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CHINA ENVIRONMENT FORUM

Sponge City: Solutions for China's Thirsty and Flooded Cities

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On Wednesday, June 21, 2017, authorities in Beijing, Tianjin, and Hebei warned residents to prepare for a storm that could trigger flooding and possibly landslides. Flood warnings have become all too common in China: In 2013, more than 230 Chinese cities experienced floods. But Mother Nature is not entirely to blame; the cities' outdated drainage systems are quickly overwhelmed and sprawling concrete gives stormwater runoff no place to go.

Flooding is just one of the major water management issues facing China's urban areas. More than half of China's cities are considered water scarce, and more than 400 rely on groundwater sources for drinking water, even though 60 percent of groundwater qualifies as relatively or very polluted.

If these water challenges are unresolved, they could have significant economic and security implications for China. Urban flooding poses serious safety risks and causes tremendous economic losses. Water scarcity could hamper many of China's most pressing policy objectives, including continuing urban growth and achieving food self-sufficiency. While there is no one-

size-fits-all solution to China's urban water issues, a new nationwide initiative—the "sponge city" program—offers a flexible solution for both water-scarce and water-logged cites.

What is the Sponge City Program?

Unlike traditional cities, where impermeable roadways, buildings, and sidewalks interfere with the natural water cycle, sponge cities mimic and support the natural water cycle. They use nature-based solutions, such as rain gardens, green roofs, constructed wetlands, and permeable pavement, to naturally capture, slow down, and filter stormwater. That water can then replenish groundwater aquifers or be stored for future use. Sponge city technologies could also support sludge-to-energy development by preventing excess stormwater from diluting sewage water so much that it cannot be used to generate electricity for powering treatment plants.

At the December 2013 Central Government Working Conference on Urbanization, Chinese President Xi Jinping spoke about the need to develop sponge-like cities that naturally accumulate, filter, and purify rainwater. Since then, the Ministries of Finance, Water Resources, and Housing and Rural-Urban Development have issued supportive policies and launched a pilot program to test different techniques.

Sponge cities mimic and support the natural water cycle

Under the program, pilot cities will receive generous annual subsidies from Beijing for three years. Municipalities will receive 600 million RMB, provincial capital cities get 500 million RMB, and all others receive 400 million RMB. Moreover, the Ministry of Finance offers additional funding (up to 10 percent of the initial amount) for cities that develop public-private partnerships to finance or operate sponge city projects. The 30 pilot cities selected by the finance, water, and housing ministries include Beijing, Shenzhen, Chongqing, Fuzhou, Dalian, Shanghai, among others.

These cities have begun developing plans, securing financing, and implementing sponge city projects. Beijing, for example, announced plans to develop more than 70 new green spaces throughout the city to collect excess stormwater, and Shanghai set a goal of planting 400,000 square meters of new rooftop gardens in 2016.

In October 2015, the State Council issued guidelines dictating that by 2020, 20 percent of urban areas should locally store and reuse 70 percent of all rainwater. By 2030, 80 percent of urban areas should meet that target. Achieving this goal will mean retrofitting existing urban areas and designing new development to incorporate sponge city features.

Will it Work?

There are reasons to be optimistic about the government's approach. The pilot projects in Xiamen and Wuhan have already achieved positive outcomes. Wuhan, which has invested two billion RMB in 104 projects, efficiently managed heavy storms on June 11, 2016. The reconstructed areas of Xiamen, a coastal city in southern China that is developing 236 projects costing over 7.2 billion RMB, endured Typhoon Nepartak without waterlogging.

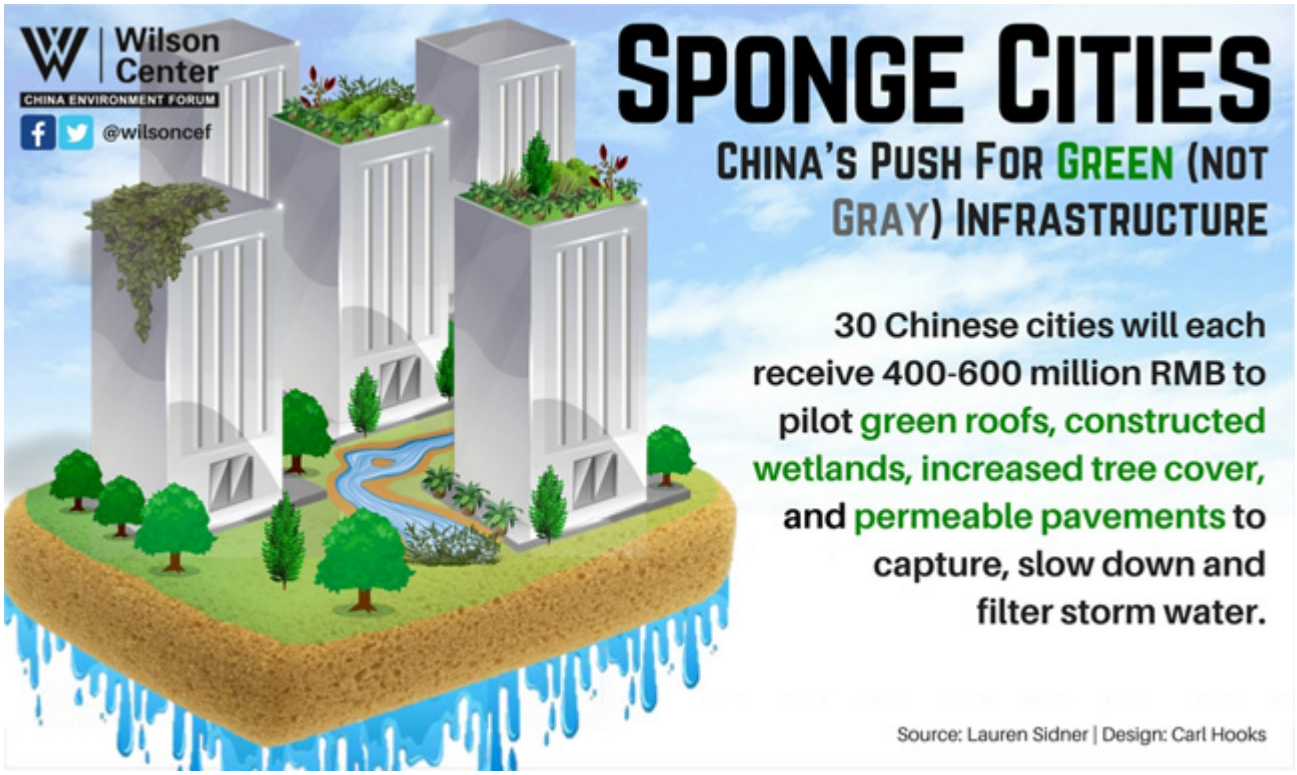
Around the world, green infrastructure options perform many of the same functions as their traditional (or "gray") infrastructure alternatives, and in many cases, they are more cost-effective. Gray infrastructure—which includes drains, concrete channels, piped drainage systems, pumps, and treatment plants—tends to be single purpose, whereas green infrastructure provides a variety of environmental, social, and economic co-benefits.

Green infrastructure performs many of the functions of traditional alternatives

For example, in 2010, New York City released a city-wide green infrastructure plan that integrates new rain gardens and green roofs into existing stormwater systems to improve overall performance at a projected cost of $5.3 billion, $1.5 billion less than a comparable gray infrastructure approach. The green infrastructure approach is also expected to reduce energy demand and CO_2 emissions, improve air quality, and increase property values. One key objective of the plan is to reduce combined sewer overflows. While implementation of the plan is ongoing, in 2016, the New York Department of Environmental Protection reported that the project had already reduced annual overflows by 507 million gallons.

In 1993, Ford Motor Company invested in a 600-acre green stormwater treatment system at the Ford Rouge Center in Dearborn, Michigan. At the center of the project is one of the world's largest green roofs, spanning 10.4 acres. The project also includes an extensive system of bio-retention swales, porous pavement, and sustainable landscaping to slow and cleanse stormwater, restore soils, and support wildlife habitat. The $15 million project allowed Ford to forego a $50 million water treatment facility and reduced heating and cooling costs by 5 percent.

While construction and maintenance costs and even the ultimate effectiveness of green infrastructure are influenced by site-specific conditions, these examples show that green infrastructure has the potential to save money by avoiding capital costs, lowering maintenance costs, and reducing stormwater treatment costs. Integrating natural infrastructure into existing systems can (1) improve stormwater management, (2) restore ecosystem services, and (3) enhance climate change resilience, all of which helps to explain the strong enthusiasm in China for sponge cities.



Potential Stumbling Block: Financing

Just because sponge city projects have the potential to be cost effective does not mean that funding them will be easy. China's central government is providing a significant amount of funding for the pilot cities, but the subsidies are far from enough to fully fund sponge city construction. Estimates suggest that sponge city construction could require investments of RMB 100 million to 150 million per square kilometer, while the total area under construction in just the first 16 pilot cities is more than 450 square kilometers.

Local governments will have to find ways to fill the funding gap. Some might be able to publicly fund sponge city projects, but most will need to attract private investment to support their efforts. Even though the central government is offering financial incentives to encourage the use of public-private partnerships, securing private investment could be difficult. Sponge city projects do not generate obvious streams of revenue, and the benefits they provide typically are not marketable. Nevertheless, leveraging private sector financing is crucial for the success of the sponge city program, so local governments will need to identify innovative financing tools to operationalize their sponge city plans. There are four possible ways Chinese city governments could finance sponge cities:

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- **Levy a surcharge** to supplement existing water resource fees. In much of China, water users are charged based on quantity used. But lack of widespread metering technology and spotty implementation limit cities' ability to use water resource fees to finance water development.

- **Provide direct financial incentives** to encourage firms to install green infrastructure technologies. Offering inducements, such as tax credits or subsidized loans, could ameliorate financial obstacles to incorporating green alternatives into projects. Incentives could also increase awareness of those alternatives.

- **Offer incentives to individuals and communities** to explore green infrastructure options. For example, Seattle offers rebates to homeowners who plant rain gardens on their property. While these incentives would not produce results on the scale needed to achieve sponge city targets, individual and community involvement may raise awareness of urban water challenges, encouraging conservation. Demand reduction—an important element of urban water management—is generally not addressed by the sponge city approach.

- **Pay private investors for the ecosystem services** that sponge city projects provide. China's central government has experience with ecological-compensation mechanisms that could provide a model for the use of eco-compensation in the context of the sponge city program.

Ultimately, none of these financing options is perfect, and developing a financing scheme that suits a particular city's needs while providing sufficient funding will be no easy task. But with careful planning, innovation, and flexibility, sponge cities could lessen China's urban water woes.

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Sources: American Society of Landscape Architects, Asian Development Bank, China Daily, chinadialogue, China Water Risk, CitiScope, Global Water Partnership, ICLEI-Local Governments for Sustainability, Natural Resources Defense Council, Netherlands And You, NYC.gov, World Bank, Yale Environment 360

Photo Credit: Flooding in China, July 2016, courtesy of Flickr user Paul Gonzalez.

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