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# GIANT SEA WALL CONSTRUCTION: IS IT THE RIGHT SOLUTION TO OVERCOME JAKARTA'S SINKING? Research Project for Environmental Management

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## **GIANT SEA WALL CONSTRUCTION: IS IT THE RIGHT SOLUTION TO OVERCOME JAKARTA'S SINKING?**

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**Abstract:** The National Capital for Integrated Coastal Development (NCICD) or so-called Giant Sea Wall (GSW) was planned to be an integrated solution to Jakarta City's climate-related problems such as flooding, sea level rise and land subsidence. This paper aims to determine whether GSW is the right solution to overcome Jakarta's sinking. Literature review and document analysis are the methods used to analyze the impacts of GSW construction. The results show that GSW is not appropriate because the primary factor to Jakarta's sinking is land subsidence, and the GSW can only provide coastal defense. Also, long time construction period to build the GSW; adverse impacts on ecological, hydrodynamic, and socio-economic aspects; pros and cons related to GSW construction; these factors indicates that Jakarta is not yet ready to build and maintain the GSW, and looking for the other alternative solutions seems required.

## **1. Introduction**

Jakarta City is currently facing the climate-related disaster, including flooding and sea level rise, which in turn cause massive loss of life and infrastructure and the damage to national and regional economies. Nowadays, about 40% of Jakarta is located below sea-level (Firman et al., 2011). Recent big floods occurring during the rainy season affected up to 60% of the city area (Dsikowitzky et al., 2016). The causes of flooding in Jakarta go beyond the geographical difficulties of this water-rich region and are mostly anthropogenic (Steinberg, 2007). Also, the overexploitation of the groundwater resources, the load of constructions as well as the natural consolidation of the alluvial soils caused a land subsidence (in some locations up to 20–28 cm/year), mainly in the northern and central parts of Jakarta City. The land subsidence induced changes in river and canal flow systems, malfunctions of the drainage system and a wider expansion of flooding areas, tidal flood, and seawater intrusion (Abidin et al., 2011).

To face these problems, the government of Jakarta planned to build The Giant Sea Wall (GSW). However, this construction is currently being postponed for many reasons. This paper considers whether Giant Sea Wall (GSW) is the appropriate solution to overcome Jakarta's sinking.

## **2. Background**

### **2.1 Seawall Overview**

The seawall is the engineering tool (Kelly, 2000); a massive structure which protects areas of human property, conservation and coastal tourism threatened by tides, waves or tsunamis (Kamphuis, 2010); or a form of coastal defense construction. The seawall can be built from many materials, such as concrete, gabions, boulders, steel, vinyl, fiberglass composite, aluminum, wood, and large biodegradable sandbags (Clarke, 1994). Many types of sea wall that have been used today may represent both the different physical forces they are planned to resist and specific locations, such as local climate, coastal position, wave regime, and landform value (Kraus et al., 1996).

On the one hand, sea wall can be effective in protecting beachfront property from extreme events against the onslaught of storm waves (Kelly, 2000). The seawall is a kind of long-term solution instead of soft beach sustenance. The seawall is also a strong coastal defense that can survive longer in high energy environment and can be used for sightseeing. On the other hand, a sea wall may create conflict with the dynamic coastal nature and block the sediment exchange between land and sea. Seawall can disrupt natural shoreline processes and ruin coastal habitats such as mangrove and intertidal beaches. A part of the beach is lost when the seawall is built (Kelly, 2000).

Other challenges of using sea wall is the high cost of construction and maintenance. Approaches like cost benefit analysis/contingent valuation may be an effective way to find out whether a seawall is a right solution and whether the benefits are worth the cost (Vatn, 2009). However, many countries such as Netherlands (Tooley&Jelgersma, 1992), Germany (Belyea, 1992), and Japan (New York Times, 2011) use the sea wall to protect their coastal land, while New York builds a sea wall to protect the land from future hurricanes.

## **2.2 The Jakarta Giant Sea Wall (GSW) Master Plan**

In 2014, the government of Jakarta in cooperation with the Netherlands under Jakarta Coastal Defence Strategy (JCDS) planned to develop the National Capital for Integrated Coastal Development (NCICD) or so-called Giant Sea Wall (GSW). This offshore solution for protecting coastal zone is conceived based on the facts that the existing seawalls can no longer protect the environment for the long-term. Moreover, Jakarta has limited space to create the sufficient storage basins (Ministry of Economic Affairs, 2014).

The mega project of GSW aims to overcome flood, to protect Jakarta City from sinking, to supply fresh water for Jakarta inhabitants, to facilitate socio-economic development, to provide settlement area, industrial estate, and the harbor extension. By this project, the government plans to do reclamation some part of the Jakarta Bay, builds a high dike and toll road that will connect western part to eastern part of the bay, and developing real estate and harbor (Ministry

of Economic Affairs, 2014). This mega project will cost up to \$40 billion and also includes reclaiming land for 17 new islands (Reeves, 2014).

However, this construction is being postponed under the moratorium instruction by Indonesian President, including a moratorium on planning and construction practices. This moratorium is enforced because GSW construction is considered chaotic and policy overlapping (Cahyo, 2016). Therefore, it needs further analysis and assessment on whether GSW construction should be continued, to create the best decision for environmental problems in Jakarta City.

### **3. Objectives**

The objectives of this paper are: firstly, to review the impact of the GSW construction on ecological, hydrodynamics and socio-economic aspects; secondly, to analyze the pros and cons of the NCICD; thirdly, to assess whether the GSW construction is the right way to overcome Jakarta's sinking; and finally to suggest the alternative possible solutions instead of continuing GSW construction.

### **4. Methods**

As a background, this paper will briefly review the general concept and functions of the sea wall. Afterward, to bridge the general concept into the particular Jakarta's GSW case, the master plan of NCICD from Indonesian Ministry of Finance; the preliminary research about the impacts of GSW from researchers; also media release about the ongoing GSW construction and society perception; need to be reviewed to evaluate the GSW construction in Jakarta and to conclude whether GSW is appropriate as the solution of Jakarta's sinking. In the end, this paper tries to provide the possible alternative solutions instead of continuing GSW construction.

## **5. Analysis**

### **5.1 The causes of Jakarta's sinking**

There are two natural factors related to the Jakarta's sinking, namely land subsidence and sea level rise. The primary strategy in the NCICD to combat these circumstances is to build Giant Sea Wall (GSW) which is a large embankment offshore. GSW development plan intended to stop flood disaster in Jakarta should consider the facts as follows: 1.) Sea level rise of 7,3 mm/year, 2.) Decrease in soil surface reaching an average of 15 cm/year 3.) Sediment supply from rivers that empties into the Jakarta Bay is 42 ton/year (Purnomo et al., 2014). Based on these facts, it is seen that from the sea level rise factor, although relatively larger than the global situation, is not the appropriate threat to flooding and city's sinking.

### **5.2 The Project Timeframe of GSW Construction**

NCICD mega project construction consists of three main phases: phase A (improvement of the current sea defences) which is planned to be constructed from 2014 to 2018; phase B (the Great Garuda construction, land reclamation, and the offshore Tangerang – Bekasi highway) that will be developed at the period of 2018-2040; and Phase C (the specific component of East Lagoon) that will begin in 2018 and finish in 2050. The whole components of NCICD project are formulated to be able to cope with conditions up to 2080 (Ministry of Economic Affairs, 2014). It requires three decades to finish this megaproject based on the master plan timeframe. The moratorium period may delay the construction process as well. Considering the uncertainty of future climate condition that causes other climate-related problems, the GSW may no longer be an appropriate solution.

### **5.3 Brief Analysis of The GSW Design**

The GSW will be build in the shape of Garuda, the mythological bird that has been Indonesia's national symbol. The fundamental design is about 1250 hectares, allowing a huge area for future land reclamation. The outer sea wall will be 25 kilometers in length, 24 meters high (7,7 meters above sea level). In the connectivity aspect, the GSW will accommodate a new district, in which up to 1,5 million people are estimated to live and work here in the future. The dike will also provide real estate development in a new Central Business District (CBD) and a

new beach front (Ministry of Economic Affairs, 2014).

An extra margin to the dike height probably needs to be considered in GSW design as Netherland's embankment construction. It takes oscillations, gust bumps and changes in sea level rise into account (Van der Meer, 1998), in which it seems not included into the GSW design. Therefore, it requires further study to create a better design of the wall and to minimize environmental impacts that may occur in the future.

## **5.4 The Multi-dimensional Impacts of GSW Construction**

### **Ecological Impacts**

Arifin (2014) stated that the height of hard coral cover is influenced by space competition and biophysical disturbance factors that occur within reef benthic habitat over a period (short or extended period). For the South of thousand islands area, hard coral is hard to compete with other coral reef categories due to turbid climatic conditions and contamination of organic materials, heavy metals, and waste. The existence of Jakarta Bay reclamation will add the burden of environmental pressure and distance the coral range of the thousand islands.

### **Hydrodynamic Impacts**

The result of hydrodynamic model simulation with scenarios for the construction of large sea dikes indicates a current at speeds close to 0 m/s under different tidal conditions in some locations within the embankment structure. Several sites within the embankment structure with very low current velocities have the potential to cause accumulation of sediments originating from the main river that flows into the Jakarta Bay. The sediment input from the main river in the Jakarta Bay will be retained inside the giant sea wall building because it is not carried by the ocean currents (Arifin, 2014).

## **Socio-economic Impacts**

The potential for the construction of GSW should be utilized to foster new jobs for the local community, with the record that the wages they receive must be more competitive. Currently, if they work for a marine reclamation company, the payments they receive are only NZD \$6 per day (Arifin, 2014).

In the Muara Angke and Kamal Muara areas, the attitude of fishers to the construction of Giant Sea Wall shows about 35% approved the development and some others do not support Giant Sea Wall construction and some fishersrespondents do not know the planned construction of Giant Sea Wall. Regarding massive relocation, in Kamal Muara about 58% of fishers are unwilling to be relocated and only 42% are willing to be relocated to other locations. The fishermen are willing to relocate as long as the government gives a "change of profit" and the new place is close to the sea and has provided various facilities that support fishing effort (Arifin, 2014).

## **6. Discussion**

### **6.1 The Pros and Cons About The NCICD Project**

#### **Pro: The GSW can provide long-term solution**

An offshore solution of NCICD consists of an outer sea wall in the Bay of Jakarta, creating the offshore giant waduk (embarkment). The giant waduk decreases the need for more dam in the city. This option provides reliable protection up to 2080, which provides time to reduce subsidence (Ministry of Economic Affairs, 2014).

#### **Pro: Connecting to the context of current city and the sea**

NCICD plans promote mid to high-end residential mixed-use urban villages and are seen as high quality, safe and flood free locations for those who can afford to live there. The future residents of these islands will have many of their daily needs catered for within each island. At the Great Garuda, all aspects of city life and the requirements of the urban population are considered thereby providing civic amenities such as hospitals, schools and governmental functions (Ministry of Economic Affairs, 2014).



**Cons: The NCICD project provides no answer to Jakarta's sinking**

The NCICD acknowledges that the land subsidence of Jakarta is the major cause of the flood. The GSW inside Jakarta Bay can only protect the city against floods from the sea. The NCICD also fails to treat highly polluted wastewater which causes significant concerns for the water quality in the city and the bay (SOMO, 2017).

**Cons: NCICD will further increase economic inequality**

Local fishers claimed that land reclamation in Jakarta Bay caused the disappearance of local fishing grounds. The construction of artificial islands moreover disrupts free access to the open sea by local fishers, which further threatens their livelihoods. Fishers in Jakarta Bay are further marginalized while at the same time prestigious real estate projects are built in the same location (SOMO, 2017).

**Cons: the lack of public participation and consultation**

Local communities in Jakarta have not been awarded any meaningful participation or consultation in the design of a project that will disrupt their livelihoods and environment. In the case of the NCICD, no full-scale environmental assessment has been conducted (SOMO, 2017).

**Cons: High financial risk and unsustainable**

The NCICD project unloads considerable financial risk onto the Indonesian state. The NCICD is a public-private partnership, but guarantees provided by the state does not stated in the plan. The financial risks and hidden costs, such as for the massive relocation and compensation of the fishing industry and improving water quality are not considered in the NCICD master plan. These may create a high financial risk to the investor (SOMO, 2017).

**6.2 Judgement and alternative solutions**

Generally, the GSW can be a successful way to control coastal erosion, but only if they are well constructed and well-maintained. However, the main factor to Jakarta's sinking is land subsidence, and the GSW can only provide coastal defense. Also, long time construction to build the GSW; negative impacts on ecological, hydrodynamic, and socio-economic aspects; pros and

cons related to GSW construction; these factors indicates that Jakarta is not yet ready to build and maintain the GSW. The current sea level rise can be overcome by raising the existing coastal dike. Another strategy such as beach replenishment may be accepted as less environmentally damaging than a sea wall (Kelly, 2000).

## **7. Conclusion**

GSW can be very helpful; they can offer a more long-term solution than soft engineering tools, also provide tourism area and protection from extreme events as well as everyday erosion. Analyzing the extreme natural events expose weaknesses in the performance of GSW can lead to future improvements and reassessment. The planned construction of GSW requires a comprehensive review before development takes place. The Jakarta Bay water reclamation activity plan needs to be implemented effectively and efficiently to meet the technical feasibility standards. Alternative solutions such limiting the rate of construction building in Jakarta, existing coastal dike and beach replenishment can be considered to substitute the GSW.

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