Policy Implications of Singapore's "City in Nature" Strategy for China's Carbon-Neutral and Resilient City Development

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Abstract. Singapore has successfully moved from a "Garden City" to a "City in Nature", and its ecological development model in a high-density area serves as a model around the world. By organising the natural environment in the city systematically, many good results have been achieved in boosting carbon sinks for the city, strengthening its resilience to climate change, and improving the quality of life for the people living here. This paper will explore four types of cases for Singapore's "City in Nature" plan: policy concept, planning practice, governance model and transferability to China. In addition, based on this experience, it also presents targeted policy recommendations for China's goals of carbon-neutral and resilient urbanisation. Based on the analysis above, it is proposed that the overall approach of "greening" be revised to move closer to integrating "natural systems" in urban areas. It proposes building multi-scale networks of blue-green infrastructure, strengthening cross-sectoral collaborative governance, and improving public participation mechanisms. The above contents provide a reference for building a high-quality and sustainable Guangdong-Hong Kong-Macao Greater Bay Area and Xiong'an New Area.

Keywords: City in Nature; Singapore Green Plan 2030; carbon-neutral city; climate resilience; blue-green infrastructure.

1. Introduction

With the worsening global situation of climate change and China's high expectations for the "dual carbon" goals, cities that are major sources of carbon emissions and hotspots for climate impact are facing growing difficulties in their ecological governance. In 2021 and 2022, China issued the Action Plan for Carbon Dioxide Peaking Before 2030 [1] and the National Climate Change Adaptation Strategy 2035 [2], both of which have explicitly required that urban development integrate carbon sink enhancement with climate change adaptation capacity building and fully utilise the basic role of green space systems to achieve carbon neutrality and build resilient cities.

However, for many cities across China, the long-held performance indicators have often focused on expanding green cover and the proportion of green space. As a result, the structure of the construction has been "quantity over quality", "construction over maintenance", and "artificial over natural". In recent years, with the rapid development of urbanisation, there has been a reduction in available land, high-density construction, an increase in the frequency of severe weather events, and thus more urgent requirements for new climate risk-protection solutions for landscaping. Therefore, based on foreign examples, we need to study more regular, environmentally friendly and sustainable plans for urban development.

Singapore is a relatively small country with a large population density and a limited amount of land and resources; thus, ecological development has been placed at the forefront of the nation's long-term planning since gaining independence. Beginning as the "Garden City" idea proposed by Lee Kuan Yew in the 1960s, Singapore has since launched the official "City in Nature" strategy in 2021, and may thus serve as a possible model for other cities around the world, subject to local modifications. This way has achieved excellent results in increasing the carbon sink, adapting to climate change and improving the living environment; at the same time, it is in line with China's development goals for housing and urban management, carbon-neutral cities, smart resilient and sustainable cities, and the transformation of the landscape architecture profession [3, 4].

This paper is a qualitative study that combines policy-text analysis, historical evolution analysis, and comparative case studies to explore the theoretical foundations, policy system, practical experience and governance innovation of Singapore's "City in Nature" initiative in an all-encompassing way. In light of the above Chinese policies, some specific policy recommendations have been put forward, to provide theoretical support and practical references for the continuous development of China's landscape architecture profession in the era of urbanisation. This study will also offer a foundation for further research by scholars in landscape architecture, urban planning and sustainable urban governance.

The three problems this paper will discuss are as follows: (1) How has Singapore's "City in Nature" strategy changed since its earlier greening initiatives? (2) What planning and governance mechanisms have been established to connect it with the goals of carbon neutrality and urban resilience? (3) What policy lessons can be learned by China? The rest of this paper will present the research methods, introduce Singapore's strategy and representative cases, and discuss the implications for China.

2. Research Methods

This study will be a type of qualitative, document-based comparison and will not collect any primary data or conduct quantitative analysis. Reference materials include official policy documents and reports such as the Singapore Green Plan 2030, National Parks Board (NParks), Housing and Development Board (HDB), Urban Redevelopment Authority (URA) publications, and China's dual-carbon and climate-adaptation policies, as well as relevant academic research on nature-based solutions, green infrastructure, urban resilience, and biophilic urbanism. Singapore has been chosen as a representative high-density city-state with an extended history of urban greening and well-documented changes, and cases at all spatial levels, from national-level landmarks to community and building scales, have been selected to present the greening strategy. The four categories of the strategy are: policy concept, planning practice, governance mechanism and transferability to China. As this study will not be a field study or primary data collection, its results should be considered as policy recommendations rather than actual data on the ground.

3. Overview of Singapore's "City in Nature" Strategy

Singapore's development of urban greening has shown different stages and a logical connection (Table 1). In the early days of its independence (the 1960s), due to serious problems such as environmental damage and housing shortages, combined with a tropical climate, the Singaporean government proposed the "Garden City" idea. Large-scale afforestation and roadside greening have been carried out to improve the urban landscape and living environment for the public. From the 1990s to the early 21st century, the "Garden City" evolved into an organised system for green space planning, and park systems and green connectivity began to be established; thus, the landscape of a "City in a Garden" began to form [5].

Table 1. Evolution of Singapore’s urban greening strategy.

Stage	Main concept	Key measures	Policy significance
Garden City (1960s)	Beautification and greening	Roadside trees, large-scale urban planting	Improve urban image and living environment
City in a Garden (1990s–2000s)	Networked green spaces	Parks, park connectors, green corridors	Strengthen ecological connectivity
City in Nature (2021–)	Nature integrated into urban systems	Habitat restoration, blue-green infrastructure, community participation	Support resilience, biodiversity, and carbon-sink functions

The release of the Singapore Green Plan 2030 in 2021 marked a new round of reform. Serving as Singapore's master plan for sustainable development in the coming decade and beyond, the Green Plan is based on five pillars: "City in Nature", "Energy Reset", "Sustainable Living", "Green Economy" and "Resilient Future". Among these, "City in Nature" is the main pillar, and its aim is to make nature an essential part of urban life rather than merely a decorative or incidental landscape feature [3, 6].

In particular, among them are adding 1 million more trees by 2030, expanding the area of new nature parks to 200 hectares, extending the Park Connector Network, increasing rooftop and vertical greening, restoring important habitats such as mangroves, and integrating natural elements into housing, neighbourhoods and transportation systems [3]. The plan is in line with the United Nations' Sustainable Development Goals (SDGs) and the Paris Agreement [7], and will employ nature-based solutions to address several goals at the same time, such as reducing carbon emissions, protecting biodiversity, adapting to climate change, and enhancing the quality of life for the public [8].

In terms of theory, new concepts such as landscape urbanism and ecological resilience theory [9], biophilic design [10], and systems ecology have been added to the idea of "City in Nature". Now, cities and nature are no longer regarded as antagonistic but as an integrated human-environment system. Improve the general urban functions through active restoration and protection of natural processes in this way. This new model of landscape aesthetics has extended beyond the scope of traditional landscape art to include stronger ecosystem service functions, strategic value and social benefits for green space systems, thus providing a new theoretical basis for the sustainable development of high-density cities [11].

4. Analysis of Singapore's "City in Nature" Strategy

4.1. Policy Framework and Conceptual Shift

Singapore's main attributes of the "City in Nature" strategy are that it is a science-based top-down plan, has strong policy continuity, and effectively coordinates all the relevant government departments. The Ministry of National Development has been planning for some time, and NParks will be responsible for implementing this plan. Other departments, such as the Housing and Development Board (HDB), the Land Transport Authority, and the Ministry of Sustainability and the Environment, are also cooperating to build a "whole-of-government, whole-of-society" coordination mechanism. Legislatively, the Parks and Trees Act and the Building Control Act have been established to provide institutional support for the long-term and stable implementation of this strategy [3, 12].

The basic idea is that, instead of "having gardens in the city", we should aim to make "the city itself nature". In other words, the former focuses on building artificial environments and beautifying cities, while the latter seeks to restore the natural ecological processes of the city, protect biodiversity, and enable natural systems to help regulate the urban microclimate and manage rainwater, etc. This new mode of thought provides some ideological support for China's current progress in building "Ecological Civilization Cities" [8, 13].

4.2. Planning Practices for Carbon Neutrality and Climate Resilience

Singapore is trying to develop its own carbon-neutrality model through the carbon-sequestration capacity of its green-space system. Expand the area of urban forests, protect and restore mangroves (which are high-carbon-sequestration zones compared with typical tropical forests), and promote integrated green building development to enhance Singapore's urban carbon sink capability. In addition, these green space systems can help to alleviate the urban heat island effect, adjust the local microclimate and improve air quality, thus providing strong ecological support for low-carbon urban development [6, 14].

Climate-resilient Blue and Green infrastructure has been introduced in Singapore. Park Connector Networks are connected to link parks, greenways, nature reserves and waterfront areas to form a

continuous ecological corridor. Increase the number of species and expand the area of the park for residents' recreation. By converting the old concrete-lined drainage ditch into a natural-looking, curved-path ecological riverbank for flood control and landscape improvement, ecological restoration has also taken place at the Bishan-Ang Mo Kio Park Project. It has since been listed as an internationally renowned climate-adaptive landscape project [15].

Based on the above, the green-area system in Singapore will no longer be regarded merely as a "beautiful scenery" but rather as a crucial component of the whole city system to address the problems of climate change and achieve high-quality development.

4.3. Governance Mechanism and Public Participation

Singapore's reforms of the governance system can be regarded as three types: institutionalisation, normalisation and dissemination. NParks will be in charge of planning and developing the green spaces across the country as the special agency. At the same time, platforms for cross-sectoral coordination have also been established to ensure that policies in housing, transportation, environmental protection, education, etc., are in line with ecological goals [12].

Singapore's Governance System is open to participation by citizens and businesses. Through the "Community Garden Program", "Park Adoption Scheme" and "Citizen Science Monitoring Projects", the people who live in the area have been involved in the design, construction and maintenance and operation of the new green spaces. The model of "co-construction, co-governance and co-sharing" has reduced long-term maintenance costs and enhanced public ecological consciousness and a sense of environmental responsibility [16].

In recent years, public-private partnership (PPP) models have been used for large-scale green infrastructure projects. Through the market mechanism, attract social capital and technological innovation to obtain diversified funds and long-term support for the execution of this plan [13].

5. Typical Case Studies

Gardens by the Bay is a typical project under Singapore's "City in Nature" plan. "Supertree" structures have developed vertically, offering vertical greening, rainwater collection and solar power generation, and also providing a science education platform, a tourist attraction and cultural events. The three attributes of the project are multifunctionality, new ideas and ecological benefits [6].

Punggol Eco-Town is a community-level application case. By integrating waterfront green spaces, rooftop gardens, ecological wetlands, green transportation, and residential areas smoothly, Punggol has formed a low-carbon, resilient, and lively modern eco-community. It can provide a transferable reference, and locally adapted, for the long-term development of high-density residential areas [17].

Singapore has also carried out large-scale vertical greening and rooftop garden retrofitting in the renovation of older residential areas, and this method is also suitable for all-sized cities. Together, these case studies show the full chain of Singapore's strategy from the top down.

6. Policy Implications for China's Carbon-Neutral and Resilient City Development

Singapore's experience offers some relevant but context-specific references for China's carbon-neutral and resilient city development. Table 2 is a comparison of the two environments in five dimensions, and the following inferences can be made.

Table 2. Comparison between Singapore's practices and implications for China.

Dimension	Singapore's practice	Challenges in China	Possible implications
Policy concept	From Garden City to City in Nature	Emphasis on greening quantity	Shift toward ecosystem-service-oriented planning
Spatial planning	Blue-green network and park connectors	Fragmented green spaces	Build multi-scale ecological corridors
Governance	NParks and inter-agency coordination	Departmental fragmentation	Strengthen cross-sectoral coordination
Public participation	Community gardens and citizen science	Limited long-term participation	Develop stewardship and co-management mechanisms
Climate adaptation	River naturalization, heat-island mitigation	Flooding and heat-island risks	Combine sponge-city and nature-based solutions

First, conceptual transformation: Governments and planning offices at all levels may incorporate the concept of a "City in Nature" into territorial spatial planning, carbon neutrality action plans and resilient city development guidelines. Move beyond a simple index of greening and consider the overall value and extended benefits of ecosystem services [8].

Second, planning and construction: Speed up the development of multi-scale blue-green infrastructure networks at the city, region and community levels. In high-density areas, such as the Guangdong-Hong Kong-Macao Greater Bay Area, expand the construction of vertical greenery and rooftop gardens. In the new area development of Xiong'an, strengthen the reservation of ecological corridors and nature reserve areas. Systematically introduce sponge city concepts and green micro-space design in the retrofitting of old residential areas [15].

Third, institutional reform: Strengthen cross-sectoral coordination among the departments of planning, natural resources, housing and urban-rural development, and ecological environment. Set up a separate coordinating office that will function as the national park authority. Add the ecological performance of green spaces to the high-quality urban development evaluation system and the performance assessment of government officials [12].

Fourth, social participation and market mechanisms: Strengthen the construction of community gardens and public stewardship models, encourage residents to participate in the co-governance and co-construction of green spaces. Actively explore public-private partnership (PPP) models to introduce private funds for the construction, operation and long-term maintenance of green infrastructure, and build a diversified system of government leadership, market mechanisms and social participation [16].

Fifthly, construct regional routes of different natures and cooperate internationally through diverse means in various regions with different climates and urban areas. For example, in the hot and humid areas of the south, Singapore's experience of mangrove afforestation and rainwater retention can be studied, and northern cities can focus on long-term management of green spaces and heat island mitigation and develop ways that are suitable for their cold seasons. At the same time, work with Singapore to improve technical training, plan consultancy and joint research to speed up the adaptation and application of these experiences in China.

7. Conclusion

Singapore's "City in Nature" plan is relatively advanced in terms of foresight, systematic planning, innovative governance and multiple benefits, and serves as a reference for the all-round development of high-density cities around the world. From the above cases, it can be seen that only when nature is integrated into urban areas more deeply will these two goals of carbon reduction and climate resilience be achieved together to foster all-weather high-quality development.

China can learn from the high-level experience of Singapore, but needs to consider the specific conditions and development stages of China, and promote the transformation of the landscape architecture profession to a higher level of ecological civilization. Through conceptual renewal,

planning innovation, governance optimisation and social mobilisation, Chinese cities will be able to achieve greater success in building carbon-neutral and resilient cities, providing Chinese wisdom and solutions for the construction of a community of life between humanity and nature.

The sources of this study are only public policy documents and secondary case materials. It does not contain field research, interviews or quantitative measurements of carbon sink and resilience outcomes. Thus, the results should be regarded as the first policy recommendations and not as directly applicable measures.

Future research will carry out additional field investigations and long-term follow-up studies of Chinese and Singaporean cities to continuously expand and deepen the relevant theories and practices.

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