



Healing Landscape In Resilient Built Environment —Ecological Infrastructure and Sponge City

Kongjian Yu

Peking University College
of Architecture and Landscape



Challenges

Climate Change



Flood

annual flood damage costs US \$100 billion



Drought

400 of 662 cities have water shortages



Pollution

75% of surface water, 64% of underground water



Habitat loss

50% of wetlands lost in 50 years



Conventional solutions: Grey infrastructure

Stronger and increasingly
more sophisticated:



Damming



Channelizing



Flood walls fighting
against water



Sewage plants
cleansing water



Grey infrastructure can be necessary to solve urgent individual problems, but

Consumes huge amounts of concrete and energy

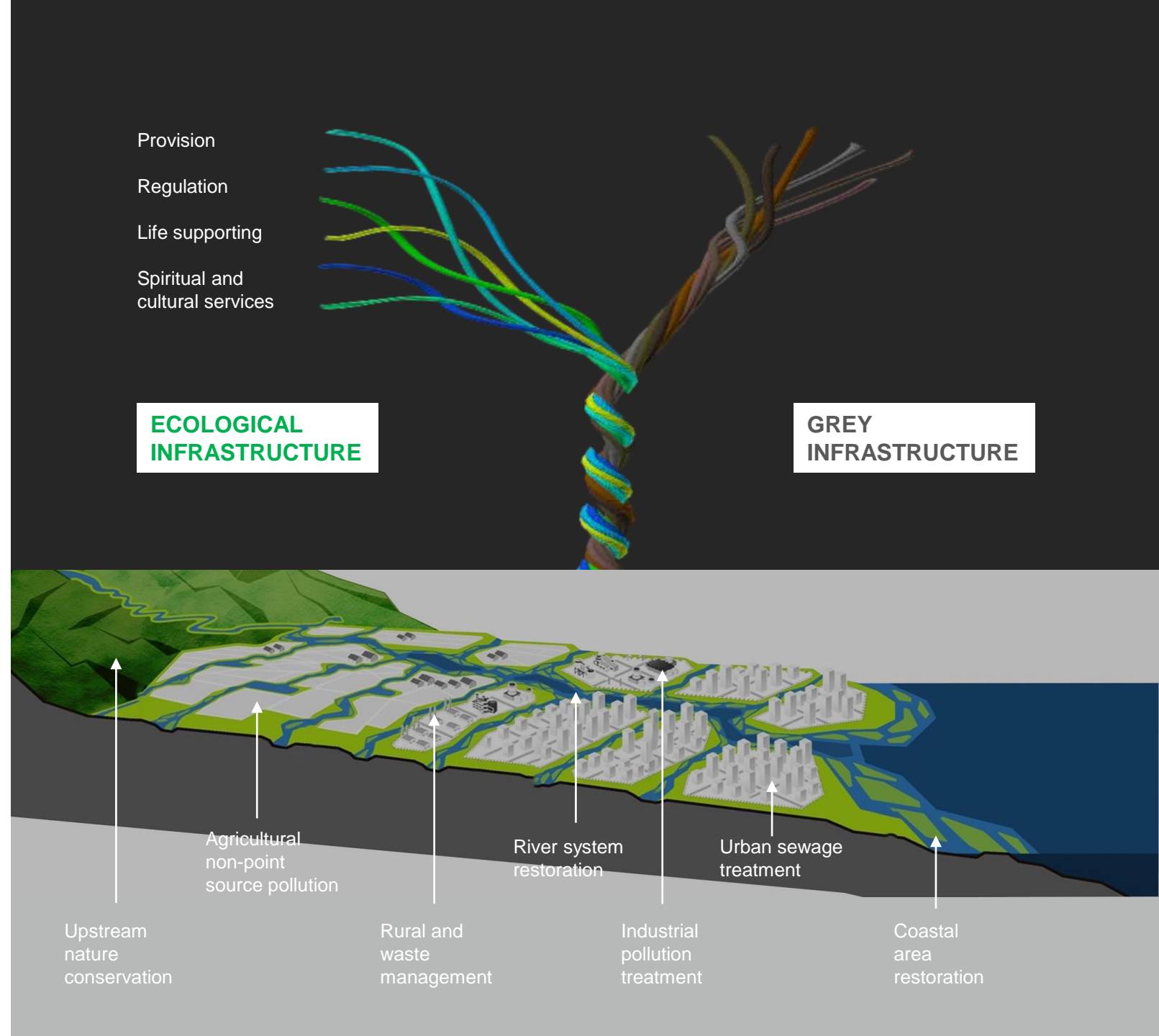
Lacks resilience and often accumulates a higher risk of disaster

Destroys nature and its resiliency

Breaks the connection between man and nature...



The alternative:
**Nature-based
ecological infrastructure**
which is critical for securing
ecosystem services
**woven together with
grey infrastructure**

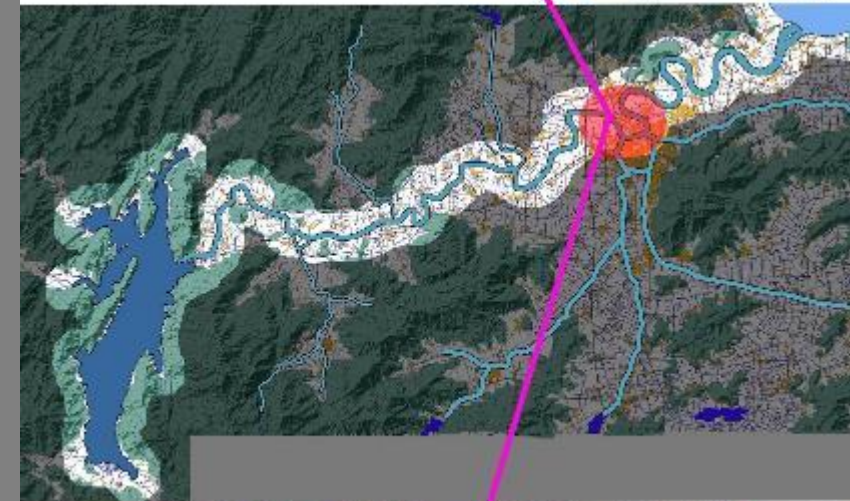
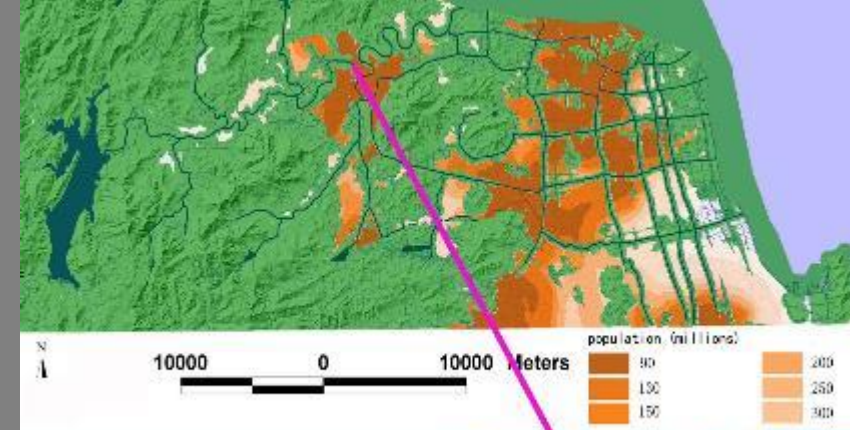
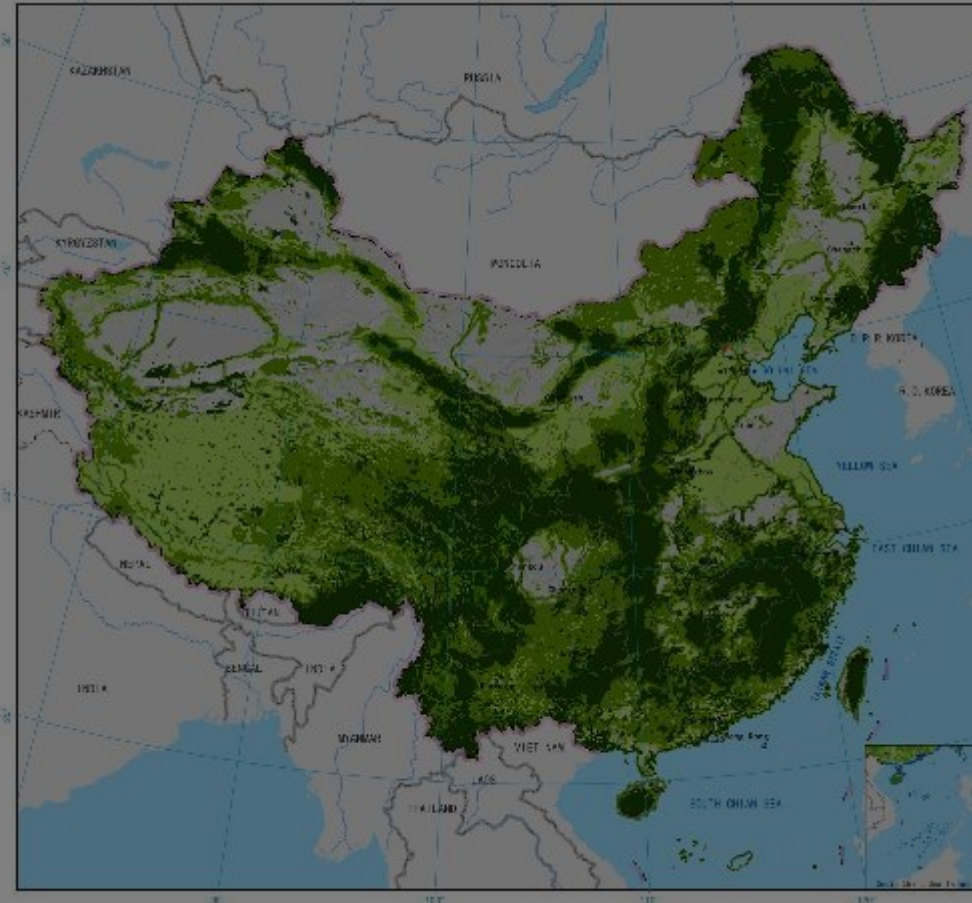


Ecological infrastructure must be planned and built across scales

National Integrated Ecological Security Pattern

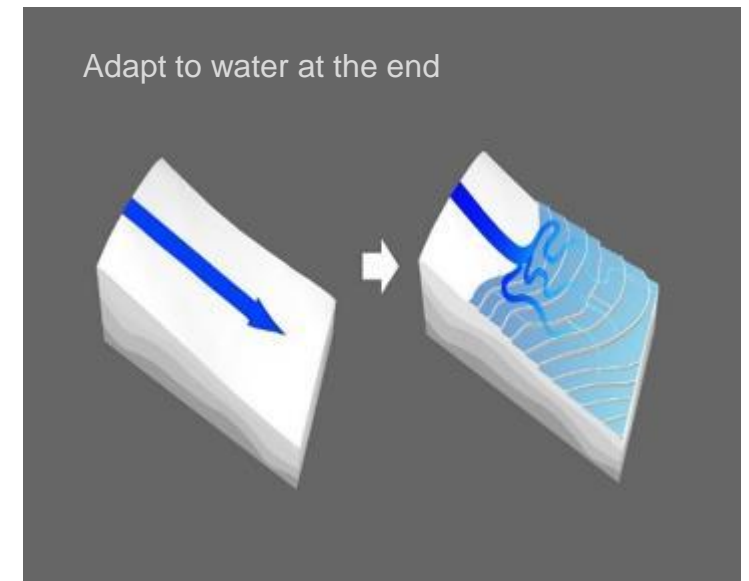
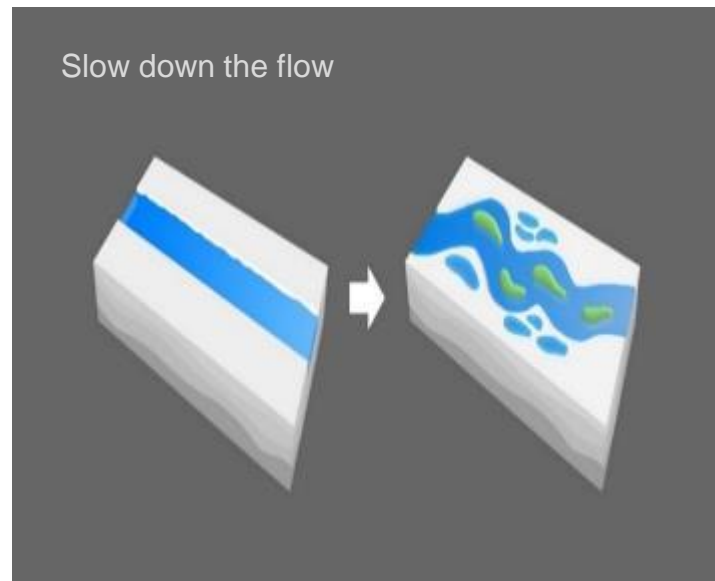
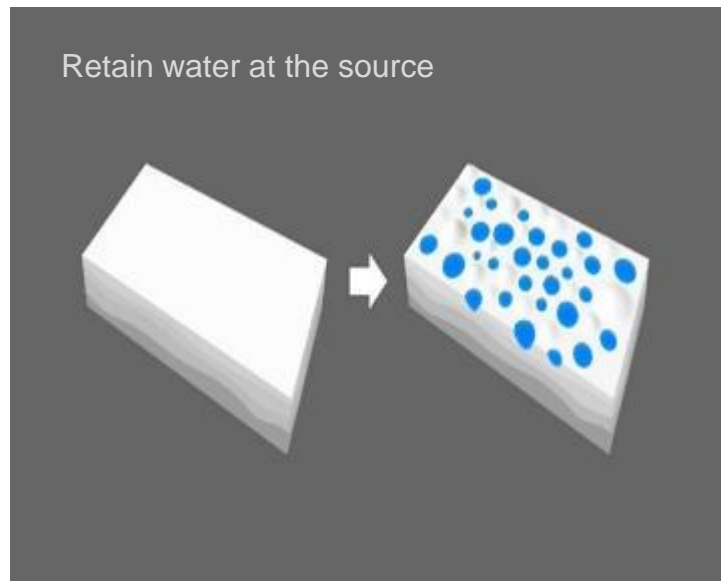
- National Capital
- Provincial Capital
- Provincial Boundary
- Ideal SP
- Satisfied SP
- Minimum SP

Scales: 0 200 400 800 1Km
Projection System: Kravosovsky_1940_Alters

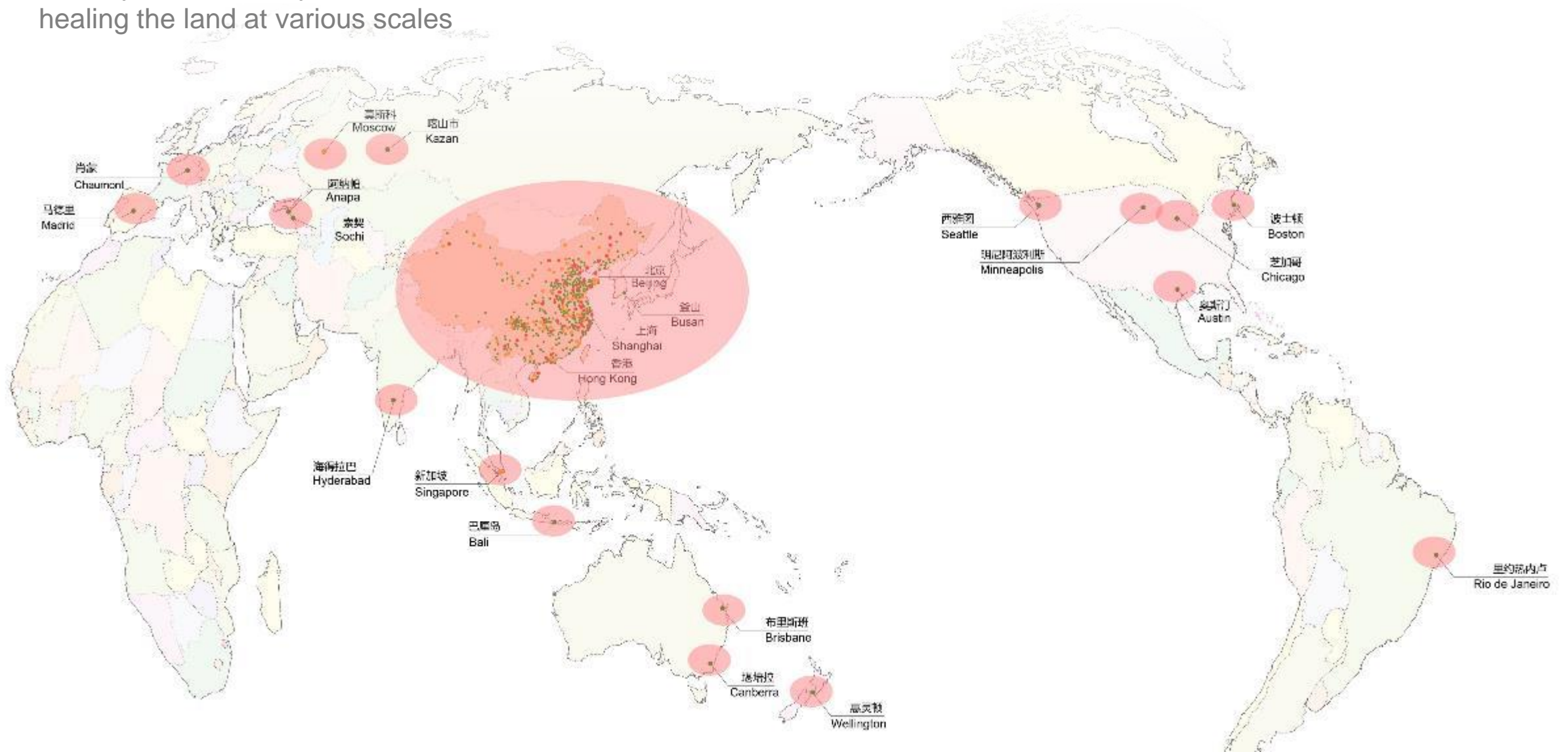


Water is the key to such ecological infrastructure

A city built on water-centered eco-infrastructure is called a **Sponge City**. Its philosophy is to retain water, slow down water flow, clean water by nature and be adaptive to water--- totally opposite to the conventional solution of grey infrastructure



For over 20 years, we have tested and built over 500 projects in 200+ cities and developed several replicable models for healing the land at various scales





Flood adaptation: embracing flooding as a natural phenomenon

In China, all urban rivers have
been dammed and channelized
with concrete flood walls

More than US \$20 billion
is invested to control flooding,
but US \$100 billion is lost every year

We have to end
this never-ending war

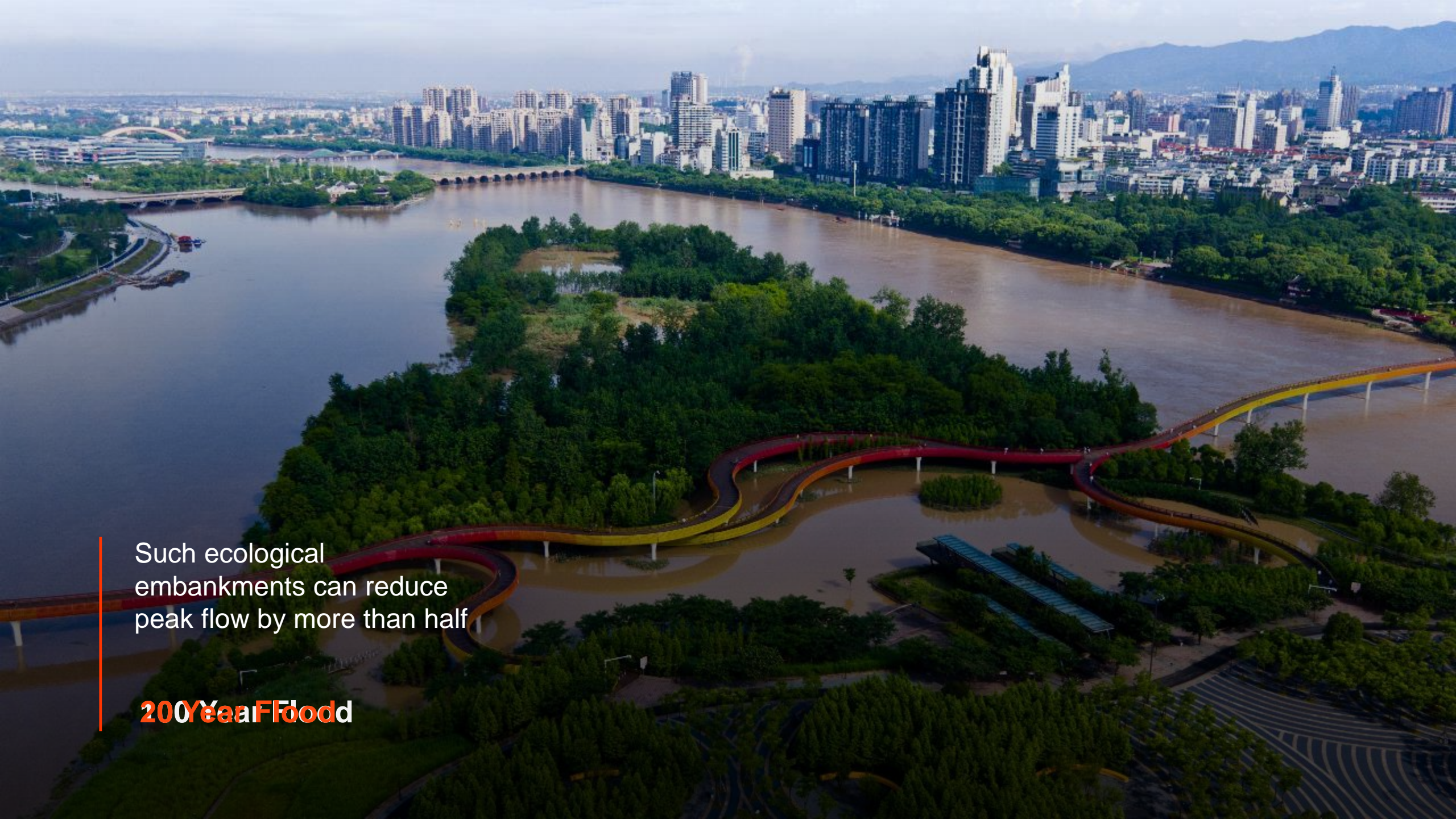




Yanweizhou Park

Jinhua City, Zhejiang, China

Ecological redesign of
the concrete flood wall to
adapt to monsoon floods



Such ecological
embankments can reduce
peak flow by more than half

200 Year Flood

**Taizhou
Jiangbei Park**

Yongning River,
Taizhou City,
Zhejiang, China,
2003



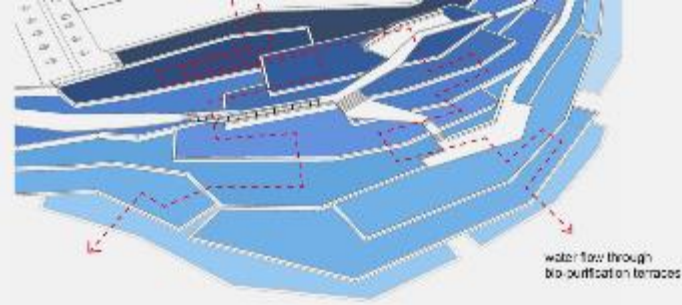
Stormwater regulation: absorbing excess water

Over **65%**

of Chinese cities suffer from
urban inundation



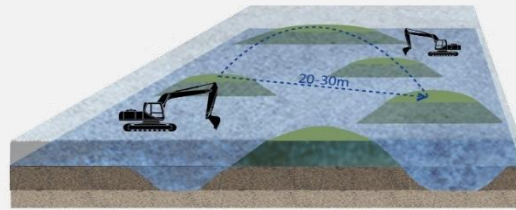
Terracing



Ponding



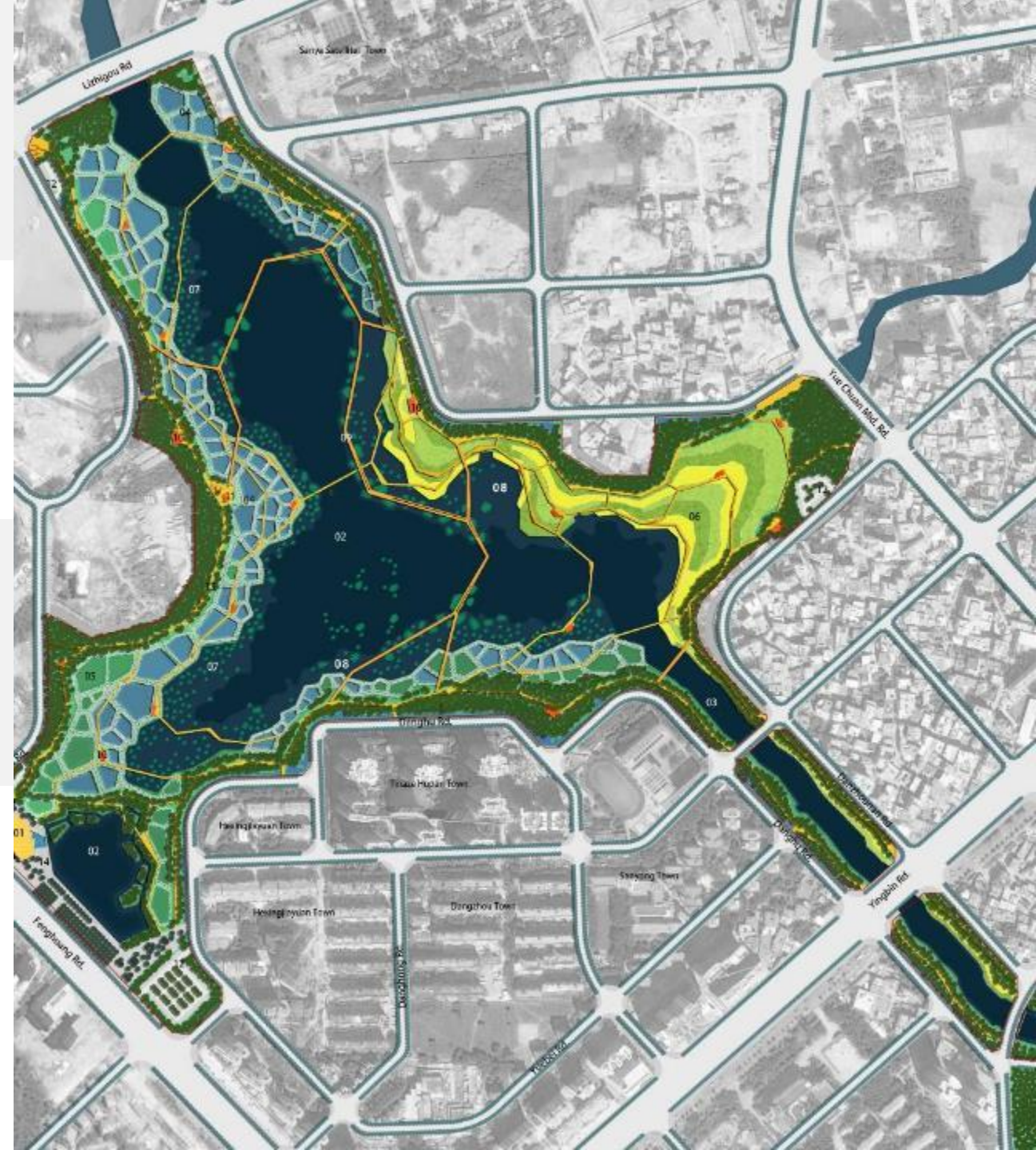
Islanding



Sanya City

Hainan Island, China

Creation of a green sponge within the city



A lush green landscape with a winding path and a body of water, surrounded by dense trees and foliage. The scene is captured in a soft, natural light, possibly during the golden hour, with sunlight filtering through the leaves. The path is bordered by low-lying green plants, and the water reflects the surrounding greenery. The overall atmosphere is serene and natural.

Sanya City

Hainan Island, China

Creation of a green
sponge within the city



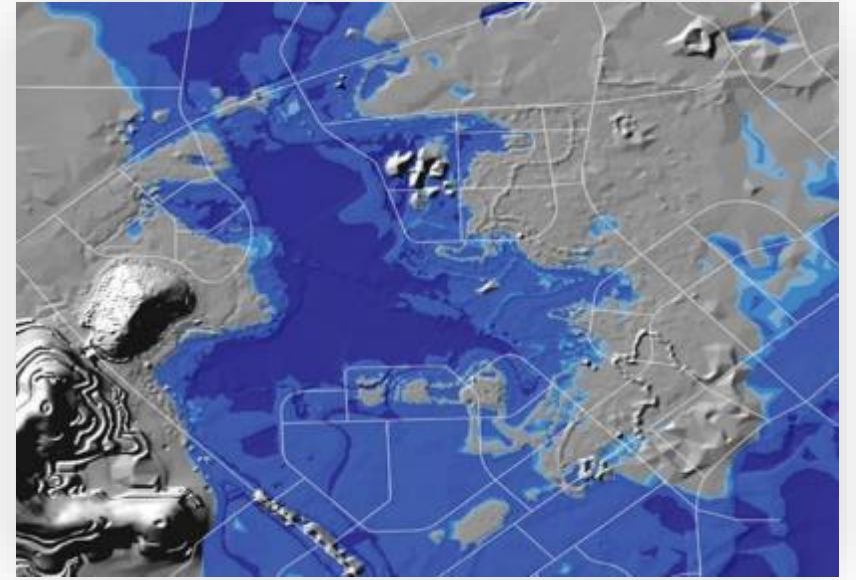




2025

Before

2015



After

2020

A Floating Forest: Nanchang Fish Tail Park

In Nanchang City, A **126-acre** coal ash dumping ground was transformed into a floating forest that regulates **1.0 million** cubic meters of monsoon storm water, recovers bird habitat, improves water quality and creates a pleasant landscape







Benjakitti Forestry

Thailand, Bangkok

We are transforming a huge **brown filed** into huge **green sponge** that regulates water and provide public space for people in the city center



Water cleansing: creating living systems to clean water

75%

of surface water
is contaminated
in China

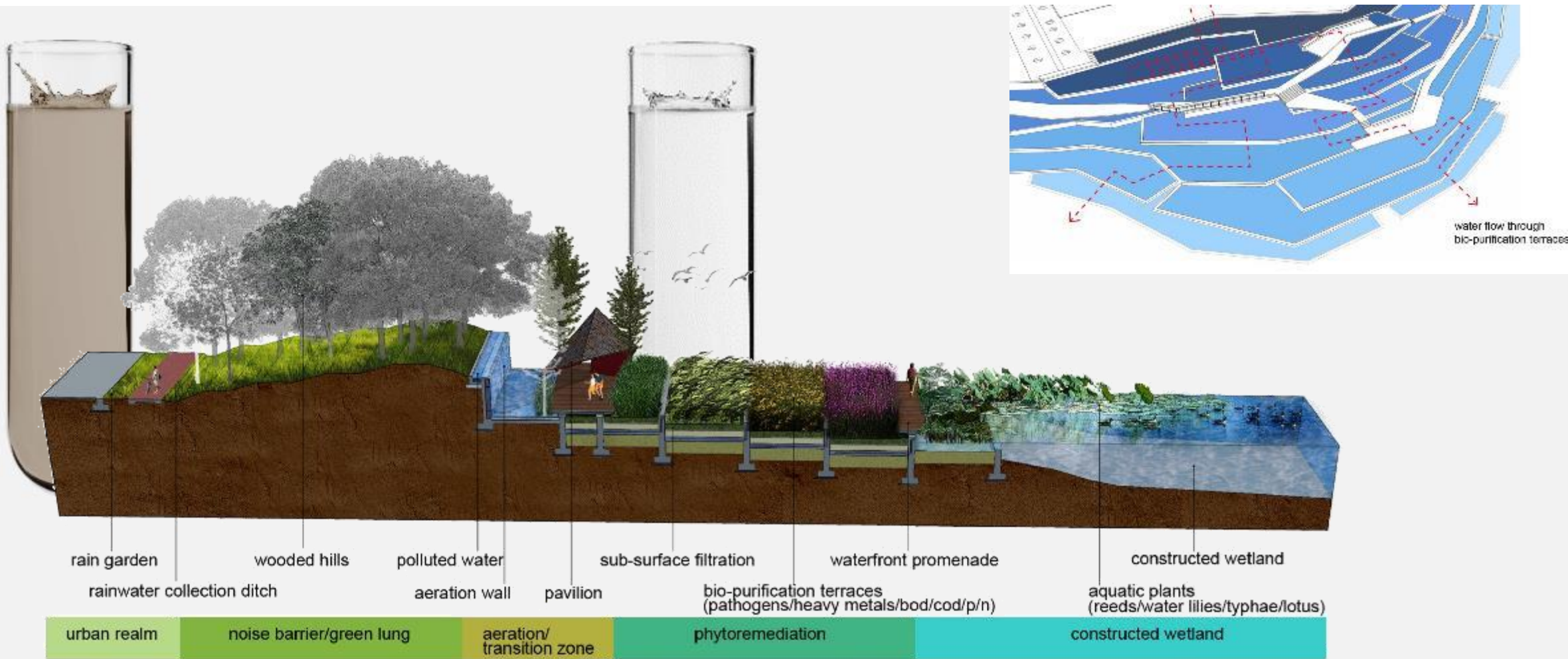
85%

of sewage globally
goes into rivers and
seas untreated

We need alternative
affordable and fast
solutions



Constructed wetlands can remove nutrients through biological processes

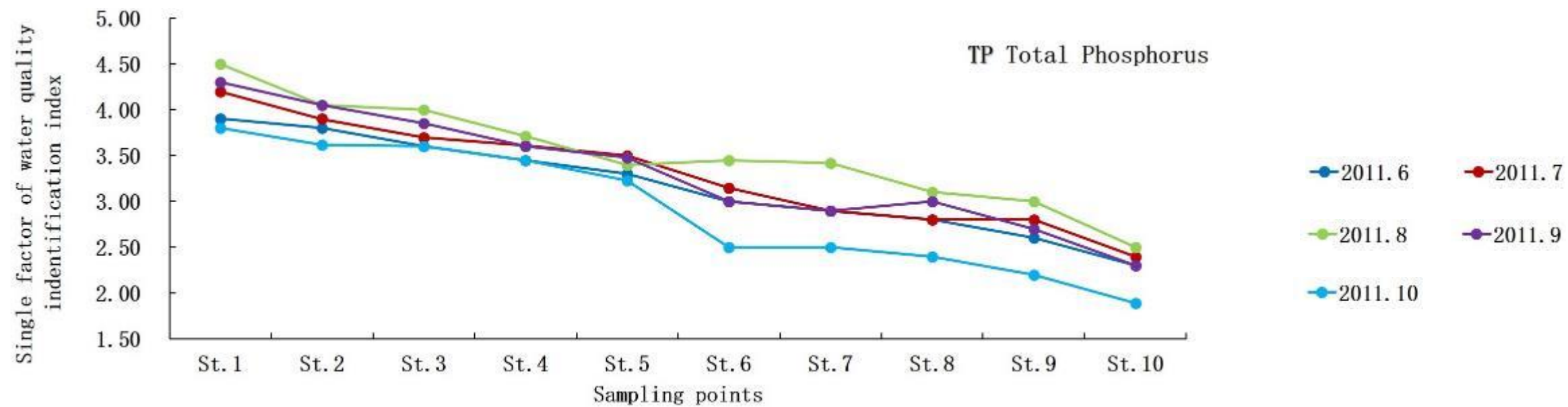




Huangpu River

Shanghai Houtan, China, 2009

Designed a living landscape on a former brownfield to treat polluted river water and recover the degraded waterfront in an aesthetically pleasing way



The Handan Wastewater Cleansing Terraces

An **10-ha** urban waste dump has been transformed into wastewater remediation system.

Daily, **15,000** tons wastewater is cleansed that has helped to recover **50- ha degraded wetland** nearby, and save **1.0 million** kWh of electricity per year







**Effective solution for
larger-scale water issues?**
The Bohai Sea (770,000 km²)
is seriously contaminated and
becoming a dead sea

An aerial photograph of a coastal wetland area. A wooden boardwalk with a railing runs along the right side of a large, calm body of water. The water reflects the surrounding green trees and vegetation. In the background, a wide expanse of water meets a hazy horizon. The overall scene is lush and green, with a mix of trees and grasses.

Qinhuangdao City

China: Pilot project

Green sponge created
along the coastal
shoreline to catch and
stop chemicals from
running into the sea

Climate resiliency: mitigating storm risk

Sanya Mangrove Park

Instead of building concrete walls, mangroves were restored.

Urban construction debris and concrete from the demolition of the flood wall was recycled on site, and an interlocking-finger design was used to lead ocean tides into the waterways to create ideal habitat for mangroves





Green Sponge as Eco-infrastructure

Meishe River Haikou City, China

23 kilometers long, the Meishe River runs through the built up area had become a nightmare for the city, for decades, a sewage dump.

Piecemeal solutions were attempted such as building walls and locks to control floods and sea tides, river bed dredging, locking off the polluted tributaries, etc. But all these measures only worsened the situation.



中新網
Chinanews.com



The concrete flood walls have been removed and replaced with ecofriendly and flood resilient waterways, constructed wetlands have been built along the river to catch and cleanse contaminated runoffs, and recreational facilities have been integrated into the ecological infrastructure.



Habitat recovered in the dense city

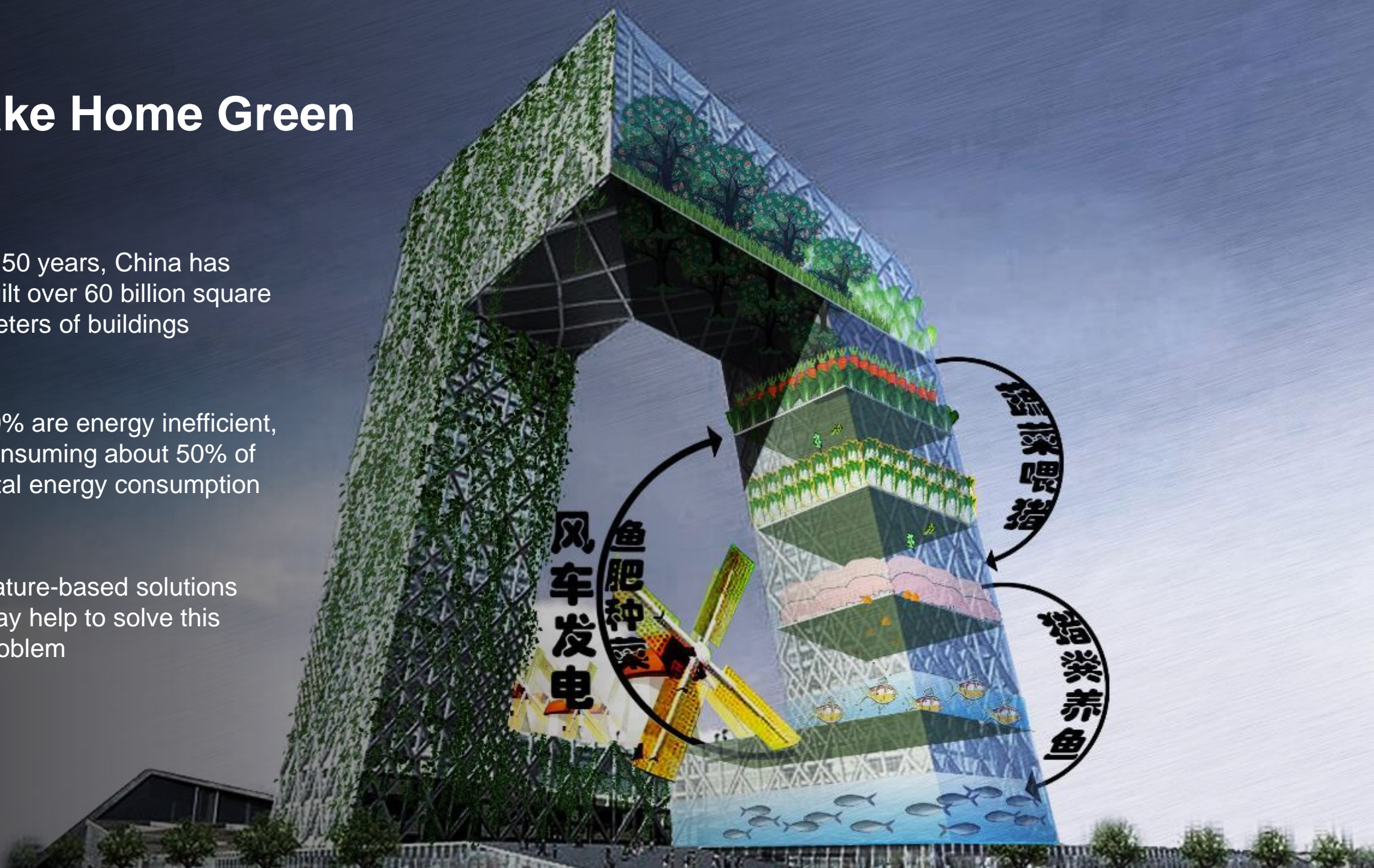


Make Home Green

In 50 years, China has built over 60 billion square meters of buildings

99% are energy inefficient, consuming about 50% of total energy consumption

Nature-based solutions may help to solve this problem



In my own home,
I collect storm
water and energy
from the roof and
grow vegetables
on the balcony



I produce
32kg of
vegetables
each year



Each year, I collect **52 tons of rainwater**, recycle water to create a living wall to air-condition the home and **save 2000 KW of electricity**



This helps show the community that **everyone can contribute to healing the planet** by practicing simple nature-based solutions at home



More than ever

we have to **rethink** the way we build our cities, the way we treat water and nature, and even the way we define civilization



Sponge City, and Sponge Planet

is a holistic and nature-based solution to protect and restore ecological infrastructure and make wise use of nature's services for the benefit of the planet and the welfare of people



**Think like
a king,
but act like
peasants**



King Yu the Great, who had the vision of healing the earth and living with nature



Peasants who transform the globe down to earth