World Bank in collaboration
With City of Guangzhou, China

Piloting Nature Based Passive Cooling Solutions

Xueman Wang
World Bank
An Overview of Urban Cooling Solutions

Source: Dr. Paul Osmond, University of New South Wales
What are the nature based passive cooling solutions

- Traditionally, cooling focuses on space cooling, using air conditioning
- Nature-based, passive solutions to cool cities are yet to be fully deployed
  - Natural and man-made green and water features
  - Urban design that minimizes heat retention
  - Dissipating heat with wind flows;
  - Solar reflectivity of urban roofs, walls; and
  - Roads that lower the amount of solar energy absorbed by urban surfaces.

- Passive solutions reduce indoor air temperatures by an average of 3–5°C, reducing energy demand by 20%
Guangzhou Cooling Project

• Guangzhou: sub-tropical climate with rapidly growing population (15 million)

• The World Bank, in collaboration with Guangzhou conducted pilots in three sites:

  - An old town regeneration project in Yongqing Fang
  - A new town development to create a low-carbon, green district in China-Singapore Knowledge City;
  - Evaluate the cooling effects and economic value of a city’s natural asset Haizhu Wetland.
<table>
<thead>
<tr>
<th>Level</th>
<th>Measures</th>
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<tbody>
<tr>
<td>Site level</td>
<td>- Increase cool alleys and spaces</td>
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<tr>
<td></td>
<td>- Reshape the size of buildings; use bamboo tube houses</td>
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<td>- Widen the streets to allow wind flows</td>
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<tr>
<td>Building level</td>
<td>- Use tradition double-layered tiles for roofing</td>
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<td></td>
<td>- Use light color coatings and rooftop greening</td>
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<td></td>
<td>- Enhance wall insulation</td>
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<td></td>
<td>- Create vertical greening as part of integrated 3D green landscape design</td>
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<tr>
<td>Landscape level</td>
<td>- Plant local trees to increase evapotranspiration cooling and creating shaded area</td>
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<td></td>
<td>- Install sprinkler facilities and solar-power fans on building façades</td>
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<td>- Install water features and fountains in public spaces.</td>
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</tbody>
</table>
Integrating cooling options into new town development
Jiulong Lake area at Sino Singapore Knowledge City

The lake area is 12.8 km$^2$ and has a population of approximately 34,000. It will be developed to accommodate 140,000 people

Key measures

• Maximizing site ventilation
• Minimize solar radiation
• Use water and greenery cooling
• Provide sun and rain protection
• Recommend building topology with cooling consideration
# Modeling Tool to assess the ecosystem services by natural assets – Haizhu Wetland

<table>
<thead>
<tr>
<th>Ecosystem Service</th>
<th>Supply Metric</th>
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<tbody>
<tr>
<td>Urban cooling</td>
<td>Air Temperature</td>
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<tr>
<td>Climate change mitigation</td>
<td>Carbon Stored or Sequestered</td>
</tr>
<tr>
<td>Recreation</td>
<td>Access (distance to parks)</td>
</tr>
<tr>
<td>Physical health</td>
<td>Access to urban nature (e.g., distance to parks, tree-lined streets, urban gardens, trails etc.)</td>
</tr>
<tr>
<td>Mental health</td>
<td>Access to urban nature (e.g., views of greenery, distance to parks, amount of trees in neighborhood)</td>
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</tbody>
</table>
Recommendation 1: Identifying Technical Solutions

• Create ventilation corridors to enhance natural wind flows
• Establish ecological connectivity to maximize cooling effects
• Design urban fabric to cool neighborhoods
• Create solar reflective surface
Recommendation 2: Building Institutional support for cooling solutions in planning and implementation

- **Integrate cooling considerations to Land use and ecological Planning**
  - Mapping natural assets and establish an inventory of ecosystem services,
  - Assessing economic value provided by the assets – putting price to natural assets

- **Develop regulatory framework and guidelines**
  An urban design plan should be supported by detailed urban design guidelines
  - The guidelines should become part of the plot management plans to be included in the land transfer contract when proposing precise planning requirements.
  
  - The design plan and guidelines should be part of the contractual arrangement “sold” to the developers
    Ensure developers to follow a predetermined urban design plan during the construction process.
Recommendation 3: Financing Urban Cooling Investment

• Financing and Incentives:
  ▪ How to incentivize developers
    • Yongjingfang example: Urban cooling will incur an engineering cost of US$600,000 to $750,000 in a total financing of $20 million investment in the site
    • For $1 investment for cooling options, the gains out of energy savings from the residents could be $1.5-$2.

▪ Cost sharing: An issue arises as to who should pay for the benefits from installing cooling measures (i.e. developers or residents)
Sustainable Urban Cooling Solutions: Guangzhou Pilots

(to be released in March/April 2022)

Overview

Guidelines
Nature based Passive Cooling Solutions
- Guangzhou Recommendations

Assessment of key ecosystem services
Haizhu Wetland, Guangzhou, China
PRIMER FOR COOL CITIES: REDUCING EXCESSIVE URBAN HEAT

WITH A FOCUS ON PASSIVE MEASURES