FLOOD RISK REDUCTION MANAGEMENT IN SOUTH TANGERANG, SUSTAINABLE URBAN DRAINAGE SYSTEM IMPLEMENTATION POTENTIAL

Anisah Nur Aini

Drainage system and flood occurrence in South Tangerang

The severity and occurrence of damaging short-duration floods in urban areas have increased globally in recent years. Urban floods are caused by high frequency and extreme rainfall as a result of a combination of local urban climate variability and global warming-induced climate change (Pour et al., 2020). The Meteorology, Climatology and Geophysics Agency (BMKG) stated there was a 116.517 mm increase in average monthly rainfall in South Tangerang from 2019 until 2022 (BMKG, 2023). Flood severity could be affected by land use, land coverage, or surface coverage in the area, which affects the land surface's rainwater infiltration capability, resulting in increased surface runoff. Current urban drainage system designs, which are intended to manage runoff to prevent floods, also tend to neglect the impact of continuous land-use changes on runoff volume and peak (Ahmed et al., 2017; Anker et al., 2019).

South Tangerang, a city in the Jabodetabek-Punjur urban area, is one of four regencies/cities in Banten Province that are predicted to have more than a 50% chance of experiencing flooding in 2025 (Ruhiat, Y., 2022). Over the years, the natural landscape of the city and the shifting of land use have caused the city to frequently be flooded due to water flow from upstream and meteorological conditions (Ihsanuddin, 2022). According to the National Disaster Management Agency (BNPB) data, floods have been the most frequent disaster in South Tangerang in the last 3 years with 5 occurrences, followed by floods and landslides with 2 occurrences (BNPB, 2022).

One occurrence that might be linked to the previous data was a flash flood that occurred on January 1st, 2020, which flooded several urban areas, including an urban housing area located adjacent to the Ciputat River, South Tangerang. The flood was estimated to have been caused by torrential rain in Jakarta, which recorded the heaviest rainfall within the last 25 years. This was then exacerbated by the narrowing of the river and poor urban drainage, adding more possibility of flood occurrence (Al Dianty et al, 2021).

Pondok Aren District, Ciputat District, and Pamulang District in South Tangerang are classified as flood-prone areas (Iriani, 2016). During the latest floods in South Tangerang, on May 21, 2023, Pamulang District was hit by an 80 cm flood in residential areas for an hour, affecting around 278 households (BNPB, 2023; Akbar, 2023). Several studies have stated that major road and residential areas were always hit with short-duration floods in the last 3 years (Yulius, 2018; Astuti, 2020; Yanti, 2020; Al Dianty, 2021; Ayustiana, 2021; Fathaya et al., 2021). This occurrence was speculated to correlate with blockage in drainage systems (Yanti, 2020), increasing discharge from surrounding water bodies (Al Dianty, 2021; Fathaya et al., 2021), shallowing of drainage (Fathaya et al., 2021), poor drainage infrastructure network (Astuti, 2020), defunct and inaccessible drainage channel, and inadequate drainage capacity to convey surface runoff discharge (Ayustiana, 2021). Other problems that may add impact in severity of the floods include backwater effects occurring in a river (Al Dianty, 2021), lack of community participation in flood preparedness (Astuti, 2020), and geographic location of the region (Yanti, 2020).

Furthermore, flooding in residential areas poses health risks for public health, such as becoming a breeding place for disease vectors (Keman, S., 2005). Therefore, drainage systems in residential areas should be a serious concern to help reduce flood risk.

Government and community efforts in improving drainage systems and flood preparedness

Urban drainage systems and flooding have been a concerning issue in South Tangerang for the past few years. Drainage infrastructure, flooding, increasing runoff discharge, and narrowing and silting of rivers and canals are all tied to each other in affecting urban drainage systems; thus, a comprehensive solution is needed to help solve this issue, and various sectors have made several attempts to overcome or lessen the impact. In 2017, the government of South Tangerang City issued a regulation—South Tangerang City Regional Regulation Number 9 of 2017—regarding the implementation of Urban Drainage Systems. The regulation manages the responsibility of various actors from the government, the private sector, and the community in the drainage sector, and states that the local government is responsible for implementing urban drainage. Since flooding is one of the seven strategic issues of South Tangerang City, the government is planning to do some interventions, including the development of infiltration and storage buildings in the form of lakes and reservoirs, arrangement of drainage, provision of public green open space (Ruang Terbuka Hijau/RTH), and establishment of zoning techniques for residential zones (Siregar, 2022).

The local government, along with the Regional Disaster Management Agency (Badan Penanganan Bencana Daerah/BPBD) South Tangerang, also has facilitated the formation of the Disaster Preparedness Community. However, this activity has not been widely attended by representatives of residents frequently affected by floods (Wulandari and Salam, 2022).

Another program set by the Ministry of Public Works and Housing, Kota Tanpa Kumuh (KOTAKU), has already been established since 2016 in West Jurangmangu, Pondok Aren district. One of the program's activities including the maintenance of drainage infrastructure (Ariani, 2022). Besides those running programs, several issues related to urban drainage systems still need to be addressed and fall under different authorities, requiring coordinated work and commitment from various institutions.

Regarding the responsibility of the non-government sector, Regulation of the South Tangerang City Number 9 of 2017 states that the responsibility can be in the form of providing infiltration wells, reservoir ponds, retention ponds, and storage ponds in residential areas (South Tangerang City Government, 2017). A few communities have begun activities to reduce urban drainage and floods related problems; for example, OKP GANESPA (Organisasi Kepemudaan Gugusan Alam Nalar Ekosistem Sosial Pemuda Aktif) has maintained the condition of Situ Ciledug located in Pamulang District since 2004. They carry out various management efforts, including lake cleaning, planting tree seedlings, spreading fish seedlings, maintaining the balance of the lake ecosystem, maintaining and supervising activities around the lake and providing reports to the government. As a result of their efforts, the area of Situ Ciledug has increased by 70%, from originally 3 20 ha to 34 ha (Muara, 2013).

Meanwhile, the responsibility of the community regarding urban drainage management ranges wide from preventing waste and wastewater from entering the canals, carrying out maintenance and cleaning local drainage, preventing construction above canals and inspection roads, managing independent/personal drainage systems area, to conveying information to the local government (South Tangerang City Government, 2017).

Community participation in flood mitigation and preparedness is already being mapped in a study that shows that the level of community participation in flood mitigation efforts is relatively similar for all the districts, which revolves around reducing flood risk by cleaning sediment and increasing public awareness. However, in terms of community participation in flood preparedness, which covers community elements in handling floods, each district shows relatively different average scores. A high average score is mirrored through good coordination among the community elements in handling disasters. Varying results in community preparedness might be caused by less involvement of all related parties in the planning and evaluation phases, resulting in partial involvement of the community in terms of decision-making and plan implementation (Nisa et al., 2021).

What can we do?

As part of the community, aside from the responsibility already stated in the regulation, there are efforts that can be made at the local level to help improve urban drainage systems into a sustainable one. One of the solutions is by implementing Sustainable Urban Drainage Systems (SUDS), an integrated network of constructed vegetated areas and open spaces (e.g., green roofs, rain gardens, porous pavements, etc.) that are utilized to conserve the natural ecosystem while also providing several advantages (Tang et al., 2021). SUDS reduce runoff quantities and peaks similar to the natural hydrological cycle in processes like infiltration and retention (Jiménez-Ariza, 2019). SUDS capture flood volume and accommodate the extra runoff caused by urbanization within the catchment so that the downstream catchments are unaffected by the post-development runoff (Ashley et al., 2018; Vincent et al., 2017).

SUDS components consist of (1) source control, which means managing runoff through decreasing the volume of water entering the drainage/river; (2) pre-treatment by removing pollutants from surface water before discharging it to water bodies; (3) retention system to delay the water flow to water bodies by providing storage; and (4) infiltration system to allow water to infiltrate to the ground to recharge groundwater and reduce the flow (Woods-Ballard et al., 2015).

SUDS differs from conventional urban drainage, which is designed to let the water flow to water bodies time efficiently. Instead, it is designed to let the water infiltrate the ground but still consider the safety and main objective of drainage systems. As a result, SUDS have the potential to minimize water discharge at the end of the channel, increasing retention time to allow water infiltration, increase ecosystem connectivity, and minimize flooding risk, thus helping in the transition of urbanized areas to water-sensitive or sponge cities (Jiménez-Ariza et al., 2019). SUDS offers environmental benefits through a longer time for water to infiltrate the grounds. SUDS provide a suitable ground layer to allow runoff water to seep well, which is one of the problems urban development tends to neglect, and a suitable medium for runoff water infiltration. Dense media without pores hinder the infiltration process; thus, less runoff water infiltrates the ground and stays more aboveground, eventually leading to local floods if the drainage system does not function well.

On a community scale, some areas in South Tangerang City have started implementing SUDS, such as bio pore infiltration holes (LRB) in Pondok Aren district (Alvin et al., 2022) and Ciputat district (Safitri et al., 2019).

In the future, the development of the practice of SUDS as an effort to maintain the urban drainage in South Tangerang is expected to spread across larger areas to help reduce the flood risk. For efforts such as transitioning a conventional drainage system to SUDS, the government, especially the public works department, could imitate a good practice from Gurugram City, India. This study used SUDS components, infiltration trenches, and retention ponds to improve conventional drainage systems to SUDS and found that there is a significant improvement in the resilience of the UDS, proving the efficiency of SUDS in mitigating pluvial floods (Guptha, 2022).

Conclusion

As flooding becomes more frequent and severe, flood risk reduction management should be implemented more thoroughly, incorporating both managerial and design aspects; one of the potential methods is by implementing SUDS. Aside from implementing a small to mid-scale sustainable drainage system to help reduce the risk of flooding as short to mid-term solutions, SUDS designs could be set to be mandatory in the new development process as a fundamental step in creating a more water-sensitive city in the future. Successful implementation of SUDS requires the collaboration of various actors to design, construct, approve and maintain the system, and wide knowledge of covering flood risk management, water quality, biodiversity, and facility management to obtain long-lasting multiple benefits. The implementation of SUDS to reduce flood risk might be challenging but still could be implemented well through collaborative work between local government, the private sector, and the community.

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Author
Anisah Nur Aini
Poltekkes Kemenkes Jakarta II

Supervisor
Firdha Laila Amalia
WWM Research Officer
Resilience Development Initiative

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