vulnerability
Spatial plan	Response	Plan-oriented development sustainability	Balance of the northern region to the southern	Vulnerability reduced if policy is properly implemented
The development involves the society	Response	Community is involved in development planning	Bottom up development	Vulnerability is reduced if the community is involved in the development of sustainable coastal
Regional development	Response	Improving and preserving the quality of environment, maintain the fishing settlement, developed the port function new beach: beach reclamation for service, trade, ports and tourism	Coastal ecosystems and fisheries-based economic activity continues required analysis of the impact of reclamation of the coastal ecosystem	Vulnerability is increased or decreased depending on the ability to maintain balance ecosystems. Vulnerability increases if reclamation does not take into the importance of conservation

DPSIR: Driver pressure state impact response

CONCLUSION

Population growth and industrial development along the coast have greatly influences pollution loads in marine environment. In terms of demography and socio-economics indicator in Jakarta, there is significant increase in population from 1,137,211 in 1998 to be 1,182,749 in 2004 with population growth of 0.67% per year, The density of 7,486 km^{-2} in 1998 increases to 8,475 km^{-2} in 2004. The rate is the highest in Jakarta (2.09% per year). Those increasing changes bring implications for the environment, such as conversion of land use, increased water consumption and environmental pollution.

In terms of environment indicator, there has been a change in land use during the period 1998-2004, from total area 16,529,0 in 1998 become 16,579,3 in 2004 deteoriting function of many fields and shrunk the extent of the reservoir. The development area and population activities affected to decreasing in water quality and coastal directly and indirectly. Applying six chemical parameters used in this study: pH, DO, PO_4, NO_3, NH_3 and salinity infers the condition of marine environment unsuitable for marine life. The area classified as suitable fishery category is 36,256,4 ha in 1998 and in the contrary it falls significantly into 23,993,2 ha in 2004 but 21,277 ha remain is in the category of unsuitable.

Using DPSIR methods, the study recommends several points to be considered as follows:

- Based on social change indicators, we need to design programs that encourage the creation of power employment and reduce migration, community of understanding for important coastal ecosystems and regulation of residential land
- Based on economic change indicators, we should make regulation that could control expanding industrial area in the outside and establish industry-environmental friendly
- Based on environmental change indicators, we need to put regulation on domestic and industrial waste, development in environmentally bases and allocation protection area as buffer pollution

REFERENCES

Arifin, Z., R. Puspitasari and N. Miyazaki, 2012. Heavy metal contamination in Indonesian coastal marine ecosystems: A historical perspective. Coastal Marine Sci., 35: 227-233.

CAS., 1999. North Jakarta in figure 1998. Central Agency of Statistics (CAS), Statistics Jakarta Utara Municipality, Jakarta, Indonesia, pp: 122.

CAS., 2005. North Jakarta in figure 2004. Central Agency of Statistics (CAS), Statistics Jakarta Utara Municipality, Jakarta, Indonesia, pp: 126.

Fauzi, A. and E.A. Buchary, 2002. A socioeconomic perspective of environmental degradation at Kepulauan Seribu Marine National Park, Indonesia. Coastal Manage., 30: 167-181.

Fauzi, A. and S. Anna, 2002. Evaluation on the status of the sustainability fisheries development: The application of RAPFISH approach (Jakarta North-Caost Waters Case Study). J. Coastal Manage., 4: 36-49.

Fedra, K. and E. Feoli, 1998. GIS technology and spatial analysis in coastal zone management. EEZ Technol., 3: 171-179.

Ferianita-Fachrul, M., M.R. Salim and M.I.M. Said, 2011. The effect of water quality disturbances on macrozoobenthos communities in Jakarta bay waters, Indonesia. http://civil.utm.my/ismid/files/2013/01/CO07ChemFachrul_1-1.pdf.

Hosono, T., C.C. Su, R. Delinom, Y. Umezawa, T. Toyota, S. Kaneko and M. Taniguchi, 2011. Decline in heavy metal contamination in marine sediments in Jakarta Bay, Indonesia due to increasing environmental regulations. Estuarine Coastal Shelf Sci., 92: 297-306.

Jakarta Regional Government, 1998. The environmental impact analysis reclamation regional and revitalization North-Coast of Jakarta. The Jakarta Regional Government, Jakarta, Indonesia.

Jakarta Regional Government, 1999. Spatial planning a special area of the capital Jakarta 1995-2010. The Jakarta Regional Government, Jakarta, Indonesia.

Ministry of Environment Republic of Indonesia, 2004. Quality standards of sea water. Decree of the Minister of Environment No. 51/2004, Jakarta, Indonesia.

Nontji, A., 1997. [Seasonal variation factors the marine ecology in Jakarta bay]. Indonesian Oceanol. Indonesian Inst. Sci., 11: 27-36, (In Indonesian).

Noronha, L., N. Lourenco, J.P. Lobo-Ferreira, A. Lleopart, E. Feoli, K. Sawkar and A. Chachadi, 2002. Coastal tourism, environment and sustainable local development. Tata Energy Research Institute, National Institute of Oceanography and Goa University, India, pp: 1-51.

Putri, L.S.E., A.D. Prasetyo and Z. Arifin, 2012. Green mussel (*Perna viridis* L.) as bioindicator of heavy metals pollution at kamal estuary, Jakarta Bay, Indonesia. J. Environ. Res. Dev., 6: 389-396.

Riyadi, A.S., T. Itai, T. Isobe, M. Ilyas and A. Sudaryanto *et al*., 2012. Spasial Profile of Trace Elements in Marine Sediments from Jakarta Bay, Indonesia. In: Interdisciplinary Studies on Environmental Chemsitry: Environmental Pollution and Ecotoxicology, Kawaguchi, M., K. Mizaki, H. Sato, T. Itai, M. Nguyen, J. Ono and S. Tanabe (Eds.). Terra Publication, Tokyo, pp: 141-150.

Suzy, A. and A. Fauzi, 2007. Economic loss of pollution to fisheries: An economic analysis of the Jakarta bay fisheries. Proceedings of the American Fisheries Society Symposium, November 2007, Bethesda, Maryland, pp: 587-593.

Takarina, N.D., S. Yasman and A. Reza, 2008. [Speciation heavy metals in the sediment of estuary and Jakarta bay waters]. J. Environ. Chem., 9: 153-160, (In Indonesian).

Takarina, N.D. and A. Adiwibowo, 2011. Impact of heavy metals contamination on the biodiversity of marine benthic organisms in Jakarta bay. J. Coastal Dev., 14: 168-171.

UNESCO., 2000. Reducing megacity impacts on the coastal environment-Alternative livelihoods and waste management in Jakarta and the Seribu Islands. United Nations Educational Scientific and Cultural Organization (UNESCO), Coastal Region and Small Island Papers No. 6, Paris, pp: 59.