Anchoring the Sinking Jakarta City with Nature-based Solutions

Hasna Khadijah

Summary

This paper explores nature-based solutions (NbS) for Jakarta's current water crisis. The correlation between urban resilience and the urban water cycle that is currently changing proposes a resilient answer, demanding room for nature-based solutions. Nature-based solutions utilise nature to address environmental challenges while simultaneously creating social and economic benefits. Jakarta's past efforts to solve flood problems mostly rely on grey infrastructure and neighbourhood-scale solutions. This calls for an integrated grey and green infrastructure with a wider scale, such as the city-scale of a river-basin scale of NbS. This study mentions two examples of nature-based solutions: a living river in Singapore and sponge cities in China. Implementing nature-based solutions in Jakarta requires consideration regarding the opportunities and challenges in the city to optimise the solutions to address the water crisis.

Keywords: *Jakarta, nature-based solutions, water issue*

Introduction

"The Sinking City" is the infamous call for Indonesia's most dense city and province — Jakarta. With a total population exceeding 10 million people in December 2023 (Databoks, 2023), Jakarta is currently facing a time-ticking bomb throughout the city: a water crisis. There has been extreme rainfall and droughts in Jakarta in the last five years, with numerous news articles highlighting issues ranging from water scarcity to pollution. In March, an area in Pancoran, South Jakarta, was hit by floods up to 20 cm high after heavy rain for three hours (Jati, 2024). Land subsidence is also happening as the result of excessive groundwater use, followed by climate change and sea level rise. The National Research and Innovation Agency (*Badan Riset dan Inovasi Nasional*/BRIN) predicted the sinking of Jakarta in 2050.

More than 10 million people live at risk, as Jakarta is a business nucleus that serves as a home and workplace for those people. This study aims to discover alternative solutions from nature and adopt resilience infrastructure in Jakarta to turn the water crisis into water abundance and create a more resilient, adaptive, and sustainable city.

Jakarta Flood, A Tale as Old as Time

The local government in Jakarta has constructed some flood mitigation structures such as a polder system — pumps and dams — in the last few years (Ogara, 2021), and planned to build more as mapped out in the Regional Long Term Development Plan 2025-2045, including dams, polder/pump system, and increasing drainage capacity. One of the newest gray infrastructure to mitigate Jakarta's flood is Ciawi Dam, located in Bogor Regency. This Indonesia's first dry dam can mitigate flooding in 12 districts in Jakarta, even though it is located in another regency. However, the efforts to reduce disaster risk and build climate resilience primarily in Jakarta are still focused on conventional gray infrastructure and — other than Ciawi Dam — neighbourhood-scale solution.

Figure 1. Tanjung Barat Retention Pond/Polder construction. Construction has finished this year.
Source: Media Indonesia, 2023

Figure 2. President Jokowi (centre) after inaugurating the Ciawi Dam, Bogor Regency, West Java Province, in 2022.
Source: BPMI Setpres, 2022

Urban Water Cycle

Understanding Jakarta's water cycle requires a systemic approach; seeing water as a whole system rather than just the sum of its parts is necessary. Urban Water Cycle (UWC) is a water cycle concept that addresses crucial water systems in the city. The natural and urban water cycles have some differences, as UWC incorporates water supply, wastewater, and stormwater systems. The amount of water in the cycle remains the same; however, the treatment and where it flows needs to be better considered. Infiltration in cities happens less, and runoff occurs more often than in natural landscapes. Cities with asphalt and concrete create more surface runoff, and the overflow may overburden the water basin. On the other hand, the lower the infiltration rate, the less groundwater is being filled.

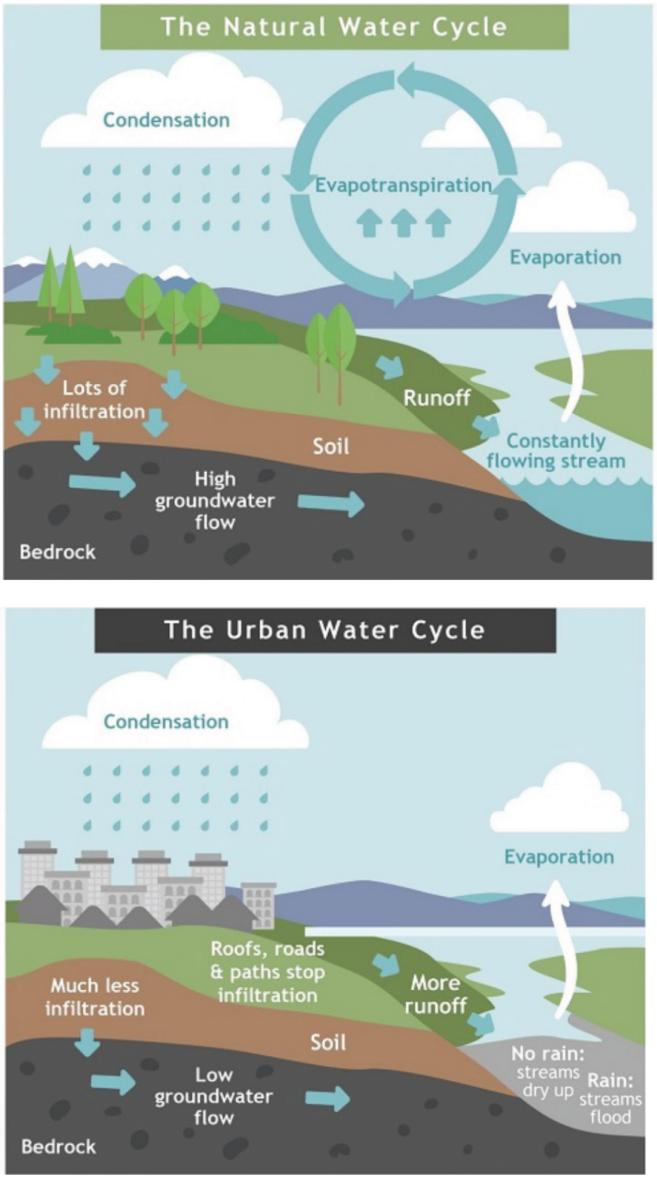

Figure 3. Figure 3. Natural Water Cycle vs Urban Water Cycle
Source: ACO Technology, n.d.

Urban Resilience

Urban resilience is the ability of a city's systems, businesses, institutions, communities, and individuals to survive, adapt, and grow when facing chronic and acute stresses (Resilient Cities Network, 2018). Urban resilience is expected to grow due to climate change, urbanisation, and land use. Whereas climate change is expected to increase the frequency and intensity of some natural hazards, urbanisation can also lead to higher city exposure of people and assets (World Bank, 2021). One of the solutions to improve urban resilience is through building

resilient infrastructure — an infrastructure system that is adaptive and robust towards urban challenges and can contribute to a more sustainable city and community.

Nature-based Solutions

One initiative in resilient infrastructure is Nature-based solutions (NbS). NbS aims to support society's development goals and protect human well-being by reflecting cultural and societal values, enhancing ecosystem resilience, and providing necessary services. It offers the unique ability to provide environmental, social, and economic benefits simultaneously (Raymond et al., 2017). Implementing nature-based solutions can act as a climate change mitigation and adaptation strategy. The climate-related ecosystem services provided can be measured and quantified into climate-related outcomes and impacts, as shown in **Figure 4** below.

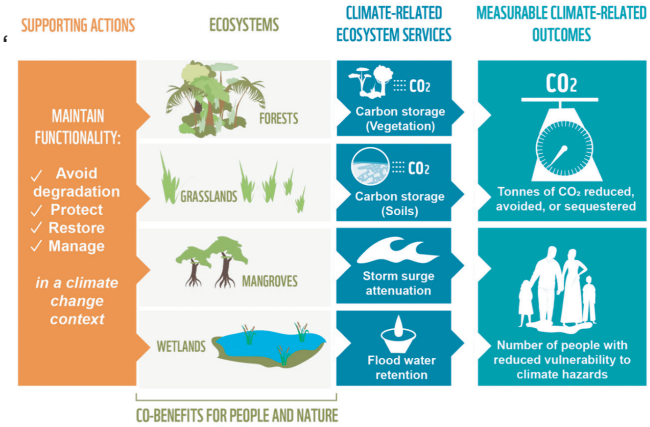

Figure 4. Nature-based Solutions for the Climate
Source: WWF, 2020

The World Banks' "A Catalogue of Nature-based Solutions for Urban Resilience" describes NbS at three spatial scales: the river basin, city, and neighbourhood scales. These three scales must be incorporated and considered because different types of NbS can be applied based on each location's characteristics.

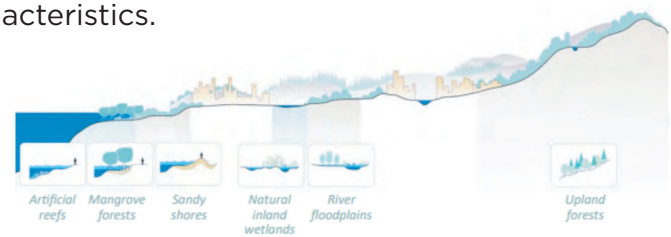

Figure 5. Schematic section of NbS at the river basin scale
Source: World Bank, 2021

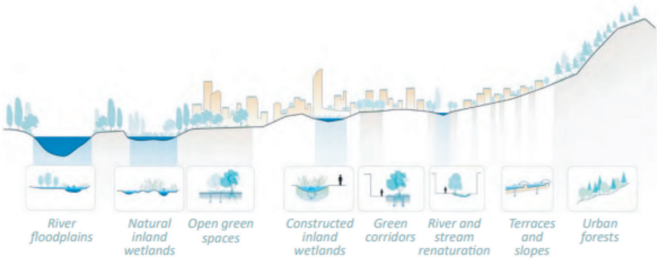

Figure 6. Schematic section of NbS at the city scale
Source: World Bank, 2021

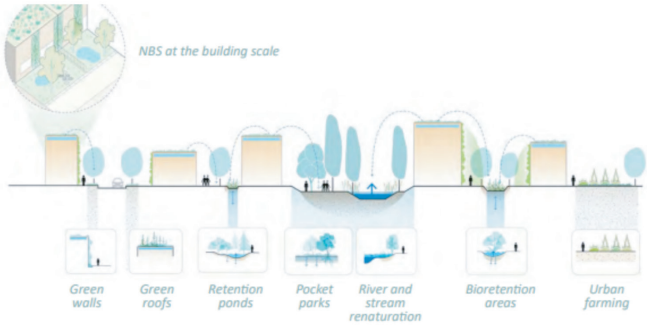

Figure 7. Schematic section of NbS at the neighbourhood scale
Source: World Bank, 2021

Addressing water issues in Jakarta can be effectively achieved through NbS. These solutions include providing clean water, enhancing filtration rates, reducing runoff, preventing floods, and protecting watersheds.

NbS Success Stories

1. Singapore's Living River

Bishan-Ang Mo Kio Park is a project in Singapore to restore its storm drain and a concrete canal and turn them into a 3-km meandering river with lush vegetated banks and wildflowers. As ecological corridors, rivers can function as flood prevention while reducing urban heat islands' effects and improving well-being through their recreational function. Senior Director of IBCD, National Parks Board, Dr Lena Chan, mentioned that while a utilitarian drain only serves one function, a naturalised stream hosts other functions, like flooding and erosion prevention by the natural vegetation, avoiding droughts, and a place for biodiversity to thrive (WWF International, 2021).

It was opened in 2012 and for around ten years since the river has been constructed, it has invited more than 100 species of birds, 40 species of dragonflies and damselflies, more than 50 species of moths and butterflies, and more than ten species of native riverine plants.

Figure 8. Bishan Ang Mo Kio Park
Source: Ramboll, n.d.

2. China's Giant Sponge City

Yu Kongjian, an urban design thinker and founder of Turenscape, is the man behind the sponge city concept of managing floods in Chinese cities. A sponge city is a city-scale urban design that has transformed hard surfaces, such as roads and pavements, into permeable surfaces that can absorb, seep, purify and store water and later release stored water for use (He, 2023). Yu pointed out the key components of the sponge city approach: stormwater should be caught using green infrastructure at the fall source, and sponges should be evenly distributed and permeable to absorb the water instead of flowing it away (Green, 2021). Instead of a conventional flood water management that often seeks drains or pipes to carry away water, a sponge city pursues to soak up rainfall and slow down surface run-off in three areas: at the source (absorbing water as it falls), through the flow (slowing down and purifying the flow through rivers and vegetations), and at the sink (empties the water at the lake or pond) (Wong, 2021).

Figure 9. An example of a sponge city project in Sanya, Hainan Province, China

Challenges & Opportunities

Adopting NbS in dense, business-centric, and sinking cities like Jakarta presents both challenges and opportunities. Jakarta faces severe urban water management, intensified by high population density and limited vacant spaces. To effectively implement NbS, it is crucial to consider the types and scales of solutions that are locally relevant and address the challenges.

One of the main challenges is the need to view NbS from both city-scale and river-basin-scale perspectives – not merely neighbourhood-scale – to ensure a holistic and sustainable approach towards the urban water cycle. Implementing NbS at the neighbourhood level can serve as a pilot project, which can be scaled up to the city and national levels by adapting to the local context. Since vacant spaces are considered rare in a highly populated city like Jakarta, NbS can be integrated with existing grey infrastructure. Furthermore, a changing climate that brings even more damaging storms may require a more ambitious approach — not only green infrastructure but a combination of green and grey infrastructures altogether (Oates et al., 2020). This integration can enhance the city's capacity to withstand extreme floods, droughts, and other climate challenges and create urban resilience.

The roles of policymakers and urban planners in implementing NbS are crucial, as we have seen in the cases of Singapore and China. The government of China plans to convert 80% of its cities into sponge areas by 2030 through

the "Sponge City Programme (SCP)" to address urban water management issues (Qi et al., 2021). Integrating NbS into long-term urban planning is essential, as it offers a systemic approach that ensures a comprehensive perspective rather than isolated climate actions. Policymakers need to be involved in creating policies and ensuring that they align with and serve public needs. Most private players tend to focus on grey infrastructure primarily for private or employee benefits rather than the public good (Lakshmisha, 2024).

Other than the significance of comprehensive policy support by the government, a study by Qi et al. (2021) on SPC also highlights the key factors of public perception in applying the programmes, integrating them into urban planning systems, and localising standards by considering specific geographical and socio-economic conditions. Considering NbS on a river basin scale will address Jakarta's hydrometeorological challenges and improve both urban and coastal resilience, especially in areas located by the sea.

In Jakarta, the majority of people with low incomes provide their own shelter in spontaneous informal settlements (Winayanti & Lang, 2004). A study indicates that NbS in informal settlements can be highly site-specific and deeply connected with the residents' needs (Wolff, 2023). The study stated that while NbS can be successfully implemented in the Global South cities, future initiatives should not only address the challenges of informal urbanisation, but also connect on a deeper level with the most vulnerable members of communities and their livelihoods. Despite the abundance of NbS projects in Global South cities, research by Lakshmisha (2024) stated a lack of empowerment and co-creation. This highlights an opportunity to empower the community through co-creation and participation in NbS projects in Jakarta.

Last but not least, implementing NbS must uphold a just principle to protect nature and ecologically and socially marginalised groups. Frameworks like the one developed by Anguelovski & Corbera (2023), which encompasses justice-centred principles for NbS policy or project, are essential to avoid greenwashing and socio-environment inequalities that can lead to socio-environmental dispossessions. This framework can help guarantee that NbS does not promote nature-for-elite profit and greenwashing but justly distributes it for the public good.

Conclusion

With Jakarta's critical water issue and unsustainable urban water cycle, NbS can be an alternative solution by developing resilient water management throughout the city. There needs to be consideration regarding the different types of NbS to each resident or area's characteristics, as NbS is a tailored solution that may differ for each site. Implementing NbS in Jakarta needs to highlight the challenges and opportunities that Jakarta possess, such as integration with grey infrastructure, community empowerment and participation, justice principles, policy support and urban planning, and a wider scale of NbS. Nature can help citizens redefine their relationship with water; people often take nature for granted. Thus, nature-based solutions highlight the overlooked benefits of living in harmony alongside nature rather than against it.

Disclaimer

The views expressed in this op-ed are those of the author or authors of this article. They do not necessarily represent the views of RDI, its editorial committee, or the mentioned speakers' affiliation.

Author
Hasna Khadijah
Bandung Institute of Technology

Supervisor
Maya Larasati
Program Officer
Resilience Development Initiative

References

Anguelovski, I., & Corbera, E. (2023). Integrating justice in Nature-Based Solutions to avoid nature-enabled dispossession. Ambio, 52. https://doi.org/10.1007/s13280-022-01771-7

Green, J. (2021, August 4). *Kongjian Yu Defends His Sponge City Campaign*. THE DIRT. https://dirt.asla.org/2021/08/04/kongjian-yu-defends-his-sponge-city-campaign/

He, B. (2023, July 20). *Sponge cities beating urban heat in China - Academia*. The Jakarta Post. https://www.thejakartapost.com/opinion/2023/07/20/sponge-cities-beating-urban-heat-in-china.html

Jati, R. P. (2024, March 15). *Floods Still Haunt Parts of Jakarta*. Kompas.id. https://www.kompas.id/baca/english/2024/03/15/en-banjir-masih-menghantui-jakarta

Lakshmisha, A., Nazar, A. F., & Nagendra, H. (2024). Nature based solutions in cities of the global South—The "where, who and how" of implementation. *Environmental Research: Ecology, 3(2)*. https://doi.org/10.1088/2752-664X/ad53cf

Penduduk DKI Jakarta Capai 11,34 Juta Jiwa, 29% ada di Kota Jakarta Timur pada Desember 2023 | Databoks. (n.d.). Databoks.katadata.co.id. https://databoks.katadata.co.id/datapublish/2024/04/03/penduduk-dki-jakarta-capai-1134-juta-jiwa-29-ada-di-kota-jakarta-timur-pada-desember-2023

Qi, Y., Chan, F. K. S., O'Donnell, E. C., Feng, M., Sang, Y., Thorne, C. R., Griffiths, J., Liu, L., Liu, S., Zhang, C., Li, L., & Thadani, D. (2021). Exploring the Development of the Sponge City Program (SCP): The Case of Gui'an New District, Southwest China. *Frontiers in Water, 3*. https://doi.org/10.3389/frwa.2021.676965

Raymond, C. M., Frantzeskaki, N., Kabisch, N., Berry, P., Breil, M., Nita, M. R., Geneletti, D., & Calfapietra, C. (2017). A framework for assessing and implementing the co-benefits of nature-based solutions in urban areas. *Environmental Science & Policy*, 77, 15 – 24. https://doi.org/10.1016/j.envsci.2017.07.008

Resilient Cities Network. (2018, October 7). *What is Urban Resilience? - Resilient Cities Network*. Resilientcitiesnetwork.org. https://resilientcitiesnetwork.org/what-is-urban-resilience/

Oates, L., Dai, L., Sudmant, A. and Gouldson, A. (2020). *Building Climate Resilience and Water Security in Cities: Lessons from the sponge city of Wuhan, China*. Coalition for Urban Transitions. London, UK, and Washington, DC: https://urbantransitions.global/publications

Ogara, Y. P. (2021, January 27). *Jakarta Optimizes Retention Ponds for Flood Mitigation*. Beritajakarta.id. https://m.beritajakarta.id/en/read/38305/jakarta-optimizes-retention-ponds-for-flood-mitigation

Winayanti, Lana & Lang, Heracles C. (2004). Provision of urban services in an informal settlement: a case study of Kampung Penas Tanggul, Jakarta. *Habitat International, 28(1), 41-65*. https://doi.org/10.1016/S0197-3975(02)00072-3

Wolff, E., Rauf, H. A., & Hamel, P. (2023). Nature-based solutions in informal settlements: A systematic review of

projects in Southeast Asian and Pacific countries. *Environmental Science & Policy, 145*, 275–285. https://doi.org/10.1016/j.envsci.2023.04.014

Wong, T. (2021, November 11). The man turning cities into giant sponges to embrace floods. *BBC News*. https://www.bbc.com/news/world-asia-china-59115753

World Bank (2021). A Catalogue of Nature-based Solutions for Urban Resilience. Washington, D.C. World Bank Group

WWF International. (2021, November 17). *Urban Nature-based Solutions: Living rivers*. YouTube.