



LAND SUBSIDENCE IN JAKARTA

To: Newly Hired Executive Director
Komunitas Ciliwung

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Executive Summary

To: Agus Jaelani, PhD, Executive Director of Komunitas Ciliwung (appointed 2018)

Jakarta faces a serious problem of land subsidence, with immense environmental and socio-economic impacts, especially in coastal and low-lying area of the metropolitan region. Over the past 20 years, Jakarta has been hit by several major floods. While seasonal precipitation patterns and topographical conditions indeed play a role, subsidence in Northern Jakarta, influenced directly by excessive groundwater extraction, results in increased flood vulnerability. The objective of this report is to raise awareness and gain insight into the driving factors of the land subsidence and to identify possible strategies and solutions for long-term development. The analysis will be examined from an institutional perspective which, besides analyzing the social, economic and environmental fronts, will highlight some other historical context factors during the colonial, growth and privatization era. The present report provides a thorough analysis of this urban system issue by revealing a wide range of direct, indirect, and hidden factors. Significant findings of this study are as follows:

- Context factors include an exploitative approach for managing water resources, inadequate government structure, poor municipal land use management and rapid urbanization, and privatization of the water supply.
- Ongoing damage and losses to competitiveness could hurt Jakarta's economy and amplify existing social and political tensions.
- Subsidence is an issue that involves many fields of expertise and requires an integrated approach.

Land subsidence will increase the maintenance and rehabilitation costs for the affected environment, economic and social aspects. It is recommended that progressive government agencies in Jakarta metropolitan region, such as the BKSP, develop partnerships with communities to address the diverse issues present in this case. Both, technical and institutional strategies need to be developed to confront the potential problems and consequent impacts by the land subsidence. We invite you, as the new executive director of Komunitas Ciliwung, based on your previous ties with the municipal government, your expertise in regional water management, and your commitment to equity in metropolitan decisionmaking, to lead the way in building this relationship for the improved quality of life of Jakarta's citizens. We recommend providing funding support for community initiatives to support monitoring and advocacy activities in addition to enhancing communication through bi-annual meetings where community and government stakeholders are present to measure progress, gain feedback and delegate duties.

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1. Introduction

Jakarta, encompassing 662 square kilometers, is located in northwest Java, along the coast of the Java Sea in the Ciliwung River estuary; the Ciliwung River splits the city into the western and eastern halves, with the northern area consisting of plains and the southern part, hills (Akmalah and Grigg 2011). The urban area sits atop various landforms, such as alluvial flood plains, swamps and mangroves, and those of marine origin (Abidin *et al.* 2015b). As Indonesia's capital, the main land uses include industry, trade and commerce, manufacturing, consumer and government services (Djaja *et al.* 2004). According to the World Bank (2015), 12 municipalities or regencies comprise the Jakarta metropolitan area, referred to as Japodetepok. Between 2000-2010, the growth rate of Jakarta exceeded that of any other East Asian city and as of 2013, this region includes 10 million people (World Bank 2015). Islam is the most predominant religion and a total of 30 ethnicities were reported on the 2010 national census, including Javanese (40.22%) and Sundanese (15.5%), and Chinese Indonesians comprising a minority group. Japodetepok displays patterns of heavy fragmentation. The built-up area crosses three provinces, including Greater Jakarta, Banten, and West Java; 37% live in Greater Jakarta while another 42% reside in West Java (World Bank 2015). Fragmentation also occurs politically in the form of extreme decentralization at the metropolitan level (Ward *et al.* 2013; Laquian 2005). According to Firman *et al.* (2011), no agency is in charge of risk and vulnerability assessments or climate-related data collection and information dissemination. Various tiers of government are responsible for different aspects of the regional water system; for example, the Ministry of Public Works manages river systems, while various provincial Public Works offices deal with drainage and local works. A level lower, municipalities and districts in the three provinces (Ward *et al.* 2013) carry out their own tasks. Furthermore, the agency BKSP (Coordinating Body for Jakarta Metropolitan Region Development), is responsible for the coordination, planning, and monitoring of Japodetepok's development. Although these activities are of prime importance for the regional urban system's functioning, it lacks power in implementing them (Ward *et al.* 2013; Firman *et al.* 2011). It is under these circumstances that the flooding and land subsidence situation has emerged.

Land subsidence poses an immediate threat to the Jakarta metropolitan region by enabling regular and severe flooding which adversely affects quality of life and basic urban functioning of the city. Lack of institutional capacity by Jakarta's government to distribute water to the whole population and conduct proper land use management are main contributors. Even worse, certain stakeholders have reinforced such issues by addressing this problem from too narrow a lens, using a grey infrastructure engineering approach. Instead, this problem must be addressed at both a regional spatial scale and within a time scale of 10 years before other phenomena like sea level rise or unpredictable precipitation patterns threaten to completely inundate northern Jakarta. Three root causes are mentioned, beginning with the Dutch colonial government's choice to settle in a landscape poorly suited for urbanization and their attitudes toward managing land and water resources. Following this, it is the inadequate government structure post-independence, which contributes to Jakarta's current political and spatial fragmentation and inability to control growth wisely. Lastly, privatization of the water supply, directly contributes to the immediate cause of land subsidence, excessive groundwater extraction and its impact on the social, economic and environmental front.

2. Impacts

2.1 Environmental impacts

2.1.1 Urban Sprawl: Increase in population and built up areas

Numerous factors have led to foreign investment in Jakarta such as high-quality infrastructure, skilled labour and entrepreneurs, and ingress to mass markets; this resulted in high urbanization rates in Jakarta and neighbouring areas. As a result, population grew along with the demand for built up areas, causing reduction in green areas (Abidin *et al.*, 2011; Firman and Dharmapatni 1995, p 179). Green areas constituted more than 35 percent of Jakarta's area in 1965, but now this lies only at 9.3 percent (Rukmana 2008). Furthermore, the surrounding area along the perimeter has also developed. This reduction in green space has negatively affected the recharge capacity of the aquifers. Urban development overall has led to watershed degradation (Firman and Dharmapatni 1995, p 179). For instance, the catchment of Ciliwung River fell from 66 to 38 percent in 30 years (1970 to 2000) and lost an entire green area by 2008. Forest cover has declined due to rising demand for settlements and industries, and loss of vegetation has been more pronounced on downstream and on the coast (Padawangi and Douglass 2015, p 525). Along with urban development and the subsequent loss of green cover, construction of roads, buildings have covered the land surface with impervious material (Firman and Dharmapatni 1995; Parai *et al.* 1994); consequently, surface runoff has increased sixfold. This also results in floods of high frequency and high peak flow. Excess runoff combined with blockage in the city's sewer and storm water drainage system, lack of maintenance, and land subsidence resulted in the massive 2002 flooding (Padawangi and Douglass 2015).

2.1.2 Impact of subsidence to urban development

Subsidence, will affect the drainage system of the city by reducing its function and decreasing its elevation; this may cause floods during seasonal rains. It further affects the coastal areas by making them prone to sea level rise in the near future. The flow pattern of surface water may change, and flooding inundation areas may get enlarged due to differential subsidence (Abidin *et al.*, 2011). The southern part of the Jakarta Metropolitan Region, which serves as water catchment area, has witnessed commercial agriculture activities. Flood frequency is enhanced due to steep slopes, extreme cultivation, and high rainfall all of which exacerbate surface runoff and soil erosion. As a result, the Ciliwung River transports more than 500,000 tons of sediments annually (Firman and Dharmapatni 1995, p 180). This sedimentation has led to a reduction in the depth of flowing rivers (Yoesoef and Hidayat 1993). Due to limited facilities, personnel, and the lack of land for sanitary landfills, 50-60 percent of the solid waste is collected, and the remainder goes to the rivers (Firman and Dharmapatni 1995, p 180).

2.1.3 Excessive use of groundwater

Water requirements have increased due to the population growth and economic activities. The supplies from piped treated surface water are inadequate; this leads to groundwater extraction, which is also cheaper (Colbran 2009, p 20). The Citarum River is the main source of the piped water supply. The water through the piped system reaches only 60 percent of residents, and in certain areas, 24 hours water supply is not ensured (Padawangi and Douglass 2015, p 534). In addition, in certain areas like Kampung Pulo,

the quality of piped water is unfit for consumption, so residents use water from the pipes only after floods to clean their homes (Padawangi and Douglass 2015, p 535). The population relies on shallow extraction (less than 40 m.) of groundwater in which the rate of extraction per well is low, whereas, industry has conducted deep extraction (more than 40 m.) which has a high rate of extraction per well (Abidin *et al.* 2011; Padawangi and Douglass 2015, p 535; Firman and Dharmapatni 1995, p 179). This excessive pumping of groundwater affects the piezometric water level (Setyawan *et al.* 2015, p 20); the level changed significantly from 12.5 m., above the sea level in 1910 to 30-50 m., below the sea level in the 1990s. (Soetrisno *et al.*1997). Poor sanitation and sewerage services have led to contamination of groundwater. Research depicts that 63 percent of groundwater was contaminated by *Escherichia coli* in 2007. It was found by the Ministry of Environment that due to the presence of liquid waste (often sourced in Bogor, West Java) in the Ciliwung River, the biochemical oxygen demand and chemical oxygen demand increases which poses threat to aquatic life (Padawangi and Douglass 2015, p 535; Firman and Dharmapatni 1995, p 179), while the increase in sea surface temperature is affecting the coral reefs and poses a threat to the biodiversity (Measey 2010, p 43).

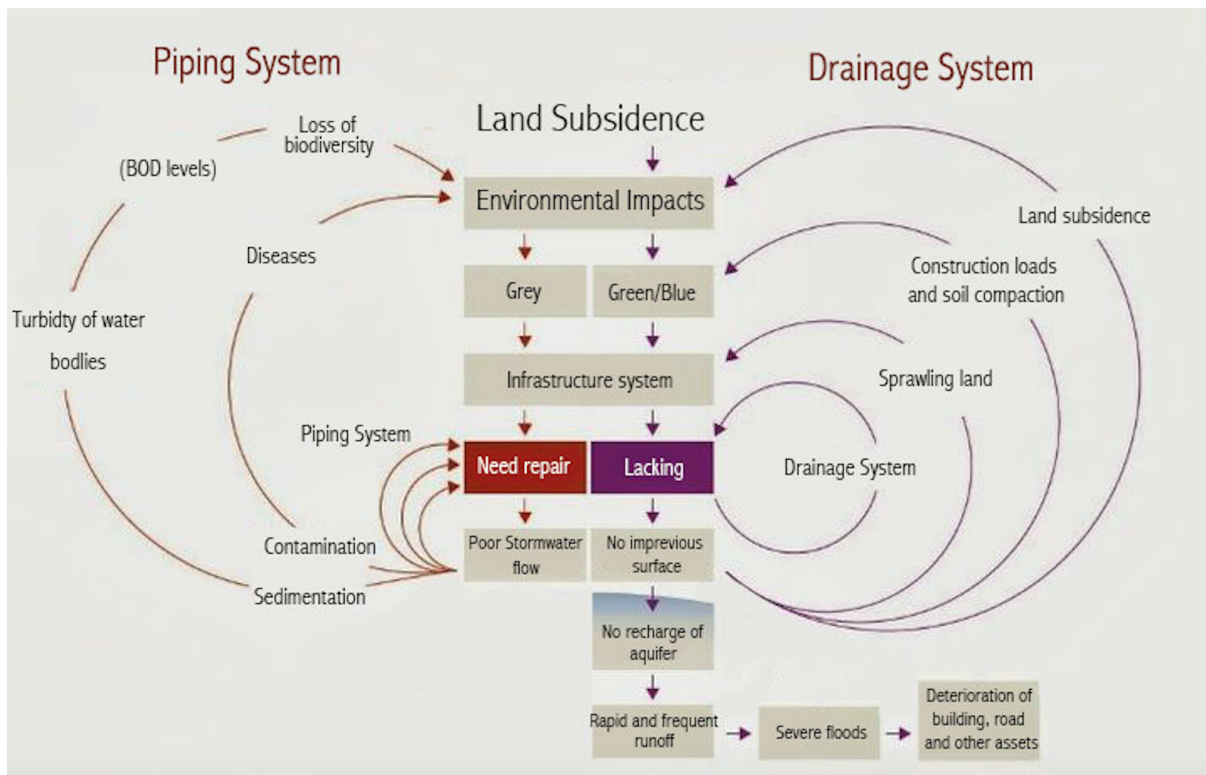


Figure 1 The Flowchart of Environmental Impacts

2.2 Economic impacts

As it mentioned previously, land subsidence impacts can be categorized into environmental, economic, and social impacts, which are also highly related to each other and form a well-connected system (Abidin *et al.* 2015) as seen in Fig. 2. The immediate economic impact is caused by the costs paid in damage from flooding. Over the past 20 years, Jakarta has been hit by several major floods, particularly in the rainy

season (winter months). The flood in 2007 was the most seriously national disaster, which caused a total loss of nearly 565 million US dollars. In January 2013, another major flood caused by the excessive rain inundated 98,000 houses and incurred total damage costs worth as much as 775 million US dollars (Wijayanti *et al.* 2016), as direct economic impacts. The data below shows that flooding is the major factor of the short-term economic impact in Jakarta.

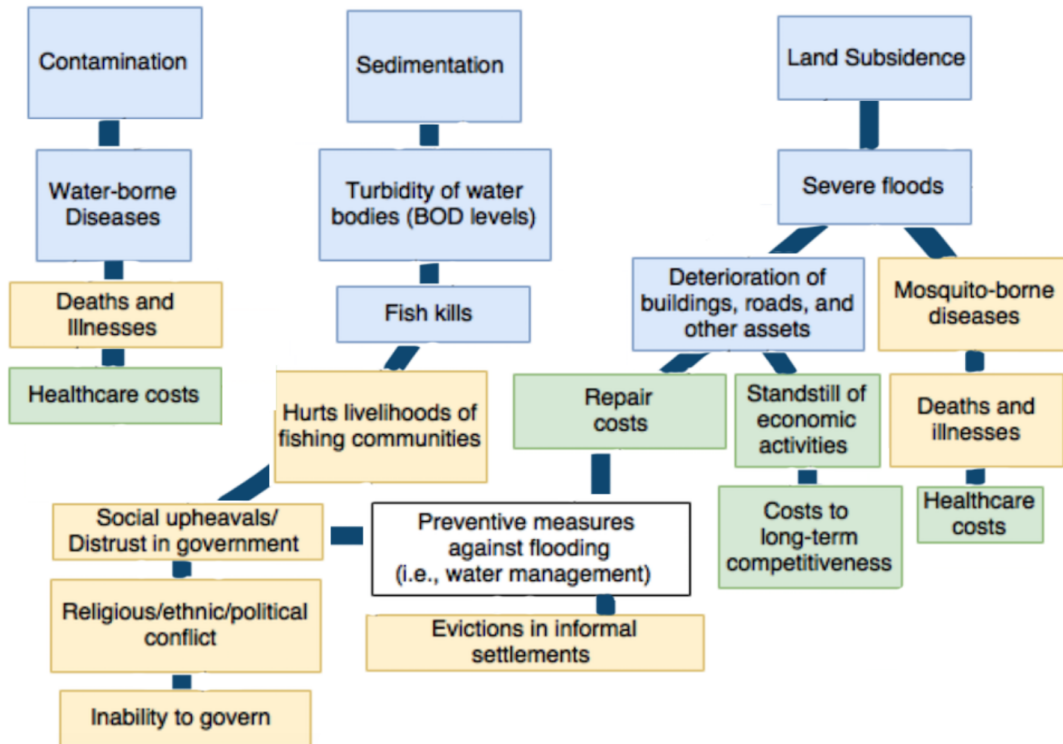


Figure 2 Economic and Social Impacts (blue: environmental; green: economic; orange: social)

The city is prone to flooding, not only because of seasonal precipitation patterns and topographical conditions but also because of land subsidence in the short-term (next 10 years) and climate change (Firman *et al.* 2011). In terms of indirect impacts, the floods worsened by land subsidence result in large scale threats to competitiveness, ranging from increasing maintenance costs of infrastructure, decreases in land and property values over time, and standstills in the economy. For example, mass evacuations lead to traffic gridlock, which affects daily commerce. In addition, regular flooding disasters negatively affect Jakarta’s reputation, potentially scaring away foreign direct investment. The above Fig.2 has indicated that rapid population growth and urbanization is putting a strain on land subsidence. Since the start of the 21st century, Jakarta’s government has experienced a 147% increase in maintenance costs of public infrastructure assets due to the sinking of properties from land subsidence and coastal flooding (Kreibich *et al.* 2011). With the emergence of potential losses due to land subsidence in Jakarta, costs will continue to increase and cannot be underestimated in urban development. At present, areas which have a high subsidence rates only account for approximately 25% to 30% of the total volume in Jakarta and the average housing price has already shown a downward trend from 2013 to 2015 (Sindi 2015). Moreover, businesses are highly reliant on functional infrastructure and a stable environment; repeated coastal flooding along Jakarta’s coastline will further deteriorate the domestic economy and bring more disruption to business

activities. In 2013, hundreds of social and business events were canceled due to coastal flooding; it is no doubt that land subsidence will further lower Jakarta's competitiveness to other cities in the next 10-20 years (Chaussard *et al.* 2014). Overall, the characteristic of economic impacts due to land subsidence can be listed as the following four main representations:

- increases in maintenance cost of infrastructure
- decreases in land and property values
- disruption to economic activities
- lowers the city competitiveness of business development

2.3 Social impacts

Between December and February of each year, North Jakarta's residents are condemned to live surrounded by pools of water and forced to leave their homes because of the severe floods that batter their city. Massive evacuations take place and the breakout of spreading diseases becomes a major threat. In the last 20 years, three major floods were registered. In 2002 floods killed 21 people and forced 380,000 to leave their homes (Mydans 2007); in 2007, the worst and relentless floods took place, they killed 70 people and displaced more than 340,000; in 2013, 29 people died and 37,000 needed to be evacuated (Majcher 2014). Flood waters affect poor and wealthy people in Jakarta, but the way each cope with the consequences is conspicuously different.

Flood waters are not the only problem Jakartans have to deal with. As part of a supposed strategic plan to reverse the situation, the Indonesian central government and the Jakartan government have been carrying out numerous evictions, being the low-income people the most affected. In addition to this, the construction project of a massive seawall (NCICD) to prevent floods to keep striking Jakarta, has started, and along with this, additional social issues have also surfaced.

2.3.1 Evacuations and diseases

Low-income people are the most vulnerable to the effects of flooding. As buildings in the poorest neighborhoods get flooded, families flee their homes to find shelter in schools and mosques. Evacuations in these areas are carried out by rafts and high wheeled vehicles, and access is restricted (Mydans 2007). Transitional shelters often lack the capacity to host and provide services to refugees; inadequate cleanliness, insufficient food and water, and inappropriate bedding increase their vulnerability to post-flood diseases (Fahrial 2014). Aggravating factors such as the weather, with an average external temperature of 30 °C, makes the situation worse. Clean water supply is a major problem as well, as it takes from two to three weeks, after the floods have stopped, to restore the service. On the other hand, wealthy residents who have their homes affected, book five-star hotel rooms to stay until the flooding recedes and pay for delivery of clean water (Mydans 2007).

There are several diseases closely related to post-flooding. These can be classified in three categories: food and water borne, rat borne, and mosquito borne. Resulting infections include cholera, dysentery, rotavirus and typhoid fever. Mosquito borne diseases are the most dangerous among the post-flooding diseases. Dengue Hemorrhagic Fever (DHF), is transmitted through the bite of a specific type of mosquito which lives, grows and reproduces in stagnant water. During the floods in 2007, Jakarta reported and

unprecedented outbreak of DHF, with floodwaters covering more than the half of its land. Jakarta became paralyzed (Fahrial 2014).

2.3.2 Evictions and Jakarta's administration policy

Forced evictions have become a common practice developed by the Jakartan authorities; the most affected are, without a doubt, the poorest residents. Eviction have been carried out for more than 15 years in Jakarta as a result of Indonesian security forces activities who are backed by the Jakartan administration. (COHRE 2012, pp 113,31). In 2015, the Jakarta Legal Aid Institute reported that near to 32,000 people were subjected to forced evictions between 2007 and 2012; which represented a record since the city was founded (Zulfikar and Beni 2016). Livelihoods and communities are disrupted as their residential areas are often situated close to workplaces, such as the sea for fishermen and markets for traders. Finally, this has an intergenerational effect, as the education of displaced children is affected as it is difficult to find new schools. Jakartan authorities justify these acts arguing that they are part of a program implemented to improve the city and to fight back floods; that those are not evictions, but relocations. Contrary to the Jakartan administration arguments, evictions tend to adversely affect the city's low-income populations whose historical tenure rights are overlooked. Apartments, hotels, shopping malls and luxury residences, which are built in water catchment areas tend to be omitted during evictions (Koesoemawiria 2017, pp 1-2; Zulfikar and Beni 2016).

2.3.3 The National Capital Integrated Coastal Development (NCICD) masterplan

The NCICD is part of a new plan initiated in 2014 by the Jakartan government and the Indonesian central government to enhance flood prevention, foster urban development and become a more prestigious metropolis. The NCICD project aims to enhance existing coastal dikes along 30 kilometers, construct 17 islands in the bay of Jakarta and to erect a 32-kilometer protective seawall (known as Great Garuda), which will also accommodate 'condo-like' urban development areas on its surface to attract private investors. The NCICD cost is about US\$ 40 billion, and it is being financed by the Indonesian and Dutch government along with private investor (Indonesia Investments 2016). Indonesian scientists, land activists and local residents have protested this project, viewing it as a land grab. They are afraid that it will wreak environmental and social disaster and hurt the lives of traditional fishing communities by enclosing the Java Sea and increasing turbidity, or even worse turning it into a 'septic lagoon' which hurts aquatic life. With little sewage treatment for the river water pouring into the bay, this corporate attempt to "sanitize" Jakarta's waterfront could end up having exactly the opposite effect (Sherwell, 2016). A local fisherman from Muara Angke, claims the issue is the lack of consultation to his community, stating that "there was not any discussion, or announcement to [his] community from government. [It's] as if Jakarta Bay is theirs" (Bentley, 2016). Such hidden impacts resemble a greater trend of 'climate apartheid', where technical flood management is used as a weapon to increase socio-economic divides. Various political, religious, and ethnic conflicts have ensued based on the polarization this debate has generated. In the end, the likely but hidden winners are the Dutch engineering companies, who as partners, gain technical expertise from the experimental process of water management projects and can export this knowledge worldwide.

No.	Category	Levels	Representation of impact
1	Environmental	direct	Contamination of natural water sources
			Turbidity/ Sedimentation - effect on biodiversity
		indirect	Severe Floods
			Disaster Risks Deterioration of infrastructures such as building, roads and existing pipe/ drainage systems
2	Economic	direct	Immediate economic damage by the flooding
		indirect	Increases in maintenance cost of infrastructure
			Decreases in land and property values Lowers the city's business competitiveness
3	Social	direct	Human fatalities and massive evacuations Vulnerability to post-flooding diseases
		indirect	Massive forced evictions perpetrated by the government
			Disruption of social activities (work and education)
4	Hidden	indirect	Climate apartheid
			Political, ethnic and religious conflict

Table 1. The Characteristics of land subsidence impacts

3. Context factors

So far, the web of complex, intertwined environmental, economic, and social impacts from land subsidence and the flood disasters have been mentioned. However, explaining three historical context factors, broken down into events and decisions made from the 18th century onwards, the 1960s, and then the 1990s, might do more justice. Such events and structures create path dependencies and become the root causes of land subsidence and severe flooding.

3.1. Colonial Era: (1600s-1800s)

Managing periodic flooding episodes and lagging behind in infrastructure is nothing new for Jakarta or the region of Japodetepek as a whole. It all began with a Dutch legacy of fighting back the water. Back during the Dutch colonial regime, Jakarta, then named Batavia, was a small port city on the alluvial plain of the Ciliwung River, slightly above sea level and affected by seasonal floods from the difference in tide levels (Caljouw *et al.* 2005). As with many coastal cities, the land was poorly suited for urbanization. This marked the beginning of an attempt over the next three hundred years to engineer the city and region out of its vulnerability and to control the Ciliwung River through diversions, damming, dredging, dike building and poldering; especially as the “river tried to retake its old bed” (Caljouw *et al.* 2005, p 467). All of these projects were intended to protect the old town as well as the colony’s centre, Menteng. Today, even the Dutch have learned that grey infrastructure has its limits and that green-blue approaches are necessary, even when it requires giving back highly valued land to water bodies like the ocean, lakes, and rivers, for flooding. According to Abeyasekere (1987) as cited by Caljouw *et al.* (2005), the government grew complacent to the regular flooding, no longer bothering to provide or maintain proper infrastructure. Instead of technological inertia, there was institutional inertia. Both, the colonial and post-colonial government did little to regulate externalities from agriculture and resulting land exploitation (i.e., the sugar industry), which worsened the contamination and blockage of waterways.

3.2 Growth Era: (1960s- 1980s)

Jakarta has acquired the reputation as a failed city as it lacks the capacity and will to provide basic services (Kimmelman 2017). Upon independence in 1949, Japodetepek experienced rapid growth like many other areas in the world, but its inability to control it or build accommodating infrastructure stems from its weak institutions. Agricultural exploitation of Indonesia's islands like Kalimantan and even parts of Java led people to flee to pursue urban life in Jakarta. According to Padawangi and Douglass (2015), "quarter million new migrants" are added to the region annually and by 2020, the population of Japodetepek could be 35 million (p 522). Jakarta experienced an economic boom, which brought in foreign direct investment and made it the nation's headquarters for the country's heavily resource-driven economy (Abidin *et al.* 2011; Abidin *et al.* 2015b; Padawangi and Douglass 2015; Verburg 2000). Jakarta's development patterns display a significant decline in population density over time, from 300 people/hectare in 1970 to 169 people per hectare almost twenty years later (Murakami *et al* 2005, p 6). Even outside Jakarta's city boundaries, in Puncak and Bogor which are upstream the Ciliwung, demand grew for new towns and gated communities, all of which symbolize the middle-class lifestyle (Padawangi and Douglass 2015). Without regional planning, there was no way for infrastructural development of a drainage or piping system, to catch up. According to Olesen (2012), a trend of "roll-back" neoliberalism started in the 1980s around the world. In Jakarta, this did not help the situation, as it led to a distrust in government-based planning and welcomed market-driven growth instead. The government of Jakarta continues to treat the flooding epidemic as a water management issue; however, it has not looked more holistically at regional land use patterns and their effects on the land and water ecology as major contributors. According to Padawangi and Douglass (2015), this behavior is common for other Asian cities, not just Jakarta.

3.3 Privatization Era (late 1990s)

The most recent root cause of the chronic flooding in Jakarta can be attributed to structural adjustment programs with the World Bank in the late 1990s as part of the government-led so-called 'water reform process'. Historically, Jakarta had a formal system consisting of piped water inherited from the Dutch in the colonial era, however, an informal system also exists (Kurniasih 2008). Post-independence, the formal system was managed by the government via the local water company PAM Jaya until 1997, when Jakarta's government sought to repair its water infrastructure with the World Bank's assistance. Under the promise of neoliberalization (Olesen 2012), Jakartans trusted the private sector to have better managerial capacity, stronger financial capacity, and better experiences and technological capacity to solve Jakarta's water supply issues. The loan package consisting of US \$46 billion after the 1990s financial crisis (Zaman 2003 as cited by Kurniasih 2008). Among the loan conditions was privatizing the city's water supply. This decision limited accessibility to water by a majority of Jakarta's population. In 2007, it was reported that a mere 61% could access the system (Kurniasih 2008, p 2). Heavy reliance by residents on the informal water supply ensued which partially explains the illegal and excessive extraction of groundwater. Coupled with the massive growth and industrialization of Indonesia's economy as stated above, Jakarta became a center for industries having to dig deep wells to keep up with this growth.

4. Driving factors of change

It is valuable to compare responses to the environmental and social factors that are embedded in the land subsidence and flooding crisis, as some responses may tackle root causes while others only address the symptoms. Responses can be categorized into two groups, one applying a grey infrastructure focus and

the other to a green-blue infrastructure focus. The latter approach to improving the situation is predominantly community-led. It tries to reduce vulnerability to flooding, particularly for marginalized populations, while also changing governance structures, altering harmful land use practices, and conducting resilience planning. The former ‘water management’ response, consists of mega projects like the government’s concrete embankment programs, the Jakarta Comprehensive Flood Management Plan (Padawangi and Douglass 2015), and the Great Garuda sea wall project (Sagala *et al.* 2013). However, social acceptance by the marginalized population impedes change using this approach. Such solutions are seen as short-term fixes to an immediate problem, but they have perpetuated social tension by blaming and hurting the city’s poor. Contrary to what government officials and Dutch engineering consultants believe, extreme weather does not contribute to the flooding disasters. Through this misjudgment, they tackle the wrong problem through their grey infrastructure approaches, while neglecting land use practices, poverty, and weak institutions, all of which increases vulnerability to increasing floods.

On the other hand, many communities and NGOs have identified the linkages between poverty, weak institutions, and environmental problems; systemic poverty often contributes to resource extraction and pollution upstream and a lack of preparedness downstream in areas like Muara Angke. NGOs like Ciliwung Merdeka and Komunitas Ciliwung have applied a blue-green infrastructure lens to moderate the root environmental and social causes (i.e., impervious surfaces, construction loads) and also reduce social and economic impacts (i.e., emergency flooding) of the land subsidence problem. Such “nonstructural measures” are adopted based on claims that innovation must occur on a governance and institutional front instead of just technological (Sagala *et al.* 2013). On the resilience side is the development of various capacity building projects (i.e., early warning systems, rapid disaster response, monitoring of water levels, river conditions, polluters, and fish species, and mapping of development patterns to substitute for inefficient government programs). Mapping land use patterns and using this as evidence to advocate for changing land use practices is another powerful driver of change. In addition, expanding efforts such as legal advocacy and knowledge sharing helps strengthen the network across communities to fight for their rights as tenure holders or sue the government for negligence when large-scale evictions in the name of ‘solving’ the land subsidence problem occur (Padawangi and Douglass 2015).

5. Conclusion

Underlying economic, social, political, historical, and technical forces brought about the more immediate causes of land subsidence and flooding in Jakarta, which have further intensified aforementioned upheavals. Recognizing that land subsidence is an issue that can be traced back to both, institutional and technical limitations, land subsidence should be addressed by both grey and green-blue flooding mitigation measures across Jakarta’s region. Therefore, we propose that certain government agencies, especially those that are not subject to as much corruption, develop combined approaches, in partnership with communities. NGOs like Komunitas Ciliwung can facilitate this process and partnership. To some extent, this has already begun (Padawangi and Douglass 2015). All of these actions potentially bring about a power transfer from central government to local government and residents (Sagala *et al.* 2013). Both technical engineering and resilience strategies are needed to confront the challenges that cause and worsen land subsidence and consequent impacts. However, policies by these departments, such as those that upgrade riverside housing and renovate communities instead of evicting and relocated, are slow to come through, often due to firmly established government beliefs and practices and weak institutions. Lastly, governance innovation could lead to an integrated regional strategy, in which environmental conditions across Japodetepek as well as migration policy and demography are considered (Sagala *et al.* 2013).

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Appendix

Brief Statement of Authorship:

Executive Summary- Halina, Huan

Introduction-

Jakarta background: Halina, Edward

Problem statement: Everyone

Impacts

Environmental Impacts - Nikita

Economic Impacts - Huan

Social Impacts - Edward

Root Causes- Halina and partly Edward (water privatization section)

Driving Factors of Change/Conclusion- Nikita and Halina

Charts & Graphs – Halina, Huan