ACCSCIENCE PUBLISHING

Journal of Chinese Architecture and Urbanism

ORIGINAL ARTICLE

Rooted Currents: Research-through-design for regenerative urbanism in Changzhou Island

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Abstract

Changzhou Island in Guangzhou's Pearl River Delta represents a site of both cultural significance and environmental vulnerability, facing increasing pressures from flooding, rapid urbanization, and the erosion of Lingnan architectural heritage. This article reframes the award-winning design proposal of the student competition Rooted Currents as a research-through-design (RTD) inquiry into regenerative urbanism in deltaic environments. The study develops a multi-scalar framework integrating landform modification, transit-oriented development, and distributed water–energy–nutrient systems, informed by heritage-based spatial strategies. Scenario-based modeling and literature-benchmarked estimations indicate that land elevation, ecological water management, and decentralized infrastructure can significantly reduce flood exposure and enhance resource self-sufficiency. At the architectural scale, reinterpreting Lingnan typologies, such as cold alleys and courtyard systems, demonstrates their continued relevance as performative climatic and social infrastructures. The findings are synthesized into three transferable principles: landform as infrastructure, heritage as anchor, and distributed systems of resilience. The article contributes by demonstrating how RTD can generate transferable knowledge for urban resilience in heritage-rich delta regions. While the results remain scenario-based, the study provides a framework applicable to rapidly transforming waterfront cities in China and beyond.

Keywords: Research-through-design; Regenerative urbanism; Flood resilience; Delta urbanism; Lingnan architecture; Guangzhou

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Citation: Schoch, M., & Lawanyawatna, S. (2026). Rooted Currents: Research-through-design for regenerative urbanism in Changzhou Island. *Journal of Chinese Architecture and Urbanism*. 8(4):026170031. https://doi.org/10.36922/JCAU026170031

Received: April 26, 2026

Revised: August 11, 2026

Accepted: August 14, 2026

Published online: September 10, 2026

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1. Introduction

The Pearl River Delta (PRD) is one of the world's most densely populated and economically vibrant regions, home to megacities such as Guangzhou, Shenzhen, and Hong Kong. With over 70 million residents and a significant share of China's gross domestic product, the PRD exemplifies both the potential and the dangers of rapid urban growth. At the center of the delta, Guangzhou has transformed from a historic port city into a global metropolis.

Yet, its fragile deltaic environment makes it highly susceptible to climate change, particularly sea-level rise, more frequent storm surges, and flooding (Yang *et al.*, 2014). Changzhou Island, located east of downtown Guangzhou, exemplifies these vulnerabilities (Figure 1). Once known as Dane's Island, it has long served as a maritime gateway to the

city. Its importance goes beyond its geography. The island is home to the Whampoa Military Academy, founded by Sun Yat-sen (1866–1925) in 1924, which has influenced generations of Chinese military leaders. While the island's built fabric has been substantially altered, most residential buildings date from the 1950s and 1960s and have lost their traditional architectural character; it retains significant cultural traces: ancestral halls, temples, narrow alleyways, and spiritual gathering places that reflect Lingnan spatial traditions. Isolated survivals of oyster-shell wall construction remain, but these are exceptions rather than a continuous heritage fabric. The island's villages are best understood as traces of Lingnan spatial culture rather than intact architectural ensembles, a distinction with direct implications for the heritage strategy proposed here. Recent development pressures threaten this heritage. Large parts of the island are slated for redevelopment, industrial land is shrinking, and informal settlements face demolition. At the same time, flood maps indicate that much of the southern edge of the island would be submerged in +3 m scenarios, exacerbated by tidal backflow and storm events.

In response to these issues, the Designing Resilience Global (DRG) 2025 student competition adopted the theme "A Tale of an Island on the Pearl River: Regenerative Urban Design for Changzhou Island." Hosted by the School of Architecture, South China University of Technology (SCUT), Guangzhou, the competition focused on regenerative urbanism, going beyond sustainability to actively restore ecological and cultural systems, and required multi-scalar design approaches that address both local challenges and broader metropolitan contexts. The competition brief, site survey, heritage protection atlas, and questions and answers (Q & A) documents were prepared by SCUT and provided the primary spatial and contextual data that informed this study. Among the participating teams, the School of Architecture and Design at King Mongkut's University of Technology Thonburi (KMUTT) submitted the project Rooted Currents, developed by a team of fourth-year undergraduate students. The project gained international recognition, receiving the Climate Resilience Urban Design Excellence Award.

This article positions speculative urban design as a mode of inquiry through a research-through-design (RTD) framework (Figure 2), investigating how cultural heritage, ecological systems, and infrastructural strategies can be integrated into resilient urban environments. It reinterprets Rooted Currents not just as a static competition entry but as a methodological experiment in design. RTD treats design artifacts as tools for generating knowledge (Stappers & Giaccardi, 2017). Using this approach, the project tested strategies like landform modification, heritage integration, and distributed resource systems. By analyzing their environmental, spatial, and cultural effects, the study identifies transferable principles relevant to delta cities facing climate stress.

Despite growing research on urban resilience in delta regions and the increasing adoption of ecological infrastructure approaches such as sponge cities, two critical gaps remain. First, existing studies often treat resilience as primarily an infrastructural or environmental challenge, with limited integration of cultural heritage as an active, performative component of adaptive urban systems. Second, while RTD has gained recognition in design disciplines, its application to large-scale urban resilience, particularly in rapidly transforming Chinese delta cities, remains underdeveloped and methodologically ambiguous. As a result, there is a lack of frameworks that integrate flood adaptation, heritage continuity, and distributed resource systems in a coherent, multi-scalar urban design approach.

This study is guided by three research questions. First, how can RTD be operationalized as a method for generating transferable resilience knowledge in heritage-rich delta cities? Second, in what ways can Lingnan architectural heritage function as a performative climatic and social system rather than a static cultural artifact? Third, what integrated spatial framework can link flood adaptation, heritage continuity, and distributed resource systems at multiple urban scales?

This article addresses these gaps by reframing the competition project as an RTD inquiry into regenerative urbanism in deltaic environments. The study develops and evaluates a multi-scalar design framework that integrates landform modification, heritage-informed spatial strategies, and distributed water–energy–nutrient systems. It contributes to the field in three ways. First, it operationalizes RTD as a method for investigating climate resilience at the urban and district scale, clarifying how speculative design can generate transferable knowledge. Second, it reconceptualizes Lingnan architectural heritage not as a static cultural artifact but as a performative system that contributes to climatic adaptation and spatial organization. Third, it proposes an integrated framework, articulated through the principles of landform as infrastructure, heritage as anchor, and distributed systems, that links ecological resilience, cultural continuity, and urban metabolism. In doing so, the article positions speculative design not merely as a representational exercise, but as a methodological tool for advancing resilient urban futures in heritage-rich delta regions.



Figure 1. Location of Changzhou Island within the Pearl River Delta and the designated competition site (red outline). Source: Map by the authors

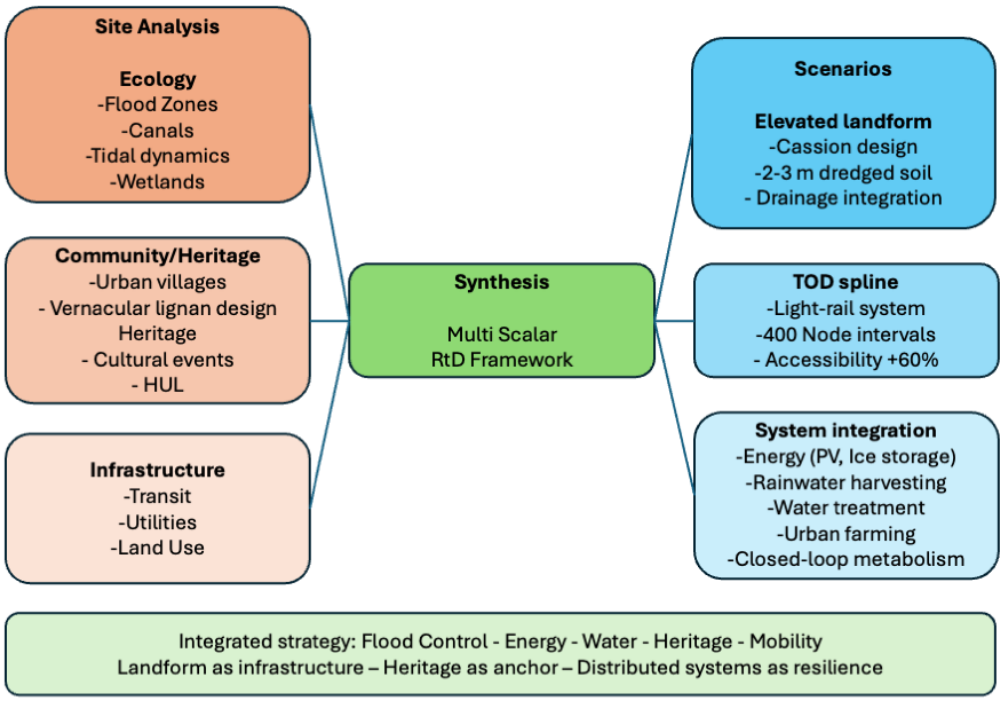


Figure 2. Integrated site analysis and scenario framework (ecology, heritage, culture, infrastructure, and design strategies)
Abbreviations: HUL: Historic urban landscape; PV: Photovoltaic; RTD: Research-through-design; TOD: Transit-oriented development. Source: Diagram by the authors

2. Literature review

Understanding urban resilience in deltaic settings requires a comprehensive view that includes ecological, infrastructural, cultural, and design-focused aspects. In the field of urban resilience, Meerow *et al.* (2016) provided a thorough definition, describing resilience as the ability of connected social and biophysical systems to withstand shocks, adapt, and transform while maintaining core functions. This idea emphasizes the importance of using multiscale strategies to address environmental and socio-cultural challenges (Kong *et al.*, 2022).

2.1. Urban resilience in delta regions

Building on this theoretical foundation, China's widely promoted sponge city model illustrates how ecological infrastructure can reduce urban flooding and water shortages. H. Li *et al.* (2017) provide a comprehensive review of sponge city implementation across pilot districts in China, demonstrating that interventions such as permeable pavements, retention systems, and bioswales enhance urban flood resilience, contribute to broader ecological restoration, and capture and manage stormwater across multiple scales, from source control to system-wide interventions. They also highlight the effectiveness of sponge city measures and emphasize their integrative role in advancing sustainable urban development. However, despite promising prospects, implementation challenges persist. Boncheva (2022) points out obstacles such as funding limitations and the inconsistent adaptation of Western low-impact development models to Chinese hydrological conditions. More empirically grounded, Q. Li *et al.*'s (2019) study in Guangxi assesses combinations of low-impact development practices, including bioretention and sunken green spaces, achieving runoff reductions of up to 75% at the neighborhood level. This evidence confirms that dispersed, nature-based solutions can significantly lessen hydrological pressures in densely built urban environments.

While urban resilience is widely discussed as a conceptual and strategic framework, its operationalization often relies on indicator-based assessment methods that quantify system performance and identify limiting factors. Recent studies have applied composite indices and obstacle factor analysis to diagnose weaknesses in urban systems and guide targeted interventions in specific regional contexts (Chen *et al.*, 2023). Such approaches highlight the importance of translating abstract resilience principles into measurable and context-sensitive planning tools.

2.2. Regenerative urbanism and delta landscapes

The concept of regenerative urbanism extends beyond sustainability by aiming to restore and enhance ecological and social systems rather than merely reducing negative impacts. Mang and Reed (2012) described regenerative design as a process that reconnects human and natural systems, emphasizing place-based relationships and long-term adaptability. In urban contexts, this perspective has been further developed through the notion of regenerative development, which integrates ecological cycles, cultural identity, and resource flows into spatial planning (Cole, 2012). Within delta regions, landscape-based approaches have been identified as particularly relevant due to their capacity to accommodate dynamic water systems. Meyer *et al.* (2017) argued that delta urbanism requires adaptive strategies that combine hydrological processes with urban form, moving beyond defensive infrastructure toward spatial integration. Similarly, Nijhuis (2023) highlights the role of landscape as an ordering system that enables resilience across scales in the PRD. These perspectives provide a theoretical foundation for understanding how landform, infrastructure, and cultural landscapes can be synthesized into regenerative urban strategies. These approaches are closely aligned with China's national sponge city program and broader climate adaptation strategies, which promote integrated water-sensitive urban design and flood resilience (Chan *et al.*, 2018). However, regenerative urbanism as a design methodology remains underexplored in rapidly urbanizing Asian contexts, where the pace and scale of transformation often exceed the capacity for long-term, place-based ecological relationships to emerge (Mang & Reed, 2012). This gap reinforces the need for design-led research that tests regenerative principles under the specific environmental, cultural, and temporal pressures of deltaic heritage cities (Nicholls *et al.*, 2007).

2.3. Heritage urbanism and Lingnan cultural continuity

Turning to heritage-led urbanism and climate-responsive architecture, Lingnan traditions offer practical, deeply rooted lessons. Zhao *et al.* (2024) showed that cold alleyways, narrow shaded passages typical of Lingnan homes, can significantly improve thermal comfort by lowering indoor temperatures and enabling passive cooling. Similarly, Ji *et al.* (2023) found that shading and ventilation strategies in traditional Lingnan buildings reduce solar gain by over 50%, maintain outdoor wind speeds around 1.5 m/s, and keep interior temperatures below 26°C. Studies on vernacular courtyard systems in southern China indicate that configurations such as shaded alleys and enclosed courtyards improve indoor thermal comfort and humidity regulation through enhanced ventilation and reduced solar gain (Knapp, 2000; Ng, 2009). Overall, these studies highlight indigenous architectural tactics that successfully

blend cultural form with environmental function, which are key to climate-adaptive and heritage-respecting design. Taken together, these studies position architectural traditions not merely as cultural artifacts to be conserved, but as active spatial systems capable of structuring climate adaptation - a reconceptualization central to this study's framework.

In the Lingnan context, cultural continuity is becoming a matter of sustaining evolving relationships among settlement form, landscape systems, and changing urban-rural conditions. In the PRD, planning initiatives such as regional greenway networks have been explicitly framed as instruments to address urban-rural disparities and to reconnect environmental, social, and spatial systems across the region (Liu *et al.*, 2019). Recent studies from Guangdong show that rural heritage revitalization is increasingly shaped by broader development agendas, revealing both the opportunities and tensions involved in maintaining cultural continuity within rapidly urbanizing territories (Law *et al.*, 2025).

2.4. Sustainable mobility

In the context of climate resilience, mobility systems play a critical role not only in facilitating movement but also in structuring access, redundancy, and socio-economic stability during disruptions. Transit-oriented development (TOD) has been widely promoted in Chinese cities as a strategy to integrate land use and transport infrastructure, particularly within rapidly expanding metropolitan regions such as the PRD. Beyond improving efficiency, TOD contributes to urban resilience by concentrating development around accessible nodes, reducing dependence on single transport modes, and enhancing walkability (Cervero & Murakami, 2010; Pan *et al.*, 2009). In deltaic environments, where flooding and infrastructural disruption can fragment urban systems, such spatial structuring becomes particularly significant. S. Wang *et al.* (2022) illustrate how integrating transit in urban design enhances not only traffic performance but also the social resilience and economic stability of megaregions in China. However, existing TOD research largely focuses on performance metrics such as density, accessibility, and economic value, with limited attention to its integration with cultural heritage and environmental adaptation. This suggests an opportunity to reconceptualize TOD not only as a mobility framework, but as a spatial armature capable of linking resilient infrastructure, heritage landscapes, and everyday urban life.

2.5. Research-through-design

From a methodological perspective, RTD has emerged as a recognized mode of inquiry within design disciplines, enabling knowledge generation through iterative making and testing. Frayling (1993) originally distinguished between research into, for, and through design, with the latter emphasizing the production of knowledge via design practice itself. In architecture, RTD has been further elaborated as a reflective and projective process in which design proposals function as hypotheses, enabling the exploration of complex and uncertain conditions, such as climate change and urban transformation (Bang *et al.*, 2012; Groat & Wang, 2013). Speculative design, as described by Dunne and Raby (2013), extends this approach by using scenario-building to engage critically with possible futures. Within urban contexts, however, the application of RTD at larger territorial scales remains less clearly defined, particularly in relation to resilience planning. This gap suggests the need for approaches that combine spatial modeling, design experimentation, and evaluative reasoning, positioning design proposals as analytical tools rather than purely representational outputs.

Finally, situating the discussion in comparable geographic contexts enhances relevance. Nijhuis (2023) positioned landscape-based design as a crucial lever for adaptive transformation in a multiscale regional planning study of the PRD, enabling the subregional scale to support urban resilience through ecological and social integration. Meanwhile, S. Chen *et al.* (2022) analyzed urban green space dynamics across the PRD, identifying significant changes in vegetation patterns driven by rapid urbanization, which underscores the need for regeneration-focused design strategies that re-center greenery in spatial planning. Peiris (2024), using a spatial resilience index in flood-prone Asian megacities, further highlights the interdependence of natural resilience, infrastructure, and social systems in managing water risks.

3. Methodology

This study adopted an RTD framework to investigate regenerative urban strategies for Changzhou Island, in which speculative design was deployed both as a method and as an output. RTD has been widely discussed in architectural research as a practice-led mode of inquiry in which design artifacts serve as vehicles for knowledge generation (Bang *et al.*, 2012; Giaccardi, 2019). Unlike empirical methods alone, RTD enables design scenarios to serve as probes for complex and uncertain conditions, such as climate change and urban resilience. In this study, the competition entry *Rooted Currents* is reframed as a research instrument, structured around the iterative processes of site analysis, scenario development, and evaluative synthesis.

3.1. Research-through-design process, timeline, and author roles

Transparency about the sequence and authorship of this study is essential for its methodological credibility. The DRG 2025 competition brief was issued by SCUT in February 2025, providing the primary site data, design program, and evaluation criteria. The student team, 12 fourth-year undergraduates at the School of Architecture and Design, KMUTT, developed and executed the Rooted Currents design under competition conditions, with the faculty advisor supervising. The RTD reframing, the analytical elevation of the competition entry into a research instrument governed by explicit research questions, was subsequently undertaken by the faculty advisor and co-authors, in close consultation with the student team and drawing directly on the competition report, technical appendices, and simulation data produced during the competition.

This constituted a post-hoc RTD reframing, a recognized and legitimate variant in the literature (Bang *et al.*, 2012; Gaver, 2012; Giaccardi, 2019), in which the researcher–designer relationship operated through close supervisory engagement rather than full identity. The faculty advisor's role as design supervisor provided the proximity that RTD required: design decisions were made with direct methodological input, simulation outputs were interpreted in dialogue with the research questions, and the competition's own evaluation criteria, which explicitly required quantified performance metrics, multi-scalar approaches, and replicability assessments (DRG 2025 Brief); served as an externally defined research protocol, a point developed further in Section 5.

The RTD process had three phases: site analysis and problem framing using geographic information system (GIS) mapping, heritage, and hydrological review; scenario development with three models tested for flood resilience, energy, water, heritage, and mobility; and evaluative synthesis separating site-specific decisions from transferable principles via benchmarking.

3.2. Case context and data sources

Changzhou Island, situated in Guangzhou's PRD, embodies overlapping challenges of flood vulnerability, heritage preservation, and socio-economic transition. The 46-hectare southeastern site specified in the DRG 2025 competition brief is low-lying, intermittently agricultural, and bounded by historic industrial remnants. Hydrological surveys indicate susceptibility to inundation of up to 3 m during extreme tide and storm events. Heritage mapping identifies layers of significance, including the Whampoa Military Academy, Qing-era (1644–1912) forts, and traditional village settlements.

However, the island's built fabric has been substantially altered by decades of uncoordinated development. Most residential buildings date to the 1950s and 1960s, and most have lost their traditional architectural character (DRG, 2025). Intact Lingnan architectural features are therefore sparse rather than continuous: oyster-shell wall construction, for instance, survives at only one location on the island. What persists is primarily at the spatial and intangible level: narrow alleyways linking village clusters, ancestral halls and temples marking civic and spiritual life, and the scale of traditional settlement patterns. The heritage strategy developed in this study proceeded from this honest baseline: it aimed for the recovery and reinterpretation of spatial logics that persisted as cultural memory rather than the replication of an architectural fabric that no longer existed. This distinction, between heritage as a surviving physical ensemble and heritage as a set of recoverable spatial principles, was central to the study's claim that Lingnan traditions can function as a performative resilience system in a contemporary context.

Data sources informing the analysis were both primary and secondary. Primary datasets included the official DRG 2025 site survey, heritage protection atlas, and Q & A documents, which outlined geomorphology, land-use restrictions, cultural traditions, and demographic structures. Secondary sources included municipal planning regulations, previous hydrological studies, and climate datasets from the Greater Bay Area (Peiris, 2024). Together, these formed a composite baseline for design experimentation.

3.3. Analytical framework

The methodology unfolded across three interrelated analytical dimensions. First, ecological analysis employed GIS-based mapping and Rhino/Grasshopper modeling to examine topographic profiles, riverine connections, and flood-prone zones. Similar to methods used in sponge city evaluations, hydrological layers were spatialized relative to projected rainfall and tidal variations to assess landform resilience (Yin *et al.*, 2021). This integrated approach reflected emerging perspectives on urban resilience that highlighted the interdependencies between environmental systems and resource flows at the district scale.

Second, heritage analysis involved spatial and qualitative mapping of cultural anchors: ancestral villages, heritage corridors, and intangible practices such as festivals and clan-based rituals. This approach aligned with the *historic urban landscape* (HUL) methodology promoted

by the United Nations Educational, Scientific, and Cultural Organization (UNESCO), which viewed heritage as both the tangible fabric and social practices that influence spatial resilience (Bandarin & van Oers, 2012; UNESCO, 2011).

Third, infrastructural analysis assessed connectivity, utilities, and socio-economic constraints. Limited transit (three bus routes and ferry connections) currently isolates the island, suggesting opportunities for transit-oriented intensification. Utilities such as water, waste, and energy were analyzed using regional data and local accounts; for instance, the waste system was identified as outdated and reliant on multiple transfer stages. These infrastructural weaknesses informed subsequent proposals for distributed systems.

Spatial analysis and scenario testing were conducted through a combination of GIS-based mapping and parametric modeling. Base maps were derived from the DRG 2025 site survey and competition atlas materials, supplemented by publicly available satellite imagery and municipal planning information. Terrain and flood-prone zones were reconstructed as a simplified digital site model in Rhino and Grasshopper, using elevation bands and canal-edge conditions indicated in the competition documentation. Because a high-resolution hydrodynamic model was beyond the scope of the competition-based study, flood exposure was assessed through scenario-based spatial overlays rather than full hydrological simulation. Three flood conditions were tested: baseline site condition, a moderate inundation scenario of 1.5 m, and a severe inundation scenario of +3.0 m, corresponding to the competition's projected extreme flood framing. Elevated land scenarios were then modeled by raising selected development parcels by 2.0–3.0 m, allowing comparison of exposed versus protected site areas under the same assumed water levels. Resource-cycle estimates for photovoltaics (PVs), rainwater harvesting, and cooling systems were derived from typological area calculations and literature-based performance benchmarks for subtropical Chinese urban districts. These outputs should therefore be interpreted not as precise engineering forecasts but as scenario-based estimates for comparing design strategies and identifying transferable resilience principles.

3.4. Scenario development

Building on the analysis, the design exploration produced three speculative scenarios, each addressing resilience at different scales. The elevated landform scenario involved raising vulnerable parcels by 2.0–3.0 m using dredged soil from the Pearl River. Elevation was thought to reduce direct flood exposure while creating terraces for agriculture, public spaces, and clustered housing. This echoes precedents in adaptive landscape design, such as Rotterdam's "Room for the River" program, where landform modifications balance ecological cycles with flood defense (Pahl-Wostl, 2015). The TOD spine scenario organized growth along a linear pedestrian and transit corridor anchored by a proposed tram/light rail line connecting Changzhou Island to the neighboring Shenjing and Hongshengsha islands, with interchange nodes linking to the planned Guangzhou Metro Line 7 extension (Figure 3). This above-ground system was referred to throughout as the "TOD spine"; individual tram stops functioned as the walkability nodes that structured the design. The line was conceived as a new surface transit layer intended to complement the planned metro station, extending walkable transit connectivity across the 46-hectare competition site and between neighboring islands. Nodes spaced roughly 400–500 m apart ensured that most residents would stay within a five-minute walk of a transit stop. The aim was to address Changzhou's mobility issues while embedding compact, walkable nodes, consistent with TOD approaches observed in rapidly urbanizing Chinese cities (Lyu *et al.*, 2016).

The distributed systems scenario introduced localized sustainability infrastructure, including rooftop PVs projected to meet 15%–20% of energy demand, rainwater harvesting to cover 25%–30% of non-potable needs, and neighborhood-scale ice storage systems to cut cooling loads by about 30%. Inspired by Terra Preta sanitation models, nutrient-rich soils from waste recycling were proposed to close metabolic loops and improve agricultural productivity. These measures are supported by studies on decentralized energy-water systems for climate resilience in urban areas (Z. Wang *et al.*, 2022). Table 1 illustrates that while individual strategies performed unevenly across criteria, their integration yielded a balanced system, supporting the argument for multi-scalar synthesis over single-solution optimization.

3.5. Evaluation methods

Given the study's speculative and design-led nature, evaluation was conducted through comparative scenario testing rather than empirical validation. Building on the analytical framework described in the previous section, evaluation criteria were applied across both quantitative and qualitative dimensions. Quantitative criteria included: flood exposure reduction under the +3.0 m scenario, percentage of energy demand met by rooftop PV, proportion of non-potable water supplied by rainwater harvesting, cooling load reduction through ice storage, and improvement in pedestrian accessibility. Qualitative criteria addressed cultural integration, urban legibility,

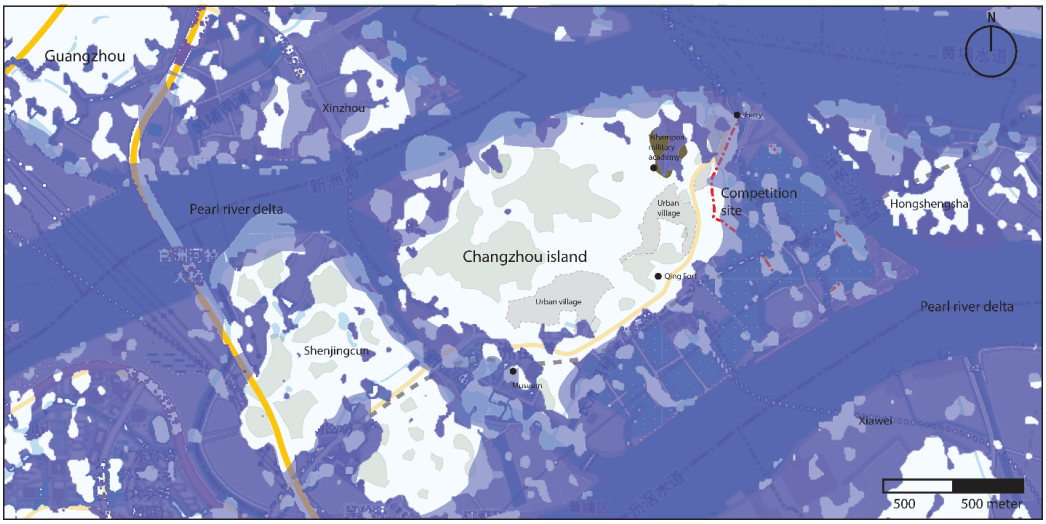


Figure 3. Integrated site analysis framework showing ecological flood zones, heritage anchor locations, and infrastructural constraints across the 46-hectare competition site. Source: Map by the authors

Table 1. Scenario matrix (criteria: flood resilience, energy/water self-sufficiency, heritage integration, mobility)

Scenario	Flood resilience	Energy	Water	Heritage	Mobility
Elevated land	High	Low	Medium	Medium	Low
TOD spine	Low	Medium	Low	Medium	High
Distributed systems	Medium	High	High	Low	Medium
Integrated strategy	High	High	High	High	High

Notes: Ratings are indicative scenario-based assessments benchmarked against literature; they do not represent validated engineering predictions.
Abbreviation: TOD: Transit-oriented development.

and socio-spatial cohesion. This distinction between measurable performance estimates and qualitative design judgments was important for interpreting findings appropriately.

Each scenario was subjected to evaluative testing along both quantitative and qualitative dimensions. Flood simulations were conducted to contrast baseline and elevated land conditions and to measure the reduction in exposure. Resource cycle models calculated potential energy and water contributions using benchmarks from sponge city pilot projects and renewable energy simulations (Yu *et al.*, 2015). Morphological overlays examined walkability, accessibility, and integration with heritage anchors.

Qualitative evaluation considered cultural integration, urban legibility, and socio-spatial cohesion. Cold alley and courtyard morphologies were reinterpreted into modular cluster typologies, aligning with findings from Zhao *et al.* (2024) and Ji *et al.* (2023) on the climatic benefits of Lingnan traditions. The evaluation also drew on comparative precedents in heritage-sensitive regeneration, including projects aligned with the HUL approach in Chinese cities, where integrated conservation strategies balanced development pressures with cultural continuity (Bandarin & van Oers, 2012; UNESCO, 2011).

Rather than selecting a singular scenario, the methodology culminated in synthesis, combining elements across scales into a cohesive framework. Elevated land provided territorial resilience, the TOD spine offered connective tissue, and distributed nodes ensured metabolic

sufficiency. Heritage anchors structured the morphology, ensuring cultural continuity. This integrative approach reflected recent scholarship advocating for multi-scalar resilience strategies that are ecological, infrastructural, and socio-cultural simultaneously (Nijhuis *et al.*, 2020; Yang *et al.*, 2025).

3.6. Limitations

As with many design-based research endeavors, limitations must be acknowledged. The competition timeframe constrained stakeholder engagement and detailed hydrological calibration. While parametric simulations offered insights, they remained approximations, not substitutes for long-term field monitoring. Data scarcity, particularly regarding utilities and demographics, required reliance on regional benchmarks and extrapolations. Finally, speculative design, by definition, cannot claim the ability to implement; instead, it functions as a generative probe to expand the horizons of urban resilience discourse. It should also be acknowledged that RTD, as a methodology, remains contested: critics, including Cross (2006) and Gaver (2012), have questioned whether design artifacts can reliably produce generalizable knowledge or primarily document situated intuition. This study addressed that critique by explicitly distinguishing between site-specific design decisions and transferable principles, and by benchmarking scenario outcomes against empirical literature rather than relying solely on design judgment.

4. Results

The results show scenario-based outcomes from design modeling as well as literature values. They allowed comparison of resilience strategies rather than exact real-world predictions. As such, they should not be interpreted as validated technical predictions.

Across the three scenario dimensions, headline outcomes are as follows. Landform elevation of 2.0–3.0 m substantially reduced flood exposure under the +3.0 m scenario, with lower zones reconfigured as retention and buffer landscapes. Energy performance modeling showed a 70%–75% reduction in purchased electricity after implementing passive design and renewables, thereby cutting carbon dioxide (CO_2) emissions in line with the design strategy.

Rainwater harvesting was projected to supply 25%–30% of non-potable water needs, and ice storage systems were estimated to reduce cooling loads by about 30%. TOD spine restructuring improved pedestrian accessibility by approximately 60% based on scenario-based isochrone analysis of tram stop spacing compared to the baseline. These outcomes are discussed in detail in the following sections.

4.1. Spatial and environmental outcomes

The simulation of flood exposure under current conditions showed that large parts of the southeastern competition site, especially low-lying areas near canals, would flood under a 3 m flood scenario, aligning with broader predictions for the PRD (Yang *et al.*, 2014). By modifying the landform through strategic elevation of 2–3 m using dredged soil, scenario-based modeling indicated a substantial reduction in flood exposure. Elevated land parcels formed a three-tier system: the lowest served as ecological buffers and stormwater retention ponds, the mid-levels were used for agricultural terraces and pedestrian pathways, and the highest served as residential and community clusters. This layered landscape resembles adaptive strategies seen in Rotterdam's "Room for the River" program, where landform adjustments support multifunctional resilience (Warner *et al.*, 2012).

In water management, combining bioswales and constructed wetlands with raised terrain was projected to increase onsite water retention capacity by up to approximately 30%, based on benchmark comparisons. This aligns with empirical results from sponge city pilot projects in Wuhan and Xiamen, where distributed low-impact development systems reduced runoff by 20%–35% (Q. Li *et al.*, 2019; Zevenbergen *et al.*, 2018). By combining elevated land with ecological stormwater strategies, the project suggested a form of layered resilience in which complex infrastructure and flexible ecological systems work together.

The energy performance of the architectural prototype was evaluated using building energy simulation software (version 28, 2024, Graphisoft, Hungary), calibrated to Guangzhou's subtropical climate (23°N, 113°E). The simulation compared a baseline design (total energy use: 32,192 kWh/a; CO_2 emissions: 3,841 kg/a) with an improved design incorporating passive cooling, optimized orientation, high-performance envelopes, shading, and onsite renewables. The improved design reduced energy use to 25,253 kWh/a, with onsite renewable generation of 8,528 kWh/a (PVs: 5,277 kWh/a; wind: 1,603 kWh/a; solar thermal: 1,648 kWh/a), lowering net electricity purchase to 4,614 kWh/a—an indicative 73% decrease in electricity cost, as well as CO_2 emissions (scenario-based life cycle assessment estimate). Life cycle assessment showed a global warming potential of 4.4 kg CO_2eq/m^2/for the improved prototype, down from 16.3 kg CO_2eq/m^2/a. Ice storage helped manage cooling loads, reducing grid dependency during peak summer. These results align with Chinese eco-district guidelines (Liu *et al.*, 2019), China's sponge city goals, and eco-district development in Shanghai and Shenzhen (Zhang *et al.*, 2011).

Water recycling strategies also demonstrated clear benefits, with rainwater harvesting systems shown to significantly contribute to non-potable water demand, particularly for irrigation and toilet flushing, in high-rainfall urban contexts such as Guangzhou (Campisano *et al.*, 2017).

Incorporating Terra Preta–based sanitation cycles suggested potential reductions in wastewater by closing nutrient loops and regenerating soils, although these remained hypothetical without full-scale testing. Overall, these measures positioned the site as an experimental ecology, in which the built environment functioned as part of a water-energy-nutrient cycle rather than as a linear resource consumer. These results should be interpreted as comparative scenario-based estimates that illustrate the relative performance of design strategies, rather than as calibrated engineering simulations.

While the specific performance figures derived from Changzhou Island's subtropical conditions, the landform-as-infrastructure principle, redistributing flood exposure through topographic modification while creating multifunctional public landscapes, applies to any low-lying deltaic site where conventional embankment strategies are ecologically or financially untenable. The distributed water-energy-nutrient loop model is similarly relevant to waterfront districts in other rapidly urbanizing cities where centralized infrastructure is under stress from climate variability.

Scenario-based flood modeling indicated a substantial redistribution of exposure by landform elevation. As illustrated in Figure 4, areas previously subject to inundation under the +3 m scenario remained above projected water levels after elevation, while lower zones were reconfigured as retention and buffer landscapes. This supports the view that landform modification is a spatial resilience strategy rather than a purely defensive intervention.

The integration of water, energy, and nutrient flows is conceptualized as a localized urban metabolism. As shown in Figure 5, rainwater harvesting, PV generation, and nutrient recycling are interconnected within a closed-loop system, suggesting how distributed infrastructure can reduce dependency on centralized networks while enhancing systemic resilience.

4.2. Urban and mobility outcomes

At the urban scale, the restructuring of circulation around a TOD spine suggested a significant restructuring of accessibility patterns. Nodes spaced at approximately 400–500 m intervals were designed to place the majority of residents within a five-minute walking distance of transit, the widely accepted benchmark for TOD effectiveness (Cervero & Murakami, 2010). Pedestrian isochrone analysis indicated an accessibility improvement of approximately 60% compared to baseline conditions, where mobility is constrained by reliance on three bus routes and ferry terminals.

The spine was not conceived merely as transit infrastructure but as a civic axis linking heritage clusters, canal promenades, and shaded pedestrian alleys. This integration of walkability and cultural anchoring reflects established TOD principles, in which compact station-area planning fosters not only mobility but also placemaking and economic vibrancy (Renne & Curtis, 2016). Importantly, in Changzhou, TOD was framed as a corrective to isolation, dissolving the island's peripheral status by knitting it into the broader metropolitan region while preserving its distinct identity.

Canal promenades reinforced the spine by introducing water-based mobility, echoing Lingnan traditions of riverine connectivity. Shaded pedestrian pathways further enhanced comfort, drawing inspiration from historic cold alleys known for their microclimatic benefits (Zhao *et al.*, 2024). In spatial synthesis, the circulation system exemplified how mobility and climate adaptation can converge within a culturally grounded framework.

Accessibility analysis indicates a significant improvement in walkability through the introduction of the tram/light rail TOD spine. Figure 6 demonstrates that the proposed node spacing enables most residential areas to fall within a five-minute walking radius, indicating a substantial improvement over existing fragmented mobility conditions.

The TOD spine model, which organizes compact, walkable neighborhoods around a surface transit corridor connecting a heritage-rich island to a broader metropolitan network, applies to other peripheral urban islands and waterfront districts in Southeast and East Asian cities facing similar isolation-and-overdevelopment pressures. The integration of tram infrastructure with canal promenades and heritage corridors offers a replicable template for embedding mobility within a culturally and ecologically grounded spatial framework.

4.3. Cultural and architectural outcomes

The architectural results centered on translating Lingnan traditions into modular, climate-adaptive clusters. Each cluster was based on a 9 × 9 m modular grid, allowing combinations that formed housing units ranging from 36 to 144 m^2 and were adaptable to diverse household configurations. The ground floors utilized low-carbon concrete and recycled clay brick, ensuring durability against moisture and floods. In contrast, the upper levels

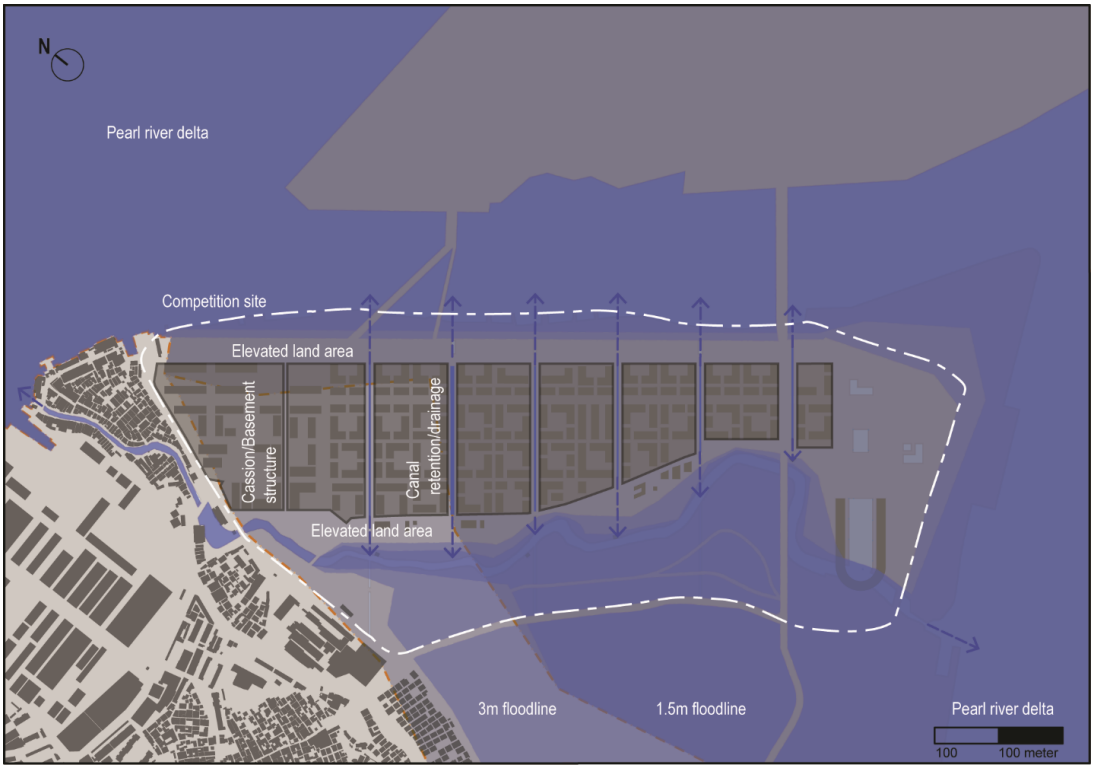


Figure 4. Scenario-based comparison of flood exposure under elevated land conditions. Residual exposure after 2.0–3.0 m landform elevation, showing reconfigured retention zones and protected development parcels. Source: Map by the authors

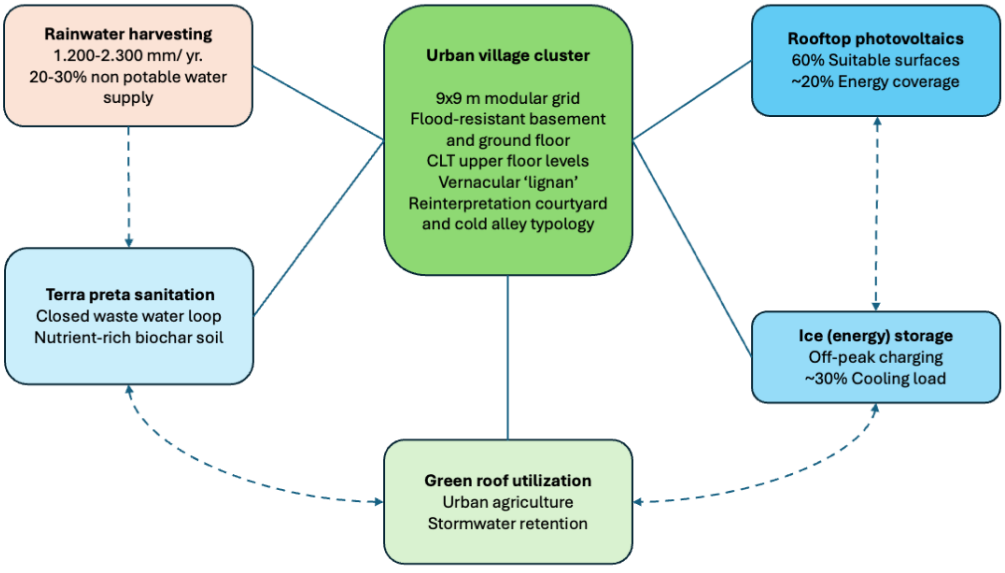


Figure 5. Closed-loop resource cycle diagram illustrating the integration of rainwater harvesting, rooftop photovoltaics, ice energy storage, and Terra Preta sanitation within the cluster framework. Source: Diagram by the authors

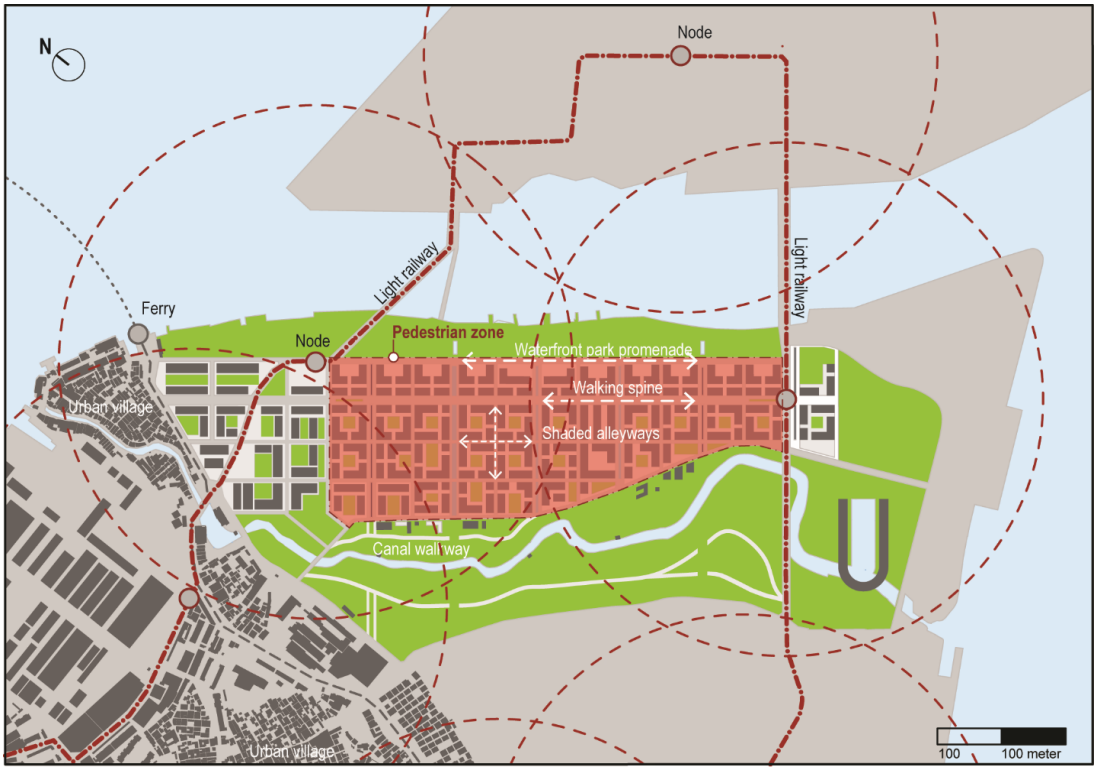


Figure 6. Transit-oriented development spine and pedestrian accessibility map. Five-minute walking isochrones from transit nodes illustrate a projected 60% improvement in accessibility relative to baseline conditions, compared to available bus routes. Source: Map by the authors

were constructed with cross-laminated timber, aligning with lifecycle studies that show cross-laminated timber can significantly reduce embodied carbon by up to 50% compared to reinforced concrete (Dodoo *et al.*, 2014).

Spatially, the cold alleys between rows of buildings were designed to provide shaded passages, with airflow simulations suggesting wind speeds of 0.6–1.0 m/s even under calm external conditions, corroborating the findings of Ji *et al.* (2023). Vernacular spatial systems in the Lingnan region, including narrow, shaded alleys and courtyard configurations, demonstrated climate-responsive strategies that enhanced ventilation, reduced solar gain, and mediated thermal comfort through compact, porous urban forms (Emmanuel, 2012; Lin *et al.*, 2010). Façade incorporated oyster-shell walls, once a vernacular technique along Guangzhou's coastlines, reinterpreted as insulating panels (Han *et al.*, 2025). Together, these material and spatial devices illustrated how heritage morphology could be leveraged as a climate adaptation mechanism rather than a nostalgic gesture.

Cultural integration extended beyond materiality into programming. Heritage clusters anchored TOD nodes, positioning historic sites and cultural landscapes as organizational frameworks for growth. Festivals such as the Golden Flower Festival and the Carambola Festival, identified in the DRG 2025 Q & A document (DRG, 2025) were envisioned as central to the public space calendar, embedding intangible cultural heritage into the everyday life of the new district. This approach aligned with UNESCO's HUL framework, which posited that heritage should be harnessed as a dynamic process to foster social cohesion (Bandarin & van Oers, 2012; UNESCO, 2011).

The modular cluster typology translated Lingnan spatial principles into a contemporary architectural system. As illustrated in Figure 7, the vertical stratification of flood-resilient base structures and lightweight upper levels enabled both climatic adaptation and construction efficiency, while maintaining spatial relationships characteristic of traditional courtyard and alley systems.

While the specific spatial devices, passive design elements, and the 9 × 9 m modular grid respond to Changzhou Island's Lingnan context, the underlying principle is broadly transferable: that degraded heritage traces can serve as the generative grammar for contemporary climate-adaptive design, even where the physical fabric has been substantially lost. In any rapidly urbanized heritage



Figure 7. Perspective view of the Lingnan-inspired cluster typology, showing the vertical stratification of flood-resilient base structures (recycled clay brick), cross-laminated timber residential floors, and productive rooftop landscapes
Abbreviations: PV: Photovoltaic; SME: Small- and medium-sized enterprise. Source: Diagram by the authors

district where spatial and cultural memory persists, on the scale of laneways, the placement of ancestral halls and the logic of courtyard clusters can structure a performative, climatically responsive architecture without requiring the replication of an intact ensemble that no longer exists.

4.4. Integrated synthesis

The synthesis of landform elevation, TOD restructuring, and heritage-based cluster design resulted in an integrated spatial framework in which individual strategies reinforce one another across scales. By layering infrastructural resilience, ecological systems, cultural continuity, and distributed utilities, the project proposed a regenerative urbanism rooted in local identity yet adaptable to global challenges.

The emergent principles can be articulated as follows. First, landform as infrastructure reframes topography as an active agent of resilience, echoing adaptive landscape precedents but grounded in the deltaic conditions of Guangzhou. Second, heritage as an anchor recognizes cultural landscapes and architectural traditions as structuring devices that embed continuity within transformation. Third, distributed systems demonstrate how decentralized energy and water cycles can complement centralized infrastructure, enhancing redundancy and self-sufficiency.

Since scenario-based projections suggest potential feasibility, implementation requires further empirical testing to confirm. Hydrological models require calibration against site-specific flood events, while PV and water harvesting outputs must be verified at the pilot scale. Heritage integration, in turn, depends on community engagement. Nonetheless, as a speculative exercise, the synthesis illustrates how design competitions can function as laboratories for resilient futures, generating both tangible spatial strategies and transferable methodological insights (Table 2).

5. Discussion

The findings presented earlier highlight how speculative design can inform resilient urbanism by integrating ecological infrastructure, heritage continuity, and distributed resource systems into a unified framework. This discussion places those results within the context of global resilience theory, regenerative urbanism practices, Chinese urban policy, and the role of design competitions as research laboratories. In addressing the three research questions posed in Section 1: the findings demonstrate that RTD can be operationalized at the urban scale by treating competition scenarios as bounded design experiments benchmarked against empirical literature (research question 1); that Lingnan architectural heritage functions as a performative climatic and social system through cold alleys, courtyard configurations, and material choices that

Table 2. Transferable principles with design examples from Rooted Currents and potential global applications.

Principle	Design application	Mechanism	Transferability
Landform as infrastructure	Elevated terrain	Flood redistribution	Delta cities
Heritage as anchor	Lingnan clusters	Climatic + cultural	Historic districts
Distributed systems	Photovoltaic, water cycles	Resource autonomy	Emerging urban areas

actively moderate temperature, humidity, and community life (research question 2); and that an integrated multi-scalar framework linking landform elevation, TOD connectivity, and distributed infrastructure is viable as a regenerative design strategy for deltaic heritage cities (research question 3).

5.1. Integrating landform as infrastructure

One of the primary outcomes of the project was the strategic use of landform elevation to reduce flood risk while also creating multifunctional urban landscapes. The idea of "landform as infrastructure" challenges the traditional division between grey infrastructure and natural systems. Instead of building linear barriers like seawalls, which can shift risks downstream or harm ecosystems, landform interventions aim to work with hydrological dynamics by redistributing exposure and building layered resilience.

This principle aligns with broader research on adaptive landscape-based flood management. Warner *et al.* (2012) described the Dutch Room for the River program as a significant shift from complex defenses to spatial flood accommodation, turning risk into opportunity by designing floodable landscapes that serve as ecological and recreational spaces. Similar ideas have been reflected in China's sponge city initiative, which encourages infiltration, detention, and reuse instead of channeling stormwater away (Zevenbergen *et al.*, 2018). Applying these concepts to Changzhou Island, the Rooted Currents project broadens the discussion by demonstrating how landform strategies can be adapted to a culturally and historically layered deltaic island, rather than a large metropolitan floodplain.

Furthermore, by elevating specific parcels while maintaining retention zones, the design adheres to Pahl-Wostl's (2015) concept of "adaptive water governance," which emphasizes flexibility and redundancy. Landforms serve not only as a shield against floods but also to support public spaces, agriculture, and ecological renewal. In China's policy context, this aligns with the National Climate Change Adaptation Strategy, which advocates for nature-based and multifunctional approaches to enhance climate resilience (NDRC, 2022).

5.2. Heritage as an anchor of resilience

Another key finding is the role of cultural heritage as a structural element for resilience. In many Chinese cities, rapid urbanization has marginalized heritage by pushing it into enclaves or turning it into simulacra disconnected from community life (He & Wu, 2016; Zukin, 2010). In contrast, Rooted Currents reinterpreted the spatial logics of Lingnan culture, the scale of narrow alleyways, the organization of courtyard clusters, the placement of ancestral halls as civic anchors, and the principle of passive cooling through a porous urban form as a generative grammar for contemporary climate-adaptive design. The island's built fabric has been substantially altered, and intact Lingnan features survive only as isolated exceptions; the project's contribution, therefore, lies not in replicating a physical ensemble that no longer exists, but in demonstrating that heritage traces at the spatial and intangible levels can structure a performative urban morphology. This reconceptualization, heritage as recoverable spatial logic rather than preserved artifact, allows cultural continuity to contribute actively to climate adaptation even in contexts of severe fabric degradation, in ways that both conventional heritage conservation and modernist planning often overlook.

This approach aligns with UNESCO's HUL framework (Bandarin & van Oers, 2012; UNESCO, 2011), which advocates integrating tangible and intangible heritage into the broader urban fabric as part of sustainable development. In Lingnan areas, architectural traditions have long served as adaptive responses to subtropical climates, as recent studies confirm (Zhao *et al.*, 2024). By reinterpreting these traditions within modular cluster systems, the project demonstrated how cultural continuity can be preserved while addressing modern housing needs.

Furthermore, designing urban spaces around cultural landscapes and festivals contributes to what Vale (2014)

called "socially resilient urbanism," in which cultural identity fosters community solidarity during disruptions. This is especially relevant for Changzhou Island, where intangible heritage, such as the Golden Flower Festival, remains deeply woven into local practices. By incorporating these traditions into the design, the project demonstrated how cultural anchors can stabilize identity while allowing for change.

5.3. Distributed systems and the metabolic city

The proposal's emphasis on decentralized energy, water, and nutrient systems illustrates the growing recognition that resilience requires redundancy and diversity in resource flows. Centralized infrastructure, while efficient under stable conditions, is vulnerable to systemic disruption, as seen in recent urban flooding and blackout events in Chinese megacities (Meerow *et al.*, 2016). In contrast, distributed systems, such as rooftop PVs, rainwater harvesting, neighborhood-scale cooling, and sanitation, provide local autonomy and flexibility.

This aligns with recent scholarship on the "metabolic city," which emphasizes urban flows of energy, water, and materials as key to sustainability (Kennedy *et al.*, 2011). Z.Wang *et al.* (2022) noted that decentralized energy systems in Chinese cities improve resilience not only by diversifying supply but also by creating opportunities for community governance and innovation. Similarly, water-energy-food nexus approaches highlight the benefits of localized systems, especially under climate stress (Meerow *et al.*, 2016). By integrating Terra Preta sanitation into nutrient cycles, *Rooted Currents* expanded this idea into soil regeneration, positioning urban design as a mediator of circular resource flows.

In policy terms, these strategies resonate with China's "dual carbon" goals, peaking emissions by 2030 and achieving neutrality by 2060. Eco-districts in Shanghai, Shenzhen, and Tianjin have piloted distributed resource systems as part of this agenda; however, few integrate them with heritage-based urban forms. China's 14th Five-Year Plan explicitly calls for eco-district development that integrates carbon reduction with place-based livability (Zhao *et al.*, 2024), yet existing pilots tend to deploy distributed energy and water systems in blank-slate developments rather than in culturally layered sites. Changzhou Island offers a model for how these national targets might be pursued within heritage contexts-embedding net-zero ambitions into the spatial logic of traditional settlement patterns rather than overwriting them.

5.4. Research-through-design

The most significant methodological contribution of this project lies in demonstrating speculative design as a legitimate research method. Dunne and Raby (2013) described speculative design as a way to provoke discussion by imagining futures, while Giaccardi (2019) argued that RTD generates knowledge through artifacts and scenarios. *Rooted Currents* exemplified this by treating a competition entry not simply as a proposal but as a research probe.

This methodological stance is particularly relevant for urban resilience, where uncertainties are profound and traditional empirical forecasting is insufficient. By modeling scenarios of elevated land, TOD spines, and distributed systems, the project tested hypotheses under speculative conditions. These scenarios did not provide definitive solutions but revealed trade-offs and potential, contributing to knowledge production in line with Bang *et al.* (2012), who emphasized the role of hypothesis testing in constructive design research.

Competitions have historically served as incubators for architectural innovation, but they are seldom explicitly framed as research. Recasting them as laboratories could expand their value, not only to produce visionary images but also to generate principles transferable to other contexts. In this sense, *Rooted Currents* contributes to the emerging discourse on design-led research in architecture and urbanism.

A stronger claim is available, however, and our study supports it: the DRG 2025 competition structure itself constituted a bounded research protocol. The brief issued specified explicit design objectives (DRG, 2025), of which some directly map onto standard RTD evaluation criteria, requiring (i) for multi-scalar design approaches analogous to RTD's insistence on iterative testing at different levels of resolution; (ii) for replicability and scalability assessments, the equivalent of demanding transferable knowledge production; and (iii) for measurable, quantified impact, the equivalent of empirical benchmarking.

The DRG 2025 jury comprised practitioners and faculty from SCUT and international partner institutions, evaluating submissions against a standardized brief with explicit performance criteria. This structured external assessment, while distinct from academic peer review in its methods and scope, provides a form of design evaluation beyond the internal judgments of a single studio, lending the RTD outcomes an additional layer of critical scrutiny. When structured this way, with explicit performance criteria, quantified outputs, and external review, competitions can be understood not merely as creative incubators but as peer-reviewed design experiments. This reframing shifts competitions from the periphery of

architectural research to a legitimate position within it, and it strengthens the methodological standing of studies that draw on them as primary research instruments.

This methodological stance requires qualification. Critics of RTD, including Cross (2006) and Gaver (2012), have raised questions about whether design artifacts can produce genuinely generalizable knowledge or primarily yield well-documented intuitions specific to their site and moment. The current study responds to that critique in two ways. First, by explicitly separating site-specific design decisions, such as the choice of Lingnan clay brick or the 9 × 9 m grid, from the transferable principles of landform as infrastructure, heritage as anchor, and distributed systems. Second, by benchmarking scenario outcomes against empirical studies from comparable contexts, ensuring that claims extend beyond the project itself. Competitions, when structured this way, can thus move from speculation toward a form of bounded design knowledge.

5.5. Broader implications for Chinese and global urbanism

The principles distilled—landform as infrastructure, heritage as anchor, distributed systems—carry broader implications beyond Changzhou Island. Within the PRD, similar islands and waterfront districts face comparable pressures of flooding, overdevelopment, and cultural erosion. Embedding these principles into ongoing sponge city and TOD programs could enrich their social and cultural dimensions, making them not only hydrologically efficient but also socially cohesive.

Internationally, deltaic cities such as Bangkok, Ho Chi Minh City, and Jakarta face similar dilemmas. In these contexts, heritage-rich waterfronts are often threatened by both flooding and speculative redevelopment. Applying the framework developed here could help balance resilience, identity, and growth.

Thus, the case contributes to theoretical debates on regenerative urbanism. As Cole (2012) argued, regenerative design moves beyond sustainability to create net-positive systems that enhance both ecological and social capital. *Rooted Currents* illustrated how this philosophy can be translated into spatial strategies in which urban design acts as a regenerative agent embedded in ecological and cultural cycles.

6. Conclusion

Changzhou Island represents both the vulnerabilities and opportunities of deltaic urbanism in China. It is at once threatened by flooding, overdevelopment, and heritage erosion, yet rich in cultural landscapes and adaptive traditions. The *Rooted Currents* project, reframed through an RTD methodology, demonstrates how speculative design can contribute to knowledge production in this complex setting.

As illustrated in the competition poster submission in Figure 8, the results highlight three transferable principles. First, landform as infrastructure underscores the role of topography as an active, multifunctional system for flood resilience, ecological regeneration, and public life. Second, heritage as an anchor shows how cultural landscapes and architectural traditions can guide contemporary design, sustain identity, and enhance climatic functionality. Third, distributed systems illustrate the potential of localized energy, water, and nutrient loops to provide redundancy and autonomy, complementing centralized networks. Together, these principles form a framework for regenerative urbanism that is both rooted in place and globally relevant.

The broader implications of this study extend in two directions. Chinese urbanism offers a model for integrating national resilience and carbon-neutrality policies with heritage-sensitive urban design. For global discourse, it contributes to comparative knowledge on how deltaic cities can adapt to climate change while sustaining cultural identity. Methodologically, it affirms the value of speculative design as a research approach, demonstrating that competitions can generate not only visionary imagery but also transferable principles.

Future research should advance this approach by moving from speculation to practical implementation. Engaging with local communities can enhance the cultural aspect, while empirical hydrological modeling would confirm performance claims. Pilot projects could test distributed systems at the neighborhood level, creating feedback loops between design, monitoring, and adaptation. These steps would help connect future visions with real-world experiences, strengthening the role of design as both a creative and scientific tool in the pursuit of resilient, regenerative urbanism. By reframing design as a method of inquiry, our study demonstrates how speculative urban proposals can generate actionable knowledge, positioning architecture and urban design not only as tools of representation but as instruments for advancing resilient and regenerative futures in rapidly transforming delta regions.



Figure 8. Competition poster for Rooted Currents: Sustained living, embraced heritage, and protected cycles, submitted to the Designing Resilience Global (DRG) 2025 International Design Competition, School of Architecture, South China University of Technology (SCUT), Guangzhou, China. Original work © 2025 Rooted Currents Design Team, School of Architecture and Design (SoA+D), King Mongkut's University of Technology Thonburi (KMUTT), Thailand. Source: Reproduced with the written consent of the student design team

Acknowledgements

The authors gratefully acknowledge the School of Architecture, South China University of Technology (SCUT), Guangzhou, for hosting the DRG 2025 competition and for preparing the competition brief, site survey, heritage protection atlas, and Q & A documents that provided the primary data for this study. The authors would also like to acknowledge the *Rooted Currents* student team for their creativity and dedication, which led to the project's recognition as the winner of the Climate Resilience Urban Design Excellence Award at DRG 2025. They are: Amornpong Asawapongpullkit, Mia Clarisse Ignacio, Sarapat Khumkhong, Niracha Limsirisakul, May Thet Khaing, Korphai Nontapaoraya, Ei Thandar Oo, Phanthira Arjarreepipat, Pranchalee Ashasuthikhun, Pruknapon Thongbai, Nattapob Wilawanwajee, and Phanurus Wongtree.

Funding

None.

Conflict of interest

The authors declare they have no competing interests.

Author contributions

Conceptualization: Martin Schoch, Sunaree Lawanyawatna
Formal analysis: Sunaree Lawanyawatna
Investigation: Martin Schoch, Sunaree Lawanyawatna

Methodology: Martin Schoch
Writing–original draft: Martin Schoch
Writing–review & editing: Sunaree Lawanyawatna

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data

The provision of competition work (DRG2025 design brief, submission panels, submission report, presentation files) can be provided upon reasonable request to Martin Schoch (martin.sch@kmutt.ac.th).

Further disclosure

The authors declare that AI language tools were used in an editing and drafting capacity during the preparation of this manuscript. All citations have been independently verified against original sources. All conceptual, methodological, and analytical decisions are solely the authors' own. No AI tool is listed as a co-author.

References

Bandarin, F., & van Oers, R. (2012). *The Historic Urban Landscape: Managing Heritage in an Urban Century*. Wiley-Blackwell.

https://doi.org/10.1002/9781119968115

Bang, A., Krogh, P., Ludvigsen, M., & Markussen, T. (2012). The role of hypothesis in constructive design research. In *Proceedings of the Art of Research IV*. Design School Kolding.

Boncheva, A. I. (2022). Innovative Adaptation to Climate Change: Chinese Sponge Cities Program (SCP). *Current Urban Studies, 10*(02), 188–211.

https://doi.org/10.4236/cus.2022.102011

Campisano, A., Butler, D., Ward, S., Burns, M. J., Friedler, E., DeBusk, K., Fisher-Jeffes, L. N., Ghisi, E., Rahman, A., Furumai, H., & Han, M. (2017, May 15). Urban rainwater harvesting systems: Research, implementation and future perspectives. *Water Research, 115*, 195–209.

https://doi.org/10.1016/j.watres.2017.02.056

Cervero, R., & Murakami, J. (2010). Effects of built environments on vehicle miles traveled: Evidence from 370 US urbanized areas. *Environment and Planning A: Economy and Space, 42*(2), 400–418.

https://doi.org/10.1068/a4236

Chan, F. K. S., Griffiths, J. A., Higgitt, D., Xu, S., Zhu, F., Tang, Y.-T., Xu, Y., & Thorne, C. R. (2018). Sponge City in China—A breakthrough of planning and flood risk management in the urban context. *Land Use Policy, 76*, 772–778.

https://doi.org/10.1016/j.landusepol.2018.03.005

Chen, N., Guo, H., & Xiang, H. (2023). Evaluation of urban resilience level and analysis of obstacle factors: A case study of Hunan Province, China. *Frontiers in Earth Science, 10*.

https://doi.org/10.3389/feart.2022.1033441

Chen, S., Zhu, Z., Liu, X., & Yang, L. (2022, Aug 19). Variation in Vegetation and Its Driving Force in the Pearl River Delta Region of China. *International Journal of Environmental Research and Public Health, 19*(16).

https://doi.org/10.3390/ijerph191610343

Cole, R. J. (2012). Transitioning from green to regenerative design. *Building Research & Information, 40*(1), 39–53.

https://doi.org/10.1080/09613218.2011.610608

Cross, N. (2006). *Designerly ways of knowing*. Springer.

Dodoo, A., Gustavsson, L., & Sathre, R. (2014). Lifecycle carbon implications of conventional and low-energy multi-storey timber building systems. *Energy and Buildings, 82*, 194–210.

https://doi.org/10.1016/j.enbuild.2014.06.034

DRG. (2025). *Competition Brief 2025*. School of Architecture, South China University of Technology

Dunne, A., & Raby, F. (2013). *Speculative Everything–Design, Fiction, and Social Dreaming*. MIT Press.

Emmanuel, R. (2012). *An Urban Approach To Climate Sensitive Design*. Taylor & Francis.

https://doi.org/10.4324/9780203414644

Frayling, C. (1993). Research in Art and Design. *Royal College of Art Research Papers, 1*(1), 1–5. https://researchonline.rca.ac.uk/id/eprint/384

Gaver, W. (2012). What should we expect from research through design? SIGCHI Conference on Human Factors in Computing Systems, Austin Texas.

Giaccardi, E. (2019). Histories and futures of research through design: From prototypes to connected things. *International Journal of Design, 13*(3), 139–155. https://www.ijdesign.org/index.php/IJDesign/article/view/3192/875

Groat, L. N., & Wang, D. (2013). *Architectural research methods* (2 ed.). John Wiley & Sons.

Han, R., Cai, S., Li, X., Zhang, S., & Wang, G. (2025). Sustaining urban memory through oyster shell Architecture: constructing an evaluation framework for vernacular heritage Planning in Guangzhou. *Journal of Asian Architecture and Building Engineering*, 1–18.

https://doi.org/10.1080/13467581.2025.2558176

He, S., & Wu, F. (2016). Property-Led Redevelopment in Post-Reform China: A Case Study of Xintiandi Redevelopment Project in Shanghai. *Journal of Urban Affairs, 27*(1), 1–23.

https://doi.org/10.1111/j.0735-2166.2005.00222.x

Ji, H., Liu, Y., & Chen, Z. (2023). Exploring the implementation path of passive cooling strategies in Lingnan architecture. *Buildings, 13*(12), 2954.

https://doi.org/10.3390/buildings13122954

Kennedy, C., Pincetl, S., & Bunje, P. (2011, Aug-Sep). The study of urban metabolism and its applications to urban planning and design. *Environmental Pollution, 159*(8-9), 1965–1973.

https://doi.org/10.1016/j.envpol.2010.10.022

Knapp, R. G. (2000). *China's Old Dwellings*. University of Hawai'i Press.

Kong, L., Mu, X., Hu, G., & Zhang, Z. (2022, Jul). The application of resilience theory in urban development: a literature review. *Environmental Science and Pollution Research, 29*(33), 49651–49671.

https://doi.org/10.1007/s11356-022-20891-x

Law, L.-y., Chen, H., Liu, S., & Cheung, M.-h. (2025). Top-down rural heritage revitalization and economic development: A case study of Tangwei village, Dongguan, Guangdong, China. *Journal of Chinese Architecture and Urbanism, 7*(3).

https://doi.org/10.36922/jcau.5029

Li, H., Ding, L., Ren, M., Li, C., & Wang, H. (2017). Sponge City Construction in China: A Survey of the Challenges and Opportunities. *Water, 9*(9), 594.

https://doi.org/10.3390/w9090594

Li, Q., Wang, F., Yu, Y., Huang, Z., Li, M., & Guan, Y. (2019). Comprehensive performance evaluation of LID practices for the sponge city construction: A case study in Guangxi, China. *Journal of Environmental Management, 231*, 10–20.

https://doi.org/10.1016/j.jenvman.2018.10.024

Lin, T.-P., Matzarakis, A., & Hwang, R.-L. (2010). Shading effect on long-term outdoor thermal comfort. *Building and Environment, 45*(1), 213–221.

https://doi.org/10.1016/j.buildenv.2009.06.002

Liu, Z., Lin, Y., De Meulder, B., & Wang, S. (2019). Can greenways perform as a new planning strategy in the Pearl River Delta, China? *Landscape and Urban Planning, 187*, 81–95.

https://doi.org/10.1016/j.landurbplan.2019.03.012

Lyu, G., Bertolini, L., & Pfeffer, K. (2016). Developing a TOD typology for Beijing metro station areas. *Journal of Transport Geography, 55*, 40–50.

https://doi.org/10.1016/j.jtrangeo.2016.07.002

Mang, P., & Reed, B. (2012). Designing from place: a regenerative framework and methodology. *Building Research & Information, 40*(1), 23–38.

https://doi.org/10.1080/09613218.2012.621341

Meerow, S., Newell, J. P., & Stults, M. (2016). Defining urban resilience: A review. *Landscape and Urban Planning, 147*, 38–49.

https://doi.org/10.1016/j.landurbplan.2015.11.011

Meyer, H., Nijhuis, S., & Bobbink, I. (2017). *Delta urbanism: the Netherlands*. Routledge.

NDRC. (2022). *14th Five-Year Plan for Economic and Social Development and Long-range Objectives Through the Year 2035 of the People's Republic of China*. https://www.ndrc.gov.cn/

Ng, E. (2009). Policies and technical guidelines for urban planning of high-density cities - air ventilation assessment (AVA) of Hong Kong. *Building and Environment, 44*(7), 1478–1488.

https://doi.org/10.1016/j.buildenv.2008.06.013

Nicholls, R. J., Wong, P. P., Burkett, V., Codignotto, J. O., Hay, J., McLean, R. F., Ragoonaden, S., & Woodroffe, C. D. (2007). Coastal systems and low-lying areas. In M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. v. d. Linden, & C. E. Hanson (Eds.), *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 315-356). Cambridge University Press.

Nijhuis, S., Sun, Y., & Lange, E. (2023). Introduction: Adaptive Urban Transformation in the Pearl River Delta, China. In S. Nijhuis, Y. Sun, & E. Lange (Eds.), *Adaptive Urban Transformation: Urban Landscape Dynamics, Regional Design and Territorial Governance in the Pearl River Delta, China* (pp. 3-19). Springer International Publishing.

https://doi.org/10.1007/978-3-030-89828-1_1

Nijhuis, S., Xiong, L., & Cannatella, D. (2020). Towards a landscape-based regional design approach for adaptive transformation in urbanizing deltas. *Research in Urbanism Series, 6*, 55–80.

https://doi.org/10.7480/rius.6.94

Pahl-Wostl, C. (2015). *Water Governance in the Face of Global Change*. Springer International.

https://doi.org/10.1007/978-3-319-21855-7

Pan, H., Shen, Q., & Zhang, M. (2009). Influence of Urban Form on Travel Behaviour in Four Neighbourhoods of Shanghai. *Urban Studies, 46*(2), 275–294.

https://doi.org/10.1177/0042098008099355

Peiris, M. T. O. V. (2024). Assessment of Urban Resilience to Floods: A Spatial Planning Framework for Cities. *Sustainability, 16*(20), 9117.

https://doi.org/10.3390/su16209117

Renne, J. L., & Curtis, C. (2016). *Transit Oriented Development*.

https://doi.org/10.4324/9781315550008

Stappers, P. J., & Giaccardi, E. (2017). Research through design. In *The encyclopedia of human-computer interaction* (2 ed., pp.

1-94). The Interaction Design Foundation.

UNESCO. (2011). Recommendation on the Historic Urban Landscape. Proceedings of the records of the general conference, 36th session, Paris.

Vale, L. J. (2014). The politics of resilient cities: Whose resilience and whose city? *Building Research & Information, 42*(2), 191–201.

https://doi.org/10.1080/09613218.2014.850602

Wang, S., Cui, Z., Lin, J., Xie, J., & Su, K. (2022). The coupling relationship between urbanization and ecological resilience in the Pearl River Delta. *Journal of Geographical Sciences, 32*(1), 44–64.

https://doi.org/10.1007/s11442-022-1935-3

Wang, Z., Chen, Z., Ma, C., Wennersten, R., & Sun, Q. (2022). Nationwide Evaluation of Urban Energy System Resilience in China Using a Comprehensive Index Method. *Sustainability, 14*(4).

https://doi.org/10.3390/su14042077

Warner, J., van Buuren, A., & Edelenbos, J. (2012). *Making Space for the River: Governance Experiences with Multifunctional River Flood Management in the US and Europe*. WIO, 11.

Yang, F., Liu, Z., Zhou, Y., & Wei, L. (2025, Jan). Urbanization weakens vegetation resilience in the Pearl River Delta, China. *Journal of Environmental Management, 373*, 123756.

https://doi.org/10.1016/j.jenvman.2024.123756

Yang, L., Scheffran, J., Qin, H., & You, Q. (2014). Climate-related flood risks and urban responses in the Pearl River Delta, China. *Regional Environmental Change, 15*(2), 379–391.

https://doi.org/10.1007/s10113-014-0651-7

Yin, D., Chen, Y., Jia, H., Wang, Q., Chen, Z., Xu, C., Li, Q., Wang, W., Yang, Y., Fu, G., & Chen, A. S. (2021). Sponge city practice in China: A review of construction, assessment, operational and maintenance. *Journal of Cleaner Production, 280*.

https://doi.org/10.1016/j.jclepro.2020.124963

Yu, K., Li, D., Yuan, H., Fu, W., Qiao, Q., & Wang, S. (2015). Sponge city: Theory and practice. *City Planning Review, 39*(6), 26–36.

Zevenbergen, C., Fu, D., & Pathirana, A. (2018). Transitioning to Sponge Cities: Challenges and opportunities to address urban water problems in China. *Water, 10*(9), 1230.

https://doi.org/10.3390/w10091230

Zhang, X., Shen, L., & Wu, Y. (2011). Green strategy for gaining competitive advantage in housing development: a China study. *Journal of Cleaner Production, 19*(2-3), 157-167.

https://doi.org/10.1016/j.jclepro.2010.08.005

Zhao, Z., Yang, J., & Chen, G. (2024). Improvement of Traditional Energy-Saving Cold Alley Spaces: Case Study of Shixiangyuan Garden Renovation and Expansion Project in Guangzhou. *Buildings, 14*(6), 1563.

https://doi.org/10.3390/buildings14061563

Zukin, S. (2010). *Naked City: The Death and Life of Authentic Urban Places*. Oxford University Press.