THE | DIPLOMAT

FEATURES | ENVIRONMENT | EAST ASIA

Are ‘Sponge Cities’ the Answer to Shenzhen’s Water Scarcity?

Shenzhen is facing its worst drought on record. Can authorities find a holistic, long-term solution?

By **Genevieve Donnellon-May** and **Guangtao Fu**

January 05, 2022

Credit: Depositphotos

Like many other countries, China is facing a multitude of water and water-related challenges, including flooding and droughts, which are linked to climate change. In the past few decades, water-related concerns in China have increased in both intensity and frequency, impacting not only society, but also infrastructure and the environment, resulting in economic losses of more than 250 billion renminbi ($36 billion) between 2007 and 2016.

This month, Shenzhen, a city of 17.5 million residents in southern China that is often referred to as “China’s tech hub,” is facing its most severe drought on record. The Dongjiang River Basin, which supplies over 90 percent of the city’s water supply, is suffering the worst drought since 1963. As a result of La Niña, the drought is likely to worsen in the winter and spring, leaving Shenzhen facing a daily water shortage of more than 1 million cubic meters. Currently, the city’s residents consume approximately 5.4 million cubic meters of water daily. Though a Cape Town-like “Day Zero” crisis seems still in the distance for Shenzhen, the current drought has sparked debate over long-term solutions to meet the increasing water demand of Shenzhen and the Greater Bay Area.

Sponge cities have been promoted by the central government as a sustainable solution for urban water problems in China. In a sponge city, nature-based solutions are implemented to infiltrate, retain, and store stormwater for future water use. Are sponge cities the solution to prevent droughts and the most severe scenario – "Day Zero" – in Shenzhen?

Shenzhen's Main Water Source and Water Concerns

Over 90 percent of Shenzhen's water supply is from the Dongjiang River (East River), a tributary of the Pearl River. The Dongjiang River provides water to over 40 million people and five other major cities, including Hong Kong and Guangzhou. The Dongjiang River Basin, which covers an area of 35,340 square kilometers, has great economic value for the regions and for China. In 2019, it contributed an enormous 4.2 trillion RMB ($660 billion), or 40 percent of the total GDP of Guangdong Province. However, the Dongjiang River Basin is one of the most water-scarce river basins in China, a concern that is further exacerbated by water pollution.

At present, it is estimated that the Dongjiang River's three main water reservoirs hold 55 percent less water than in previous years, causing widespread concern in the region. Shenzhen's water stress is exacerbated by its rapidly increasing population and economic activities. This has resulted in a great shortage of freshwater resources in the city. As a result, Shenzhen's average per capita water resources were 223 cubic meters for 2018 and 154 cubic meters for 2019, which is a mere tenth of the

average in all of Guangdong province, and just one-thirteenth of China's national average.

Last year, Shenzhen's yearly water consumption jumped by 9.3 percent as of mid-December, much higher than the 2 percent increase in previous years. Official estimates from Shenzhen Water Group (the local water utility) predict that Shenzhen used over 1.9 billion cubic meters of water in 2021, which is 150 million cubic meters more than in 2020. As a result, the city will reach a new high in total water consumption and scale, as noted by Zhang Jian'an, a Shenzhen water authority resources authority official. However, Shenzhen will also face an estimated water shortage of 890 million cubic meters by 2030.

The Local Government Response

The local government's response so far has been to implement various measures to reduce water consumption. In October 2021, local authorities issued a level 4 alert for the drought in the Pearl River. On November 1, the Guangdong provincial authorities launched a level 4 emergency drought response and decreased the amount of water taken from the Dongjiang River by 10 percent.

To fill the 1 million cubic meter daily water shortage, the city's emergency reserve waters (in local drinking water reservoirs) can supply 500,000 cubic meters every day. The other half of the shortage would be solved through water conservation and reuse. For example, Shenzhen's residents are encouraged to flush toilets with water previously used to launder clothes. To support such measures, departments in the city are also seeking to reduce water consumption by increasing the use of recycled water in construction, environmental

sanitation, shopping malls, and urban greening industries. In addition, mains pressure reduction has been applied to reduce water loss in the water distribution systems, which accounted for 9.22 percent of water supply in 2019.

In addition to these emergency measures, three potential long-term solutions could also be considered to safeguard Shenzhen’s present and future water security: the use of sponge cities, interbasin water transfer projects, and nature-based solutions for integrated river basin management.

Regearing Sponge Cities for Drought Management

A potential solution to Shenzhen’s is the use of “sponge cities” (海绵城市). Sponge cities, an integrated grey-blue-green solution for urban water management, are considered a paradigm shift for sustainable urban planning and management in China.

Sponge cities seek to reduce the impact of urban surface-water flooding, water shortages, and the consequences of rapid urbanization by promoting water security, water environmental protection, and water ecological restoration. This concept is influenced by the ancient Chinese concept of human-nature harmony development and Low Impact Development, as well as by various successful sustainable stormwater management concepts, including the United Kingdom’s Sustainable Drainage Systems, Australia’s Water Sensitive Urban Design, and Singapore’s Active, Beautiful, and Clean Waters.

The key feature of the sponge city concept is a systems-based approach to infiltrating, retaining, storing, reusing, and purifying storm

water, only discharging it into the sewer and river as a last resort. The sponge city concept marks a transformative change of China's water management from the engineering-oriented paradigm to a more holistic and nature-based approach, which aims to strengthen the sustainability of the urban water cycle.

As part of the sponge city concept, the use of alternative water supplies is strongly encouraged. Alternative or unconventional water sources, such as desalinated water, treated greywater, and harvested rainwater, can supplement non-potable water supplies. In 2020, water reuse in Shenzhen totaled 125.5 million cubic meters (recycled wastewater amounted to 120.7 million cubic meters and recycled rainwater 4.8 million cubic meters), accounting for about 6.21 percent of total water supply. Shenzhen aims for recycled wastewater to reach 15 percent of its total water supply in comparison to 27.4 percent in Beijing and 40 percent in Singapore. This demonstrates that there is great potential in Shenzhen to use alternative supply sources.

The construction of sponge cities in Shenzhen is largely aimed at tackling urban flooding and pollution problems. Shenzhen, one of the 14 pilot cities chosen by the central government in 2016, has already completed 2,888 projects with a total of 276 square kilometers of urban areas (or 28.3 percent the city's built-up areas) meeting the sponge city criteria by 2020. Shenzhen aims to reach 80 percent by 2035.

As part of the criteria, the construction of sponge cities aims to prevent flooding from 100-year storm events, but no clear targets for

drought management have been put in place. As a result, green measures are purely perceived as an approach for flood risk reduction, without addressing the needs for water demand management and water reuse. To mitigate these concerns, the construction of sponge cities should be configured for wider benefits in drought and flood management. For example, dual purpose rainwater harvesting systems could be installed for drought mitigation and flood management. Active control of green infrastructure systems or stormwater storage facilities is aligned with the needs of water supply.

Interbasin Water Transfer Projects

The second potential long-term solution is to build additional interbasin water transfer projects to divert water from one area to another. Water diversion projects create many socioeconomic benefits and may also result in ecological benefits, by recharging groundwater as well as lakes, rivers, and wetlands. An enormous water transfer project is already in place for Hong Kong’s water supply: the Dongshen Project. Initiated in 1960, and formally inaugurated in 1965 after the 1963 Hong Kong water crisis, the water diversion project transfers water from the Dongjiang River in Guangdong. Since then, it has been upgraded several times to reach the current water transfer capacity of 2.423 billion cubic meters per year, and supplies water to Hong Kong, Shenzhen, and Dongguan. However, this water diversion project cannot bear the burden of supplying water to Shenzhen.

In July 2017, the “Framework Agreement on Strengthening Cooperation between Guangdong, Hong Kong and Macao and Promoting the Construction of the Greater Bay

Area" solidified the concept of the integrated Guangdong–Hong Kong–Macao Bay Area. The Framework Agreement drew a blueprint to optimize the investment and business environments of the nine cities in the Pearl River Delta. However, building the Greater Bay Area undoubtedly increases enormous pressure on already highly stressed water resources and environments.

Part of the solution is the Pearl River Delta Water Resources Allocation Project, which is expected to be complete by April 2024. The project stretches from Liyuzhou on the main stream of the Xijiang River in the west to Shenzhen Gongming Reservoir in the east, covering the core urban agglomeration of the Pearl River Delta. According to the project proposal, 1.708 billion cubic meters of water will be diverted from the Xijiang River, located in the upper reaches of the Pearl River Basin, and the mainstream of the Pearl River, to the eastern section of the Pearl River Delta. It is expected that this project will not only solve water shortage problems in Guangzhou, Shenzhen, and Dongguan, but also provide a backup water supply for the Greater Bay Area.

However, water transfer projects are linked to severe environmental and social consequences. These include forced relocation of residents, water quality deterioration, species intrusion, and the loss of biodiversity and habitat. In 2020, China alone had 140 water transfer projects, including those currently under construction. Although restoration programs and laws, such as the Yangtze River Protection Law, may be implemented, they usually require enormous investments. In addition, they can also encounter various concerns. For example, the benefits of the national restoration program in

China being offset by droughts in several ecological restoration zones.

Nature-based Solutions for Integrated River Basin Management

A third potential solution for water security in the Greater Bay Area is to use nature-based solutions (NBS) for integrated river basin management. Cities cannot be sustainable without the support of their hinterlands. This is particularly true for water security as water transfers in the Greater Bay Area need the integrated management of the Pearl River Basin. Nature-based solutions are sustainable planning and management that use natural processes into the built environment to promote resilience to tackle concerns such as climate change mitigation, droughts, floods, and stormwater management.

As such, they are activities inspired and supported by ecosystem processes to fulfil human and societal needs, and can play a role in protecting rivers for people and nature by strengthening community resilience, particularly in urban contexts. Implementing NBS in Shenzhen and its hinterlands could protect and restore the ecosystem services, providing a long-term sustainable water supply to the Greater Bay Area.

Nonetheless, implementing NBS is not without concerns. The first challenge is developing a fair payment mechanism to support environmental and ecological restoration in water resource regions. The second concern is the establishment of monitoring systems, which are needed to understand both the current and future state of the environment. These systems are also needed to support governments and policymakers in making informed decisions on

river basin management. The third issue is stakeholder participation. Stakeholders in this instance include not only governments (local and central) and institutions, but also various interest groups such as non-governmental organizations (NGOs) and the public. With each stakeholder having a vested interest in river basin management and achieving sustainable development, also falling in line with China’s dual aims of “ecological civilization” and “beautiful China,” differences of opinion are likely. As policy formulation and implementation does not reflect the goals of all stakeholders, whose opinions should be prioritized over others?

To tackle water scarcity in Shenzhen, sponge cities should be regeared from reducing flood risks and runoff pollution to reducing freshwater demands and increasing water supply through rainwater and wastewater reuse. Further, green solutions must be expanded beyond sponge cities to wider river basins. Doing so will enable the development of integrated water resources management plans to sustain long-term water security across the Greater Bay Area.

AUTHORS

GUEST AUTHOR

Genevieve Donnellon-May

Genevieve Donnellon-May is a research assistant with the Institute of Water Policy (IWP) at the National University of Singapore. Her research interests include China, Africa, transboundary governance, and the food-energy-water nexus. Genevieve’s work has been published by The Diplomat, Inter-Press Service, and the Wilson Center’s China Environment Forum.

GUEST AUTHOR

Guangtao Fu

Guangtao Fu is a professor of water intelligence at the Centre for Water Systems, University of Exeter. He is also a Royal Society Industry Fellow working with Northumbrian Water Limited. Guangtao holds a Bachelor's degree and a Masters in Hydraulic Engineering from Shandong University, and a Ph.D. in Water Resources Engineering from Dalian University of Technology, China.

TAGS

Features Environment East Asia China China water diversion projects China water scarcity Dongjiang River Greater Bay Area Pearl River Delta Shenzhen Shenzhen drought sponge cities