Jakarta's Sinking: A Look At Current Initiatives

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Land Subsidence and Floods in Jakarta

Land subsidence has occurred or is presently occurring in major Asian cities, with Jakarta's being the most visible and gaining an international media reputation as 'the sinking city' (Bott et al., 2021; Colven, 2020). Land subsidence was recognised in 1926 in Northern Jakarta from optical levelling, but the first reports of subsidence-related impacts on infrastructure and flooding date back to 1978 (Abidin et al., 2001; Erkens & Stouthamer, 2020). It has been estimated that the total extent of the potential coastal flooded area in Northern Jakarta could expand by 110.5 km² by 2050 (Takagi et al., 2021). Rapid urban growth in Jakarta and the surrounding region has expanded dramatically in the sectors of industry, trade, transportation, real estate, and many others in recent decades. Jakarta has a shortage of clean drinking water and still lacks piped water services. With an excess of water in the soil, many residential and commercial sectors and industries extract groundwater excessively, resulting in a major issue of land subsidence in Jakarta.

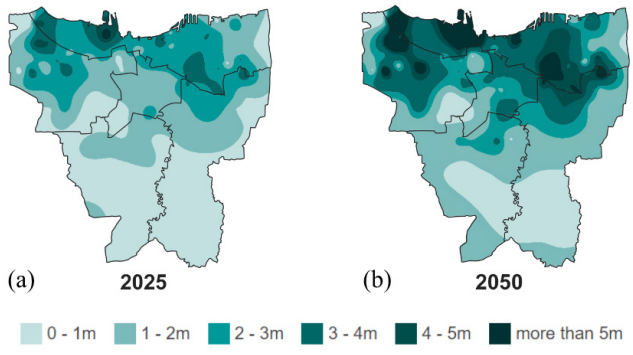

Figure 1. Jakarta's Land Subsidence Prediction. Image **(a)** illustrates the predicted land subsidence in Jakarta in 2025, while image **(b)** illustrates the predicted land subsidence in Jakarta in 2050 (Lin & Hidayat, 2018)

In recent years, land subsidence in Jakarta has reached up to 20 cm per year in the worst affected places (Takagi et al., 2021). The effects of land subsidence in urban areas can be seen in various forms, from the cracking of permanent constructions and roads, 'sinking' houses and buildings, changes in river canal and drain flow systems, broader expansions of coastal and/or inland flooding areas, to increased inland seawater intrusion (Abidin et al., 2016).

Other factors, such as increased rainfall and rising sea level, cause chronic flooding in Jakarta. For instance, during rainy seasons, floods in most of the areas in Jakarta recede quickly. However, some areas of Jakarta, e.g. Pluit, already need to pump river water up into the sea continuously due to its location below mean sea level (Bott et al., 2021). Furthermore, unsustainable groundwater extraction, building and construction burdens, urbanisation, and citizen behaviour are all uncontrolled, exacerbating the situation.

Based on this background, this opinion piece aims to remind and reflect on the regulations that have been established, preventions that have been executed, and ideas about future challenges.

Causes

The causes of land subsidence in Jakarta are primarily man-made: (1) excessive groundwater extraction (Abidin et al., 2009, 2016; Horman, 2020; Widodo, 2017); (2) high urbanisation growth (Abidin et al., 2009, 2016; Widodo, 2017); and (3) large-scale infrastructure development (Abidin et al., 2009, 2016; Colven, 2020; Salim et al., 2019; Widodo, 2017). The more developed the city of Jakarta becomes, the more people live and work there, creating a high demand to fulfil its people's basic needs. These demands include access to clean water, leisure, job, shopping, and decent housing. This phenomenon can be an opening for developers to build and satisfy the needs of the public

without considering the long-term impact on Jakarta.

In addition, Jakarta lacks open green spaces, whereas open green spaces are very important as rain absorbers to avoid flooding. According to Indonesian law number 26/2007 concerning Spatial Planning, the standard for minimum open green space areas in an urban area must be at least 30% of the area. However, Jakarta's open green spaces are currently under 10%. Therefore, the three related factors provide numerous detailed issues, such as floods, overpopulation, congestion, pollution, mentality, and a lack of green space.

Extremely fast land subsidence rates in Jakarta are mainly attributable to groundwater extraction (Colven, 2020). The sub-national governments have set groundwater policies and standards. For example, Government Regulation No. 43/2008 on Ground Water and the most recent one is Governor of DKI Jakarta No. 93/2021 on Ground Water-Free Zones. Even if regulations are established, buildings are still trying to illegally extract groundwater, manipulate water meters, and utilise illegal pipelines to access clean water. This happened because piped water utilities have only reached 66% of the DKI Jakarta population, and around 34% of the area is not supplied by piped water (Air Kami, n.d.). To achieve 100% coverage of clean water services by 2030, an additional 4,000 km of clean water pipes must be added to the current 21,000 km of pipelines.

Existing Initiatives

In order to address the causes, in 2014, the Indonesian Government implemented the master plan referred to as the National Capital Integrated Coastal Development (NCICD) to overcome the capital city from sinking. Some Indonesian governmental departments partnered with the Government of the Netherlands to minimise the sinking problem in Jakarta. The Giant Seawall project, a project under NCICD, aims to (1) provide a solution for the long-term protection of Jakarta against flooding, (2) create a new space for the National Capital by expanding seaward in a planned matter, (3) solve the current connectivity problems of West Java and Banten, and (4) address the current environmental problems (Widodo, 2017). The NCICD project consists of two main projects: building a giant sea wall (phase A) and land reclamation (phase B), expected to be finished in the next 10-15 years.

However, the project took a long time to tackle the current serious challenge, especially with the project's current situation, which appears to have faded without further updates. The previous mitigation plan for land subsidence was not adequately incorporated into the plan (Colven, 2017; Takagi et al., 2021). Prior to the construction of the offshore seawall, it was planned that the existing dike would be progressively raised to keep up with the pace of sea-level rise and subsidence (NCICD, 2014; Takagi et al., 2021). Even when the revised version of the master plan more explicitly addresses the significance of land subsidence (NCICD, 2018; Takagi et al., 2021), it can't be denied that Jakarta is one of the most vulnerable cities in the world to climate change (Firman et al., 2011; Salim et al., 2019). This massive embankment project may significantly influence the local ecosystem, which is already vulnerable. There is a strong possibility that continued land subsidence, coupled with the sea wall and sedimentation in the enclosed bay, will gradually reduce the capacity of the drainage lagoons, turning them into gigantic cesspools of urban refuse and dirty water and exacerbating flooding in the city (Salim et al., 2019). It can be argued that a large-scale project carried out over a lengthy period is inefficient and ineffective in reducing the risk of a portion of Jakarta becoming submerged by 2030 or 2050.

Inconsistency of action is a key issue in the unresolved problem of land subsidence and the programs that are frequently hampered. In addition, the incoherence of the spatial plan and implementation leads the government and stakeholders to be inconsistent in enforcing the

policies and standards that have been set. In layman's terms, there has been a lack of effective regional planning and unregulated development for years. Without comprehensive, multifaceted policies and actions, the city will soon disappear, submerged under water (Horman, 2020).

Best Practices from Which Jakarta Can Learn

(1) The Netherlands has implemented many different structures to the coastal defence systems in the past centuries. One of them is the use of groynes or sand for vulnerable coasts and riverbanks. A groyne system is made up of a number of individual groyne structures, usually of similar length and spaced at regular in tervals along the shoreline. The shore between the groynes will orient itself more or less parallel to the approaching wave crests (Perdok, 2002).

(2) Jakarta could learn from St. Petersburg in Russia because it has geographical conditions similar to Jakarta Bay, namely by building sewage to manage wastewater and drainage to absorb rainwater. These systems are built separately before building embankments to protect the city from storm surges (Tanggul Laut Raksasa, Indonesia Harus Tiru Rusia, 2016).

(3) From a monetary aspect, a recent example where a cost-benefit analysis was executed is the city of Gouda in the Netherlands (Erkens & Stouthamer, 2020; Kok, 2017). The balance between damage costs of buildings with a shallow foundation and buildings with a wooden pile foundation is reflected in the cost-benefit analyses (Kok, 2017). It shows how cost-benefit analyses, based on subsidence model outcomes, may inform decision makers, helping them to unlock the lock-in (Erkens & Stouthamer, 2020).

(4) In Tokyo, land subsidence was halted after strict regulations restricting groundwater use were implemented. The restrictions started in the early 1950s and were subsequently extended to a larger area and a larger group of stakeholders. For instance, surface water availability increased as dams were constructed in several river basins that were designated for water resource development. This gave stakeholders time to adjust and develop alternative water sources. Similarly, groundwater extraction regulation in Bangkok, Thailand, has effectively minimised land subsidence (Erkens & Stouthamer, 2020).

(5) Shanghai, China, is an example of a city with a successful subsidence mitigation strategy and a robust operational monitoring system (Erkens & Stouthamer, 2020). The city has experienced severe land subsidence as a result of excessive groundwater extraction for domestic and industrial use (Erkens & Stouthamer, 2020; Ye et al., 2016a, b). An essential element of this strategy is the monitoring network. Land subsidence in Shanghai is traditionally monitored by means of extensometers, benchmarks, and groundwater observation wells (Ye et al., 2016a).

Conclusion and Reccomendation

The major cause of Jakarta's land subsidence can be attributed in part to unregulated development by the city government for years, regardless of the fact that many regulations and standards have been set. This issue would not be solved until the main factors were addressed. For instance, enforcing strict governmental regulations and spatial plans that have been set, accelerating the water pipelines and actively monitoring the use of illegal groundwater extraction, and trying to implement nature-based solutions while involving the community. We can see how land subsidence was prevented in Tokyo and Bangkok after strict regulations restricting groundwater use were implemented.

It is difficult when all individuals lack the drive to change their minds regarding the urban challenges they are having. Many levels of society in Indonesia should be concerned about land subsidence. As a critical society, we may learn to care, be innovative, and appreciate the countries that have successfully addressed land subsidence issues. Lastly, collaboration from all levels of organisations, activists, academics, the citizens, and the government is required to minimise the issues with realistic and practical ideas.

Disclaimer

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