Available Online at http://journal.unismuh.ac.id/index.php/otoritas

Otoritas : Jurnal Ilmu Pemerintahan, 7 (2), October 2017, 54-66

Analyzing Indonesia's NCICD Project to Stop the Capital City Sinking

Aris Widodo[*)]

Public Policy and Management, School of Social and Political Sciences, University of Glasgow, Glasgow, G12 8QQ, Scotland, United Kingdom.

Received: 9 July 2017; Revised: 9 September 2017; Accepted: 10 October 2017

Abstract

Jakarta is hit by a tidal flood every year and cause some loss for the city. Beside that flood caused by sea level rise, the city risk on sinking is higher because of land subsidence problem. Without any significant action, it is predicted that Jakarta will face USD 521 million loss risks on 2050 caused by flood. To overcome the sinking problem, Indonesian government plays an active role on the international action to combat climate change. In addition, Indonesian government also implements NCICD project, in which create giant sea wall and land reclamation on the Jakarta Bay. However, the land reclamation raises an argument that it would create an environment disaster for the city. Because of that, it is suggested that Jakarta should only create a sea wall without land reclamation. Moreover, Jakarta government also should ensure that Spatial City Planning and New Rule on ground water extraction are well implemented so the land subsidence in the city is stopped.

Keywords: *Sea Level Rise; Land Subsidence; Jakarta; Flood; Giant Sea Wall*

How to Cite: Widodo, A. (2017). Analyzing Indonesia's NCICD Project to Stop the Capital City Sinking. *Otoritas : Jurnal Ilmu Pemerintahan*, *7*(2), 54-66.

Permalink/DOI: https://doi.org/10.26618/ojip.v7i2.769

[*)]Corresponding Author.
E-Mail : the.widodo@gmail.com

Available Online at http://journal.unismuh.ac.id/index.php/otoritas
Otoritas : Jurnal Ilmu Pemerintahan, 7 (2), October 2017, 55

INTRODUCTION

Every year Jakarta is flooded by the rising tides from the sea on the north side of the city. For example, from the news of The Jakarta Post and detiknews in June 2013 tidal flood with 50cm height inundated streets, shopping malls, and disturbed the traffic flow along streets in the north Jakarta. The most recent tidal flood happened in January and February 2017 which hit almost all area on the north side of Jakarta. The tidal flood had continued to hit from the middle of January until the middle of February with only 4 days dry. In addition, the flood inundated the city with about 30cm-50cm high and caused damage on street, house, and some public area.

Beside the tidal flood as the impact of the sea level rise, Jakarta also got a regular flood. A regular major flood happened in 2002, 2007, 2013, and 2014 cause billion dollars loss and created massive indirect economic failure (Budiyono, Aerts, Tollenaar, & Ward, 2016). Without any action, it is predicted that Jakarta will be sinking about 1.8m by 2030 (Jevrejeva, Jackson, Riva, Grinsteed, & Moore, 2016).

To overcome the sinking problem, Indonesian Central Government and DKI Jakarta Province already finished The National Capital Integrated Coastal Development (NCICD) project master plan in November 2014. NCICD consists of several alternatives strategy such as strengthening existed seawall and creating Garuda (bird-symbol of the state) shape sea wall as the long term project (Kementerian Koordinator Bidang Perekonomian, 2014).

However, NCICD is an expensive and complicated project. Beside needing a huge amount of budget, it will also change socio economic life in the surrounding area. It will also change the existing nature aquatic ecosystem. Because of that, this paper will present discussion about Jakarta NCICD project that will be implemented to overcome the city from sinking. In the beginning, the paper will discuss what has caused Jakarta to sink and the damaged caused by it. Then, it will present discussion and analysis about an international and local initiative to overcome the sinking problem. It will also explore the successful St Petersbug (Russia) sea wall and Saemangeum (South Korea) land reclamation. Finally, by bringing the gap between local initiative and successfully international action, the paper will present some policy recommendation in order to overcome Jakarta's sinking problem.

RESEARCH METHODS

In order to attain the knowledge, this paper is used a mixed method approach. Mixed methods research is an approach to investigate in a research which includes gathering both quantitative and qualitative data, integrating those data, and using distinct designs with a certain philosophical assumption (Creswell, 2014). This paper combined quantitative data analysis and qualitative literature analysis. Quantitative data analysis was used to determine the impact of NCICD project for economy. The qualitative literature analysis was used in order to examine literature which discuss about city problem, specifically flood which caused by increase sea level. In addition, experience from another country also presented in order to attain better understanding of the problem and propose a better solution for it.

RESULT AND DISCUSSION

As Indonesian capital city which located next to Jakarta Bay, Jakarta is facing the sinking problem. That problem is a result of combination of the two main factors which are global climate change and land subsidence. Climate change has become the major international environmental problem facing by human life

(Lankao, 2008) and will cause global sea level to rise. The rise of global sea level will also cause sea level on the north side of Jakarta to increase. In addition, land subsidence will also increase risk for the city to sink. Land subsidence and low drainage storage in Jakarta's river and canal are driver for the city sinking (Jevrejeva, Jackson, Riva, Grinsteed, & Moore, 2016). How the international problem blended with local issue affects the capital city is a serious discussion that discloses discussion on flood governance in jakarta.

Global industrialization and population growth are the main drivers that cause global warming (IC Change, 2014). Intergovernmental Panel on Climate Change (IPCC) stated that total greenhouse gas (GHG) emissions have continued to increase over 1970 to 2010 with larger absolute increases between 2000 and 2010. Since 1970 until 2010, GHG resulted from fossil fuel combustion and industrial processes contributed about 78% of the total emissions, with similar percentage contribution for the increase during the period 2000 to 2010 (IC Change, 2014). Such GHG concentration already cause 2o C global temperature increase compared to pre-industrial time (1750-1850) and it could be doubled if there is no action taken (Stern, 2006). Global warming warms the atmosphere and ocean in which results the numbers of snow and ice have decreased, and sea level has risen (IC Change, 2014).

From period 1901 to 2010, global mean sea level has increased by 0.19m. The rate of sea level rose since the mid-19th century has been larger than the mean rate during the previous two millennia (IC Change, 2014) and showed in Figure 1. Because of that, IPCC created Representative Concentration Pathways (RCPs) to describe projection global warming under a different scenario. Under RCP8.5 baseline scenario (scenario without additional action to reduce GHG emissions), it was projected that by 2040 more than 90% of coastal areas will experience sea level increase about 20cm with up to 40cm expected along the Atlantic coast of North America and Norway (IC Change 2014; Jevrejeva, Jackson, Riva, Grinsteed, & Moore, 2016). The sea level increase will create a massive damage for the coastal city and it is amongst the most densely populated areas in the world and the city also supports several important ecosystems (Stern, 2006). In addition, sea level rise will also cause storm flooding and damage, water scarcity, inundations, coastal erosion, and obstructed drainage for the coastal city (IC Change, 2014; Lankao, 2008).

One of the coastal cities that projected getting damage and flooding because of the increase of global sea level is Jakarta. Today, Indonesian sea level rise is reported between 1-8mm per year and varies for some Indonesian coastal city such as Jakarta, Belawan, Semarang, Surabaya and Cilacap (Zhuang, 2009). Under RCP8.5, by the year 2040 Jakarta sea level is projected to increase about 30cm (Jevrejeva, Jackson, Riva, Grinsteed, & Moore, 2016). By 2050, without any significant action, that condition will lead to inundation of 90 sq. km area in the north of Jakarta (Zhuang, 2009). In addition, with 50cm sea level, it is predicted that North Jakarta and Bekasi will be permanently inundated (Zhuang, 2009). Moreover, with sea level increase of about 100 cm, it was estimated that about 405,000 ha of coastal land would be inundated and some small islands on the north side of Jakarta will be lost (Zhuang, 2009).

In addition to the International Climate Challenge that threatens the sinking of Jakarta. The problem of land subsidence is also the cause of the threat of sinking Jakarta. Beside sea level increase caused by climate change, land subsidence is another factor causing the sinking of Jakarta. Rapid development of many sectors such as industry, trade, transpor-

tation, and real estate in the three last decades has created a serious environment problem in Jakarta today which is land subsidence (Taniguchi, 2011; Abidin et al., 2011).

Land subsidence in Jakarta happened to vary in a different area and different period. There was major land subsidence on west and east side of Jakarta between 1982 and 1991, west side between 1991 and 1997, and the east side between 1997 and 1999 (Taniguchi, 2011). Research conducted by Abidin et al., (2011) found that based on the results attained from levelling surveys, GPS surveys, and InSAR technique over the period between 1982 and 2010, described that land subsidence in Jakarta has spatial and temporal variations. That implies that the sources of land subsidence in Jakarta also differ spatially. Figure 2 describes how land subsidence in Jakar-

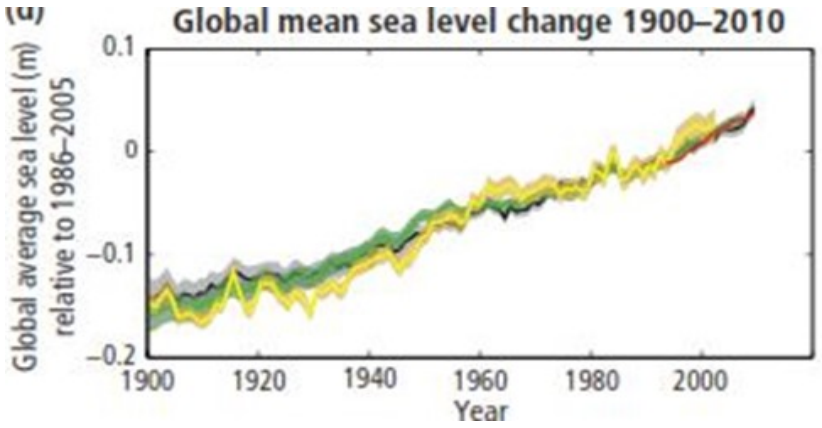

Figure 1. Global Mean Sea Level Change 1900-2010
Source: IPCC Synthesis Report 2015

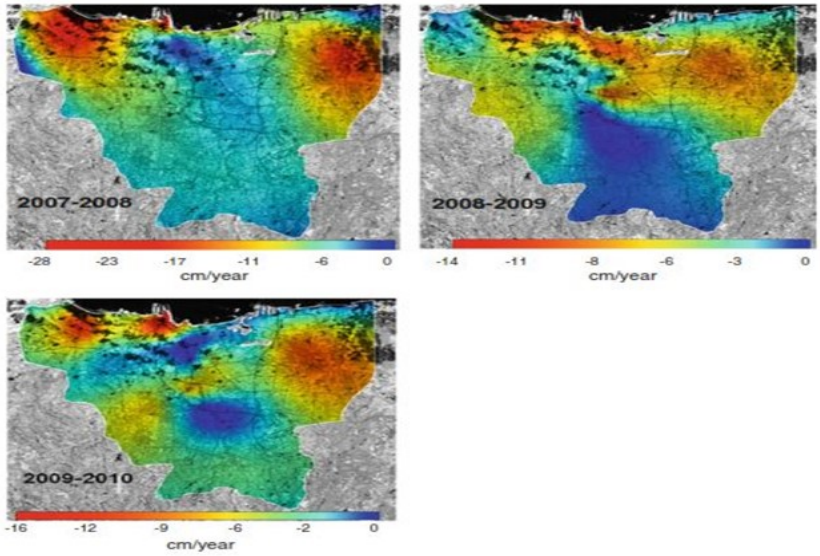

Figure 2. Land Subsidence in Jakarta between 2007-2010
Source: Abidin et al., (2011)

ta varies on different period and different area.

There are four different factors that cause land subsidence in Jakarta which are: excessive groundwater extraction, a load of buildings and constructions, natural consolidation of alluvium soil, and tectonic activities (Abidin et al., 2011). Although there is no information about the contribution of each factor on land subsidence, it is argued that excessive groundwater pumping is the major cause of Jakarta land subsidence (Taniguchi, 2011; Abidin et al., 2011). Rapid population development and urban activities drive the need for ground water and increase the land subsidence described in figure 3. For instance, the areas of shopping malls in Jakarta have significantly increased from 1.4 million m2 in 2000 to 2.4 million m2 in 2005 (Firman, 2009; cited in Abidin et al., 2011). The increase in population development and urban activities lead to Jakarta subsidence has been continuing since 1995 at the yearly rate of 19 cm in Jakarta's western part and 11–13 cm in its central part (Taniguchi, 2011).

International Climate Change and land degradation problems in Jakarta certainly have a significant impact on the occurrence of the sinking disaster of Jakarta. Sea level rise and continuous land subsidence will create a massive flood in Jakarta. Located in a delta where 13 rivers empty in the Jakarta bay, makes the city is so vulnerable with flood risk (Texier, 2008). In last few decades, it seemed that flood disaster impacts appear to have become worsen (Poerbandono, Julian, & Ward, 2014). Jakarta already experienced a massive flood at 2002, 2007, and 2013. In 2002, almost 50% area of Jakarta was inundated, 80 people died, and 381 people evacuated (BAPPENAS, 2007). In 2007, the flood caused 65% area inundated and 79 people died and flood in 2013 was worse than 2007 flood (Texier, 2008; BAPPENAS, 2007; Sagala, Lassa, Yasaditama, & Hudalah, 2013). BAPPENAS (2007) reported that 2007 flood already cause USD 890 million loss. Based on that report, it could be estimated how Jakarta would suffer in the future.

With the climate change, land subsidence and land usage change data,

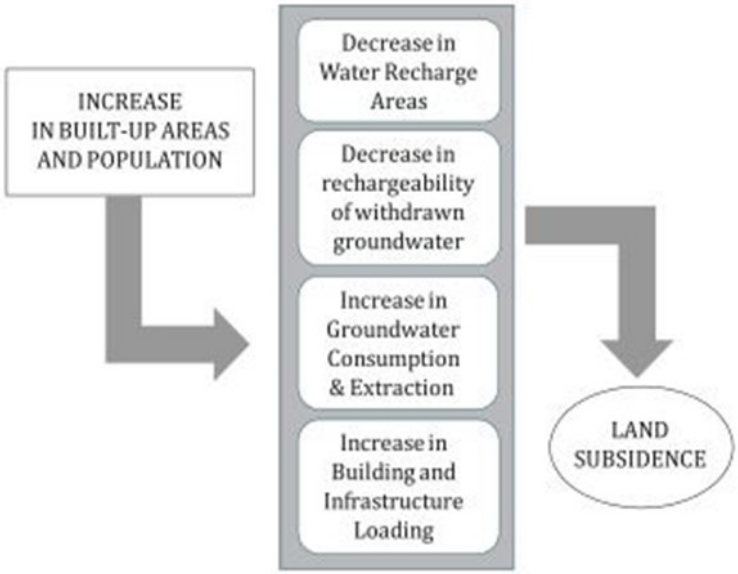

Figure 3. Relation between the increase in built-up areas and population with land subsidence
Source: Abidin et al., (2011)

Budiyono, Aerts, Tollenaar, & Ward (2016) was projecting expected future damage of flood in Jakarta on a quantitative assessment. They used damage scanner –*a disaster risk model developed* by Budiyono, Aerts, Brinkman, Marfai, & Ward (2015) to simulate an examination the individual influence of the climate change, land subsidence and land usage change to overall change in flood risk. Damage scanner needs three type input data to works which are: (1) hazard, represented by maps showing inundation depth and extent for several return period; (2) exposure, represented by maps showing the economic exposure per grid cell, which is in turn based on a land used map; and (3) vulnerability, represented by depth damage function, as vulnerability curve (Budiyono, Aerts, Brinkman, Marfai, & Ward, 2015). The specific source of data they used for Jakarta simulation is presented in Table 1. Using the framework as describe in Figure 4, they simulated the effect of each component on 50x50 m spatial resolution (Budiyono, Aerts, Brinkman, Marfai, & Ward, 2015).

With the baseline condition, they simulated that Jakarta will face USD 186 million p.a risk economical loss caused by a flood (Budiyono, Aerts, Tollenaar, & Ward, 2016). Then, they projected the economic risk that will be faced by Jakarta under influence of each factor (sea level rise, land used to change, and land subsidence) alone. **Firstly**, with the influence of sea level rise as the effect of climate change alone, they projected that under

Table 1. Damage scanner Specific Data Source for Jakarta
Source: Budiyono, Aerts, Tollenaar, & Ward (2016)

No	Input Type	Data Source
1	Hazard	hydraulic schematization resulting from field measurements in 2012.
2	Exposure	the land used map available for the year 2009, supplied by the office of city planning in Jakarta
3	Vulnerability	vulnerability curves derived from flood risk studies in large cities in the south-east Asia region

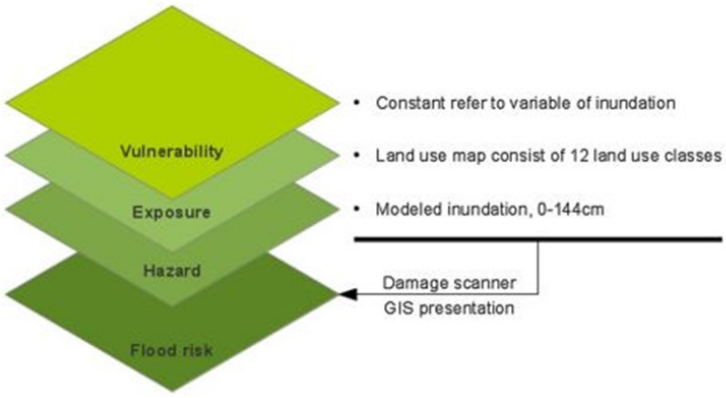

Figure 4. Damage scanner flow diagram
Source: Budiyono, Aerts, Brinkman, Marfai, & Ward (2015)

the low sea level scenario, the risk of damage was still below USD 186 million in 2030 and 2050 (Budiyono, Aerts, Tollenaar, & Ward, 2016). However, with the highest estimation of sea level, it was predicted that the risk estimates ranged from USD 24 to 380 million p.a. for 2030, and USD 34 to 517 million p.a. for 2050 (Budiyono, Aerts, Tollenaar, & Ward, 2016). **Secondly**, with an assumption only an increase in land subsidence for 2030, they found expected damage for 2030 was about USD 421 million (Budiyono, Aerts, Tollenaar, & Ward, 2016). **Thirdly**, for land used change factor, they could not project the risk because they could not find the pattern of land used in Jakarta in the past and could not predict how land will be used in the future. Because of that, using a combination of sea level rise and land subsidence factor, they simulated that in 2030, Jakarta would face USD 521 million loss risk caused by flood (Budiyono, Aerts, Tollenaar, & Ward, 2016).

In order to minimize flood risk or to overcome the sinking problem, some action needed to be conducted. Because the problem was arising from international and local problem, Indonesian government has to act in both areas. On the international areas, Indonesia has already joined on the United Nations Framework Convention on Climate Change (UNFCC).

Climate change is a global issue that is not separated by national borders because emissions anywhere affect people everywhere (Figueres, 2015). In 1992, United Nations (UN) promoted an international action as a foundation for minimizing climate change. Numerous countries enlist the United Nations Framework Convention on Climate Change (UNFCC) as international framework cooperation built to fight climate change by limiting average global temperature increases (UNFCC, 2016). The purposes of the convention was to secure greenhouse gas concentrations "*at a level that would prevent dangerous anthropogenic (human induced) interference with the climate system*"(UNFCC, 2016). In 1995, UNFCC created The Kyoto Protocol in which formally tied up developed country parties to emission reduction targets (UNFCC, 2016). Then, on 12 December 2015, hundreds of countries were taking a further action on combat climate change at the Paris Agreement, one of them was Indonesia.

For the local action, Indonesian government has implemented NCICD project to overcome the capital city from sinking. To minimize Jakarta sinking problem, Indonesian government has been working together with Netherlands government implement NCICD project. The project aim is to provide a solution for long term protection of Greater Jakarta against flooding from the sea and the rivers; to create a new space to the National Capital by expanding seaward in a planned matter; to solve the current connectivity problems of West Java and Banten; and to address many of the current environmental problems (Kementerian Koordinator Bidang Perekonomian, 2014). NCICD project is chosen among other two alternatives to solve Jakarta's flood problem as shown in figure 5.

Basically, NCICD project is an improvement of a master plan for drainage and flood control for Jakarta by Netherlands Development Company (NEDECO) in 1973. NCICD is synchronizing basic principles of NEDECO 1973 with the current condition because land subsidence level and sea level rise need to be overcome immediately (Kementerian Koordinator Bidang Perekonomian, 2014). The basic principles of NEDECO 1973 are diverting the river flow from upstream through the flood channel, protecting low lying area with polder scheme, an draining the excess water that is not through the polder to the sea through a gravity channel (Kementerian Koordinator Bidang Perekonomian, 2014).

Due to river dikes in many places not high or strong enough, river pumps become clogged with sediment and population increased, it is impossible to create a reservoir at onshore. Thus, an offshore solution is needed to solve the problem.

NCICD is an offshore solution to create giant outer sea wall in the Jakarta Bay and offshore huge pumping lake (Kementerian Koordinator Bidang Perekonomian, 2014). In addition, land reclamation which also included in the project was purposively built to provide residential land for Jakarta's people. Combining the sea wall with land reclamations, a solid and unbreakable sea defense can be made. The retention lake behind the dike will have a lowered water level which facilitates free discharge of rivers. To realize it, NCICD itself consists of three phase which is phase A, phase B, and phase C (Kementerian Koordinator Bidang Perekonomian, 2014).

Phase A of NCICD aim was strengthening the existing dikes in which has been threatening due to land subsidence and sea level rise. Beside that dikes enforcement that already started at 2014, phase A NCICD also would build seven polders and another six dikes to protect Jakarta

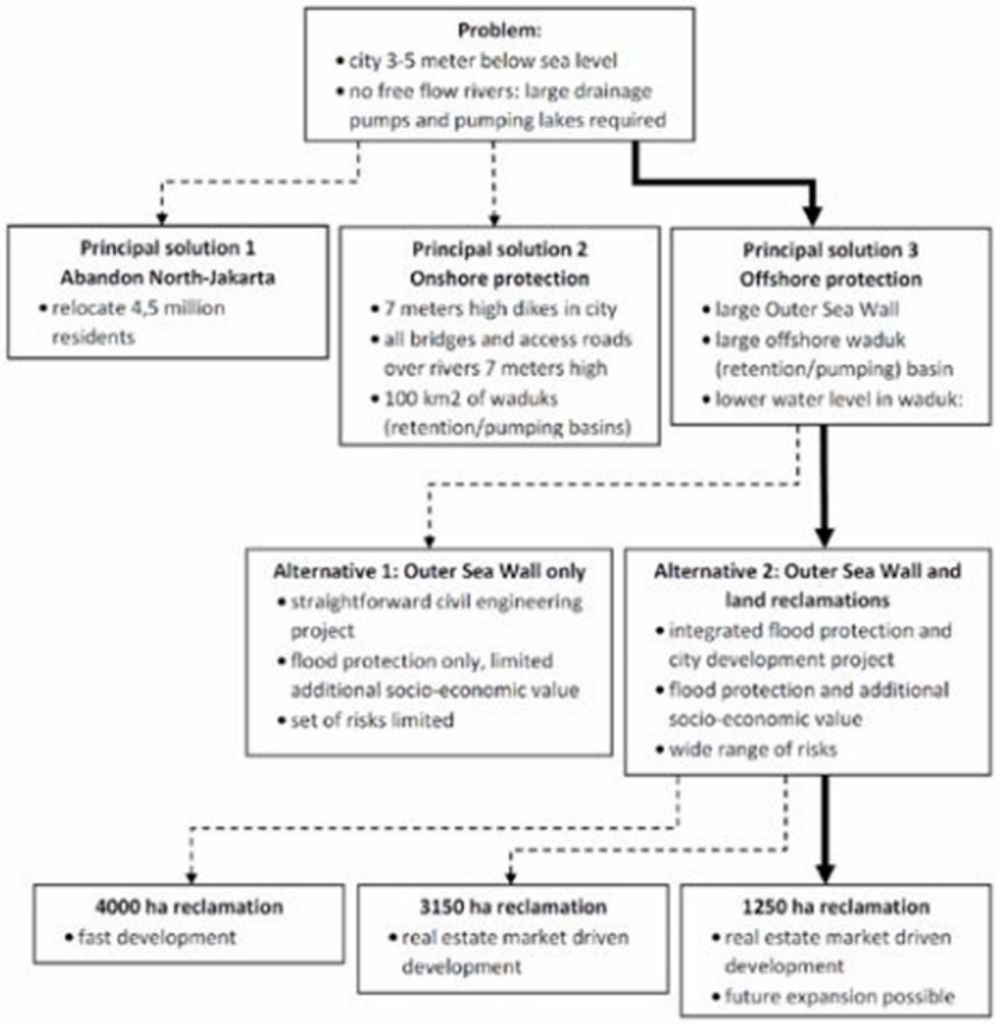

Figure 5. problem and Alternatives solution for Jakarta
Source: Kementerian Koordinator Bidang Perekonomian (2014)

from the tidal flood (Kementerian Koordinator Bidang Perekonomian, 2014). In accordance to that, phase B NCICD will create the Great Garuda-national bird symbol in which consists of another sea wall in outer rings of Jakarta and land reclamation. Moreover, in the future, Jakarta will develop phase C after 2040 because it is prepared for long term development of east lagoon of Jakarta. (Kementerian Koordinator Bidang Perekonomian, 2014). With phase A and phase B combined, it will produce 1250 ha new land and will be used as a central business district, housing, and retails. Figure 6 describe the master plan of reclamation and sea wall in northern of Jakarta.

On the NCICD Master Plan, Indonesia Coordinating Ministry for Economic Affairs stated that it needs USD 1.9 billion to finish phase A and USD 4.8 billion for phase B. In order to minimize the burden to national or city budget, private sector takes a leading role in the development of NCICD project (Kementerian Koordinator Bidang Perekonomian, 2014). Hence, private company will get revenue from land reclamation because 45% of the total area will be covered with buildings. (Kementerian Koordinator Bidang Perekonomian, 2014).

In addition it also needs ground water management. Beside overcome tidal flood caused by sea level rise, Jakarta should also implement a comprehensive action to overcome the land subsidence problem. Jakarta government already realized that ground water extraction needed to be stopped since 30 years ago (Kementerian Koordinator Bidang Perekonomian,2014). Thus, DKI Jakarta government already issued Rule no 1 year 2004 about Tax for Retrieval and Utilization of Ground Water.

However, land subsidence is still happening in Jakarta. It is still happening because many governmental buildings still extract ground water without any penalties or paying groundwater taxes (Kementerian Koordinator Bidang Perekonomian, 2014). The increase of urban population and massive building con-

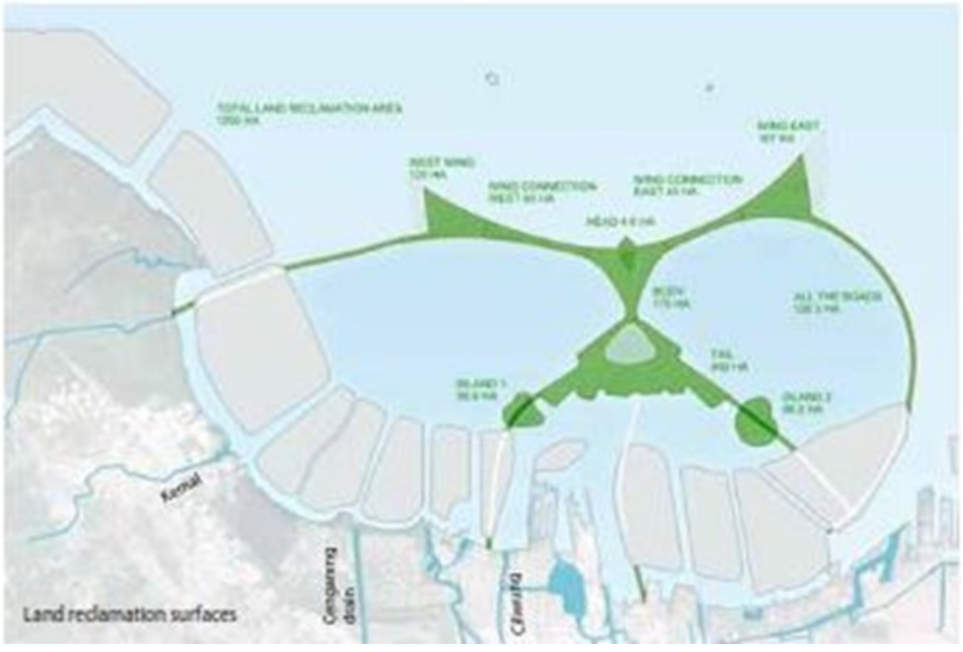

Figure 6. Land reclamation and sea wall in northern of Jakarta
Source: Kementerian Koordinator Bidang Perekonomian (2014)

struction which need huge volume of water is also another problem attached with ground water extraction.

In 2012 Jakarta also issued Spatial City Planning for 2030 to minimize the city ground water extraction. On article 77 of The Planning, Jakarta government limited the ground water extraction and restricts water pumping by a tall building. On that spatial planning, Jakarta also prioritized developing a clean water system and network by building clean water production installation, increasing today water clean network capacity, and utilizing a new source of clean water alternatives.

Jakarta is an urban area located in the coastal line which facing higher risk caused by sea level increase. Some other big city in the world also facing the same risk, but they were already successful in minimizing the flood risk caused by sea level rise. For instance, Russia successfully built sea wall in order to protect St. Petersburg city from sea level rise flood. In addition, South Korea also finished their Saemangeum land reclamation project in order to enlarge their land and build a new city. Therefore, Indonesia could learn from Russia and South Korea related to the project because NCICD project consists of two main project which are building giant sea wall (phase A) and land reclamation (phase B).

In 2011, Russia completed the multibillion dollar construction of flood protection complex in St. Petersburg to protect the second biggest city in Russia from potentially devastating flood. Having population of about five million people, St. Petersburg is located in the area where the delta of the river Neva meets the waters of the Gulf of Finland at the eastern end of the Baltic Sea (Hunter, 2012). Flood was the main problem of the city because since 1703 until 2005, a total 300 floods with peaks higher than 160cm sea level has been recorded (Gerritsen & Villars, 2015). The flood created a huge damage for the city and destructed public infrastructures.

To protect the city from the flood, Russia built a flood protection barrier on the outside of Neva Bay. Working together with Netherlands and United Kingdom, Russia successfully finished 25.4 km long dam with 100-200m wide and 7-16m deep at the estuary of Neva River (Hunter, 2012). Consumed about USD 3 billion, the barrier consists of: eleven rock and earth embankment dams (separated with channel openings); six sluices to accommodate the water flow; the road on the embankment of the dam; and complex navigation channels (Hunter, 2012). Thus, besides protecting the city from the flood, the barrier also improved navigational safety and created a recreational area along the bay without damage the environment (Hunter, 2012).

Questioned for the environment impact at 1987, the barrier itself did not harm the ecosystem or change the Neva bay environment. The completion and the operation of the barrier met relevant Russia and EU environmental and health and safety standards and has no significant negative impacts on the environment of Neva Bay and the Gulf of Finland compared to the existing situation (Hunter, 2012). It happened because on the predicted assessment NEDECO (2002) stated that the barrier would not change the pattern and velocities of hydrodynamic flow, hydrobiology (plankton and fishes), and water quality. In addition, St. Petersburg City Government also implemented an integrated water management in order to balance various needs and users of the water system for sustainable development of water (Mikhailenko, 2005).

While in Korea In 2010, South Korea completed the world longest seawall as the part of Saemangeum project. Saemangeum was a massive project purposively to reclaims the sea for industry and agricultural land. The 33 km long sea wall enclosed 401 km2 sea areas on the southwestern of Korea. The project also will

transform 283km2 areas into a rice field and 118km2 areas as water reservoir (Lie et al., 2012). South korea government has already spent USD 2.6 billion dollars on the project and tends to finish it despite the environmental concern.

It is argued that the water flow and sea tidal on the inner circle of the seawall are lower than the outer circle (Park et al., 2014). Besides that, the seawall also blocked the free exchange between sea water and fresh water (Lie et al., 2012). Thus, it changed the inner circle environment condition such as creating intensification of vertical stratification, increasing the occurrence of red tide, and depleting the oxygen level (Lie et al., 2012). Moreover, the seawall also caused a massive death of fish and changed birds migration (Lie et al., 2012).

Learn from St. Petersburg and Saemangeum, Jakarta could implement NCICD project until phase A (increase the dikes level) without continuing into phase B (land reclamation). With that policy, the pattern and velocities of hydrodynamic flowing inside and outside the wall will not change. Hence, it will not affect the tidal flow inside the wall and keep the environment safe. In addition, Jakarta could build a wall alongside the area experiencing land subsidence and increasing the river dike.

Learn from St. Petersburg and Saemangeum, Jakarta could implement NCICD project until phase A (increase the dikes level) without continuing into phase B (land reclamation). With that policy, the pattern and velocities of hydrodynamic flowing inside and outside the wall will not change. Hence, it will not affect the tidal flow inside the wall and keep the environment safe. In addition, Jakarta could build a wall alongside the area experiencing land subsidence and increasing the river dike.

Jakarta government should ensure that the Spatial City Planning for 2030 is well implemented. The implementation of the rule could decrease land subsidence in the city because the framework for groundwater utilization was already stated on article no 77. Moreover, Jakarta government also should change ground water with pipeline water by implementing Water Allocation Master Plan (Kementerian Koordinator Bidang Perekonomian, 2014). It is argued that the two actions could reduce land subsidence level on Jakarta.

CONCLUSION

Located in the coastal line, Jakarta is facing higher risk on flooding caused by sea level rise. Beside the risk caused by sea level rise, the city also facing land subsidence problem as the results of the rapid urban development. With the increase of sea level about 1cm per year and land subsidence about 11–13 cm per year, it is predicted that Jakarta will be sinking in the near future. Using a combination of sea level rise and land subsidence factor, it is projected that in 2030, Jakarta would faces USD 521 million loss risk caused by a flood.

To minimize the risk, Indonesian government already joined and signed the Paris Agreement. It was an embodiment in the international community in order to minimize GHG effect and reduce climate change. In addition, Indonesian government also launched NCICD project in order to protect the capital city from sinking. The project consists of two main actions which are building a sea wall and land reclamation. Besides that, the city municipality also issued some new rules in order to minimize the ground water extraction which is recognized as major cause of land subsidence.

However, the land reclamation as the part of the NCICD project is argued to cause an environmental disaster on Jakarta bay. It happens because the land reclamation would cause changes in distribution patterns of temperature, salinity, suspended particles, dissolved heavy metals

and sediment in the waters of Jakarta Bay.

To avoid the condition, it is suggested that the NCICD plan is conducted by increasing the sea wall without land reclamation. Sea wall would not affect the sea tides inside or outside the wall. St. Petersburg sea wall and Saemangeum reclamation are the best learning example for Jakarta. St Petersburg sea wall successfully protects the city without damaging the environment, while Saemangeum land reclamation already caused an environment disaster.

In addition, it is also suggested that Jakarta government should ensure that the City Spatial Planning is well implemented. New rules on the ground water extraction also have to be obeyed comprehensively. That condition is needed in order to reduce land subsidence in the city.

ACKNOWLEDGEMENT

The author thanks to colleague in University of Glasgow and Persatuan Pelajar Indonesia United Kingdom for their support to success this work.

REFERENCES

Abidin, H. Z., Andreas, H., Gumilar, I., Fukuda, Y., Pohan, Y. E., & Deguchi, T. (2011). Land subsidence of Jakarta (Indonesia) and its relation with urban development. *Natural Hazards, 59*(3), 1753.

BAPPENAS, 2007. Damage and Loss Assessment Report, Post-Flood Early in February 2007 in the Region Jabodetabek (Jakarta, Bogor, Depok, Tangerang, and Bekasi).Jakarta.

Budiyono, Y., Aerts, J., Brinkman, J., Marfai, M. A., & Ward, P. (2015). Flood risk assessment for delta mega-cities: a case study of Jakarta. *Natural hazards, 75*(1), 389-413.

Budiyono, Y., Aerts, J. C. J. H., Tollenaar, D., & Ward, P. (2016). River flood risk in Jakarta under scenarios of future change. *Nat Hazards Earth Syst Sci Discuss, 3*, 4435-4478.

Change, I. C. (2014). Synthesis Report Summary Chapter for Policymakers. IPCC, 31, 2014.

Figueres, C. (2015). Take urgent action to combat climate change and its impacts. *UN Chronicle, 51*(4), 30-31.

Firman, T. (2009). The continuity and change in mega-urbanization in Indonesia: A survey of Jakarta–Bandung Region (JBR) development. *Habitat International, 33*(4), 327-339.

Gerritsen, H., & Villars, M. T. (2005). Operational management of the Saint Petersburg flood protection barrier: Report on the International Workshop, 19-20 May 2005, Saint Petersburg, Russia. Z3979.

Hunter, P. (2012). The St Petersburg Flood Protection Barrier: design and construction.

Jevrejeva, S., Jackson, L. P., Riva, R. E., Grinsted, A., & Moore, J. C. (2016). Coastal sea level rise with warming above 2° C. *Proceedings of the National Academy of Sciences*, 201605312.

Lankao, P. R. (2008). Urban areas and climate change: Review of current issues and trends issues paper for the 2011 global report on human settlements. National Center for Atmospheric Research.

Lie, H. J., Cho, C. H., Lee, S., Kim, E. S., Koo, B. J., & Noh, J. H. (2008). Changes in marine environment by a large coastal development of the Saemangeum reclamation project in Korea. *Ocean and Polar Research, 30*(4), 475-484.

Mikhailenko, R., (2005). Flood and Coastal Defence and Integrated Water Management for St. Petersburg, St. Petersburg.

NEDECO, (2002). St. Petersburg Flood Protection Barrier Environmental Impact Assessment Study Executive Summary, St. Petersburg.

Park, Y. G., Kim, H. Y., Hwang, J. H., Kim, T., Park, S., Nam, J. H., & Seo, Y. K. (2014). Dynamics of dike effects on tidal circulation around Saemangeum, Korea. *Ocean & coastal management, 102*, 572-582.

Perekonomian, K.K.B., (2014). Draft Master Plan of Integrated Development of Coastal State Capital. Jakarta.

Poerbandono, A., Julian, M. M., & Ward, P. J. (2014). Assessment of the effects of climate and land cover changes on river discharge and sediment yield, and adaptive spatial planning in the Jakarta region. *Natural hazards, 73*, 507-530.

Sagala, S., Lassa, J., Yasaditama, H., & Hudalah, D. (2013). The evolution of risk and vulnerability in Greater Jakarta: contesting government policy. Institute for Resource Governance and Social Change, Kupang, Indonesia.

Stern, N. (2006). The Stern Review: The Economics of Climate Change Executive Summary. 11.

Taniguchi, M. (Ed.). (2011). Groundwater and Subsurface Environments: Human Impacts in Asian Coastal Cities. Springer Science & Business Media.

Texier, P. (2008). Floods in Jakarta: when the extreme reveals daily structural constraints and mismanagement. Disaster Prevention and Management: *An International Journal, 17*(3), 358-372.

UNFCC, (2016). Background on the UNFCCC: The international response to climate change. Change, United Nations Framework Convention on Climate. Available at: http://unfccc.int/essential_background/items/6031.php [Accessed March 8, 2017].

UNFCC, (2015). Indonesia Submits its Climate Action Plan Ahead of 2015 Paris Agreement. United Nations. Available at: http://newsroom.unfccc.int/unfccc-newsroom/indonesia-submits-its-climate-action-plan-ahead-of-2015-paris-agreement/ [Accessed March 31, 2017].

Zhuang, J. (2009). The Economics of Climate Change in Southeast Asia: A Regional Review. Asian Development Bank, Manila, Philippine.