



Can 'sponge cities' solve China's urban flooding problem?

Wade Shepard July 28, 2016

Rain water is one of the world's most wasted natural resources. Precipitation that falls upon cities typically gets expelled like a waste product, piped away via the standard complex of drainage systems.

Meanwhile cities go to great lengths to pump in water from rivers and lakes, or pump it up from aquifers that in many places are being depleted at a worrisome rate.

Three years ago, Chinese President Xi Jinping offered a new way to think about this. At China's Central Government Conference on Urbanization in 2013, Xi announced that cities should act "like sponges." This proclamation came with substantial funding to experiment with ways cities can absorb precipitation through permeable pavements, rain gardens and wetlands, or reuse the water locally for irrigation, parks or even for drinking. It also injected a new term into the global urban design vocabulary.

"Basically, 'sponge city' is a phrase that was invented in China," says Austin Williams, an urban studies professor at Jiaotong-Liverpool University in Suzhou. "Nobody used this phrase until Xi Jinping announced it."

Although the terminology is new, the idea behind sponge cities has been around for a while. Researchers have long looked for ways to deploy "green infrastructure" that can give entire cities the virtues of a rain garden. Programs in the [United States](#) as well as strategies in the United Kingdom [like "SuDS"](#) have aimed to develop new ways to handle and utilize runoff.

City leaders have begun putting some of these ideas into practice. Singapore has [installed a network of gutters, cisterns, and reservoirs](#) across half the city to capture rainwater that is used for everything from flushing toilets to — once purified — drinking water. And Portland, in the U.S. state of Oregon, is installing rooftop gardens, bioswales, permeable pavement, retention ponds and large amounts of surface vegetation.

[Read: [Why Copenhagen is building parks that can turn into ponds](#)]

But as Williams says, "the West doesn't build cities, it merely tinkers with existing ones." By contrast, China is poised to incorporate sponge-city concepts into its ambitious city building program.

China's State Council [announced a new set of urbanization guidelines in February](#) as a response to complaints that the country's cities have grown too large, too fast, and without the proper amount of quality planning. The guidelines state that new urban developments should have sponge city-like water-retention capabilities, essentially making this strategy a new national standard.

In other words, if these innovations are ever going to scale up, it's likely to happen in China first.

Preventing floods

The stakes seem higher than ever for China. The country is currently undergoing its [worst flooding in 20 years](#). More than 300 people have died and over half a million have been displaced across dozens of

provinces in both the north and south of the country. Damage estimates range from US\$22 billion to US\$45 billion.

Some of the blame lies with the ways the country has built its cities up to now. China's urban landscapes have spread farther and faster than any other place in history. Ponds, rivers and wetlands have been replaced with pavement, buildings and sidewalks. More than 40,000 square kilometers (15,000 square miles) were newly urbanized in China over the past 35 years, as the number of cities climbed from 193 to 653.

This rapidly encroaching blanket of concrete stops rain from being absorbed into the soil below. That increases runoff, which can grow to flood-like proportions as it flows downhill in even moderate storms.

While China's drainage network of mostly conventional sewer systems grew 20-fold since 1981, it hasn't kept pace with the expanding development above the surface. Half of China's cities don't meet national flood-prevention safety standards. In 2013 alone, 230 of these cities were hit by severe flooding, according to the Ministry of Housing and Urban-Rural Development (MoHURD). The situation is only expected to get worse as a changing climate triggers more extreme rain events.

China essentially has two options to curb flooding. The first is to completely retrofit and expand existing drainage systems. The second is to try something different.

The sponge-city concept is that something different.

"If properly planned, [sponge cities] can significantly manage the risk of flooding," says Derek Murphy, a Hong Kong-based architect who has done many projects in mainland China. "Excessive rainwater is collected in large lake reservoirs as opposed to overloading a network of underground sewers, which tend to block up and become damaged."

Pilot projects

In the wake of Xi's proclamation about sponge cities, the Chinese government selected an initial batch of 16 cities for pilot testing in 2015. An additional 14 cities are being added this year.

Each city in this program is allocated RMB 400 to 600 million (\$US 60 to 90 million). Cities such as Beijing, Chengdu, Chongqing, Shenzhen, Guangzhou, Shanghai and Wuhan all have large scale projects underway.

I went to Yuelai New City in Chongqing recently to see what a sponge city looks like. Yuelai New City sits far out of Chongqing, on the last stop of a metro line in a huge new development directed by the central government called Liangjiang New Area. I climbed the steps up from the metro station and found myself in front Chongqing's new expo center. At first glance, the place didn't look much different from any other partially constructed new city in China. But the real action is what happens on the ground.

The pavement here doesn't impede the flow of water and channel it off to underground drainages. Instead, the pavement absorbs the water, sucking it up into the ground beneath. If you were to pour out a bottle of water onto the ground here, no puddles would form at your feet; the water would immediately soak into the pavement and into the soil below, where it can then permeate down into the shallow aquifer or seep into nearby rivers, ponds or lakes. This porous pavement also feels different on your feet. It's not hard and unforgiving, but soft and springy, like trotting along a modern athletic track in a new pair of sneakers.

Yuelai New City is one of China's most prominent emerging sponge cities. It was one of the original 16 pilot sites. While little other than the convention center was built at the time I visited, there was evidence of other creative thinking about water. The landscaping around the edges of the center blur right into the untamed foliage of the surrounding wooded hillside. Permeable parking lots are covered in gardens, with bushes separating each parking space rather than painted lines.

Sponge cities are incredibly verdant places, as one of their key design ethics is blending natural features and the city together as seamlessly as possible. They also are wet places, and there will typically be a network of canals, ponds, lakes, and wetland parks, which distribute water throughout the development.

Signs of success

After an initial round of implementation, some of these sponge-city projects were tested by MoHURD. The results so far are very positive. In terms of flood prevention, researchers found that 85 percent of rain runoff could be controlled. In addition, the presence of retained water, well-hydrated soil, and foliage also has the effect of counteracting the urban "heat island" phenomenon. According to Li Zhongwei, the director of D+H Scape, a landscape architecture firm, these strategies actually cool the air by two or three degrees centigrade.

The sponge-city concept is likely to work best if it can be implemented widely across broad urban areas. It has to be part of a holistic urban plan, not just some permeable concrete here or an extra-absorptive gutter there. That makes blank-canvas "new cities" that are so prevalent in China — like Yuelai New City — prime testing grounds.

[Read: [What Surat learned from a preventable flood](#)]

"A sponge city is a system, it is not one part," says Li Zhongwei. "You do a pilot park, you do a pilot neighborhood, it doesn't help. You have to make sure the whole city is doing that. So it needs huge infrastructure. It's not a small thing."

On the other hand, for the sponge-city notion to really make a difference, existing cities will need to be gradually retrofitted. That won't be easy or cheap, with all the hard-wired street grids, pipes, tunnels and other existing infrastructure that Chinese cities have already built. There's only one way to start, though, and that's to begin experimenting.

"Most current [sponge city] projects are still very local and in a pilot phase," says Harry den Hartog, an urban designer and researcher at Tongji University in Shanghai. "The current flooding issues make clear that more action is required urgently, especially in the more poor and vulnerable regions."



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LEARNING FROM CHONGQING

- The city in central China is home to a 'sponge city' pilot testing ways to allow urban environments to soak up rainwater.

- Permeable pavement outside a new convention center allows rainwater to soak through to the soil below.
- Chinese researchers found projects like these can control 85 percent of rain runoff. They also help combat the urban 'heat island' effect.