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Cooling Down a City: Singapore's Urban Greenery Policies to Mitigate Urban Heat

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SYNOPSIS

Urban greenery, spotlighted as an effective measure to lower air and surface temperatures, has been commonly used in many countries to reduce the urban heat island effect. Singapore has also experienced both a rise in the annual average temperatures and urban heat island effect due to rapid urbanisation. Thus, it has implemented various urban greenery policies to mitigate urban heat and advance its national Green Plan towards 2030. This policy brief examines Singapore's programmes and policies to support the expansion of urban greenery and the effects of these programmes. It also discusses possible challenges that may hinder expanding urban greenery and future considerations to address the challenges.

KEY POINTS

- Singapore's several policies contributed to a substantial increase in the city-state's green spaces and vegetation.
- A negative correlation is observed between the concentration of green areas and the changes in temperature between 2011 and 2016, suggesting that urban greenery helped mitigate urban heat in Singapore.
- The limited land area and the reluctance of private building owners and developers due to financial concerns may pose challenges in pursuing urban greenery policies.
- A holistic approach and more incentives to promote green buildings and raise public awareness will help to encourage risk-averse building owners to commit to greening their buildings.

INTRODUCTION

Urban centres have been found to be warmer than surrounding natural or less urbanised areas, usually due to higher levels of anthropogenic heat, reduced vegetation, and densely built environments restricting airflow. This phenomenon is well-known as the urban heat island (UHI) effect. Singapore has also experienced both a rise in the annual average temperatures and the UHI effect due to the rapid urbanisation and forest decline. According to the Centre for Climate Research Singapore's *third National Climate Change Study*, released in January 2024, the annual mean temperatures in Singapore increased at an average rate of 0.24°C per decade between 1985 and 2022. Also, the daily mean temperature in 2050 is projected to grow by 0.6-2.2°C, reaching around 28.5-30.1°C, compared to the baseline temperature of 27.9°C. Furthermore, a study by researchers from the National University of Singapore in 2022 found that the daily average temperatures in areas with compact high-rise buildings were approximately 2.2-2.7°C higher than in areas with scattered trees and dense trees between March 2008 and February 2014.

While the UHI effect can help mitigate cold waves in some areas, it has deleterious impacts on human health and well-being in many regions by intensifying heat waves, lowering productivity, and increasing air pollution. To alleviate such adverse effects of urban heat, national and municipal governments have employed numerous strategies, such as climate-resilient urban planning, installing cool roofs and pavements, increasing tree and

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vegetation planting, and promoting energy-efficient, green buildings. Among various UHI mitigation strategies, increasing urban greenery is an intervention most commonly adopted since it has been recognised as one of the most cost-effective measures to absorb urban heat. Singapore, recognised as one of the world's greenest cities, has successfully increased green spaces through various programmes and aims to continue such an expansion. However, the limited land area and the financial concerns of building owners and developers may pose challenges in pursuing urban greenery policies.

ANALYSIS

Singapore's Key Policies Towards Urban Greenery

Singapore has been reputed since its early development history as a garden city with high amounts of planted greenery despite its urban environment. While the greenery policies were not designed to specifically mitigate the UHI effect in the past, recent initiatives specify that urban greenery will enable residents to enjoy a climate-resilient environment. Singapore's urban greenery policies broadly support two activities: i) expanding nature parks and tree planting in open areas and ii) covering building walls and roofs with vegetation.

Creating nature parks and planting trees have been led by the Singapore National Parks Board (NParks) since the 1960s. In March 2020, the NParks announced the City in Nature vision, which includes extending Singapore's natural capital, intensifying nature in gardens and parks, restoring nature in the urban landscape, strengthening connectivity between green spaces, and enhancing veterinary care and animal management. This vision was incorporated into the Singapore Green Plan 2030, launched in February 2021, as one of the five pillars. Accordingly, the Singapore government set several targets, including adding around 200 hectares (ha) of land for new nature parks and planting one million more trees by 2030. Under the One Million Trees Movement, organisations and individuals can plant a tree in one of NParks's managed green spaces with every donation of SGD 300 to the Garden City Fund where donors are entitled to a 2.5 times tax deduction. As a result of this movement, more than 706,000 trees were planted between April 2020 and July 2024. Moreover, as of March 2023, NParks maintains 6,583 ha of parks and nature reserves and 2,102 ha of roadside greenery, equivalent to nearly 12% of Singapore's total area.

Singapore has also encouraged green roofs and vertical green facades through several programmes. Landscaping for Urban Spaces and High Rises (LUSH) was launched by the Urban Redevelopment Authority (URA) in 2009 to mandate the adoption of greenery in new development project sites in strategic areas. This programme consists of Landscape Replacement Area (LRA) requirements and incentives for creating greenery. LRAs refer to landscaped areas, such as sky terraces, communal planter boxes, and communal ground gardens, provided either on the ground or skyrise levels to compensate for the greenery lost on the development site. In the LUSH, the total LRAs have to meet 70-100% of the development site area, depending on the location of the development site. In addition, developers are incentivised with gross floor area (GFA) exemptions if their greenery areas satisfy certain criteria so that they can have more allocated space to design and develop their projects. The programme has been revised twice, first in 2014 to include new areas and second in 2017 to introduce new landscaping features like green roofs and rooftop urban farming as part of the scheme. As of March 2022, LUSH has played a key role in the introduction of more than 300 ha of greenery within new developments.

The Skyrise Greenery Incentive Scheme was also launched in 2009 by NParks. It encourages integrating rooftop and vertical greenery on existing buildings by covering up to half of the greenery project's installation costs, with a maximum of SGD 200 per square metre for rooftop greenery and SGD 500 per square metre for vertical greenery. Various types of buildings, including community buildings like schools and hospitals, commercial and industrial developments, and non-landed residential developments, can apply for this financial support. The funded green roofs and vertical greeneries must be maintained for at least five years after completion. Otherwise, the reimbursement is recovered on a pro-rated basis. As of May 2023, about 155 ha of skyrise greenery has been installed, supported by over

SGD 10.2 million from the incentive scheme. This scheme had been designed to finish in March 2023 but was extended to March 2026 in order to achieve 200 ha of skyrise greenery.

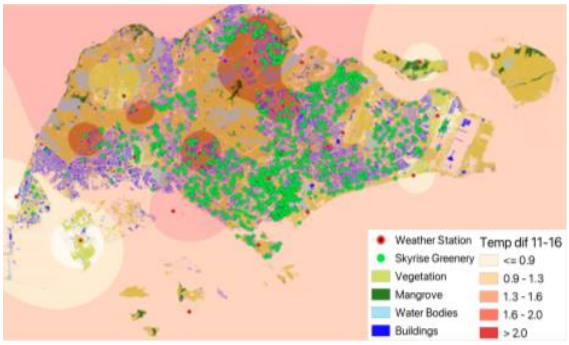
Additional policies include the Housing Development Board (HDB)'s Green Towns programme and the Building and Construction Authority (BCA)'s Green Mark certification. The Green Towns programme, launched in 2020, aims to improve the environmental sustainability of existing public housing towns through five focus areas: reducing energy consumption, recycling rainwater, reducing waste, promoting green commutes, and cooling HDB towns. Cooling strategies involve applying cool coatings on building surfaces to absorb and emit less heat as well as installing urban farms or gardens on the top decks of car parks in HDB estates. The Green Mark certifies and rewards building developers who adopt sustainable building practices. These practices are mostly related to improving energy efficiency, but the assessment criteria also include UHI mitigation measures. New and existing buildings adopting the UHI mitigation measures, such as creating green and blue spaces for landscaping and using cool coatings or paints, can earn a point for the certification.

Was Urban Greenery Effective in Mitigating Urban Heat?

Urban greenery has been spotlighted as an effective measure to cool down urban areas. Trees in parks and on the streets can provide shade that shields pedestrians against direct sunlight and reduces surface temperatures under the canopy, thereby relieving the thermal stress of pedestrians. Also, releasing water vapour of vegetation into the atmosphere through evapotranspiration lowers air temperatures. Moreover, green roofs and facades prevent the increase in the temperature of roof surfaces and building walls and provide natural insulation that stabilises indoor temperatures, leading to savings in building energy consumption for cooling. Besides reducing air temperature, urban greenery has other environmental benefits, such as rainwater management, biodiversity conservation, and carbon sequestration.

Then, in reality, was urban greenery supported by various programmes described in the previous section effective in mitigating urban heat in Singapore? To examine the relationship between urban greenery and urban heat mitigation, a map presenting temperature changes between 2011 and 2016, vegetation, and skyrise greeneries was generated (Figure 1). The greater temperature rises (2.3°C increase) are observed in Sembawang and Khatib, having less skyrise greenery (green circles). By contrast, the temperature difference was relatively small in the city area like Newton (1.4°C increase), although it is a high-density area both in terms of building heights and the number of buildings. It may be interpreted that the advancement of skyrise greenery in this area contributed to temperature stabilisation. Additionally, some areas such as Upper Thomson and Tengah do not show high increases in temperature despite a small number of skyrise greenery. It may be attributed to large nature reserves, parks and reservoirs. In brief, Figure 1 suggests a negative correlation between the concentration of green areas and the changes in temperature, implying that urban greenery helped mitigate urban heat.

Figure 1. Temperature changes (2011-2016) and urban greenery in Singapore



Source: Authors' illustration based on data from NParks Skyrise Greenery; MSS Historical Daily Records; and Gaw et al. (2019).

What Could Hinder Expanding Urban Greenery and How Can These Be Addressed?

The Singapore government has the ambition to make Singapore a climate-resilient city-state and achieve net-zero emissions by 2050. Given the effectiveness of urban greenery in reducing the UHI effect and its potential role as a carbon sink, it is expected that the government will keep the momentum for expanding green spaces. However, some issues exist that may

impede the increase in urban greenery. A fundamental challenge is the limited land area of Singapore. Creating nature parks means that the land for parks cannot be used for other purposes, including business activities and housing. If demand for land for different economic activities is high, setting aside land for greenery can be very challenging. Also, urban greenery projects may be pushed back on the priority list and need to gain public acceptance.

Hence, skyrise greenery has emerged as one of Singapore's most viable and effective urban strategies. To accelerate skyrise greenery projects, it is essential to involve private properties in addition to public buildings, including HDB residential properties. To this end, the Singapore government is supporting the integration of urban greenery into new and existing buildings through the LUSH and Skyrise Greenery Incentive Scheme, respectively. However, regarding new buildings, LUSH currently applies to new development projects in strategic areas, including Downtown Core, Straits View, Marina South, Orchard Planning Areas, and 25 other planning areas. If its coverage extends to all parts of Singapore, it will help increase green spaces and mitigate the UHI effect.

For existing buildings, the building owners, developers or landlords may hesitate to make their buildings greener due to financial concerns. They would compare the costs and benefits associated with urban greenery projects and take action when the benefits, such as the higher demand of visitors or higher rent from tenants resulting from the aesthetics of green design, exceed the costs of installation and maintenance. Although the installation cost can be partly supported by the Skyrise Greenery Incentive Scheme, building owners need to invest in professional maintenance services since green roofs and vertical greenery require regular maintenance to ensure the health of the vegetation and the longevity of the system. Therefore, more incentives, including financial support and regulations, need to be considered to promote the skyrise greenery projects. Besides, raising public awareness about the economic, environmental, and health benefits of green buildings and lowering the risk of financial goods of real estate investment could also be encouraging measures to be reviewed for furthering the green building incentives.

CONCLUSION

Singapore is leading the way in creating a greener city, with various policies implemented to advance the Singapore Green Plan 2030. While the government plays a crucial role in expanding urban greenery, particularly in creating new parks and planting street trees, private building stakeholders are vital to integrating greenery into buildings. In addition to the existing policy support, a holistic approach and more incentives to promote green buildings and attract public interest need to be developed in order to encourage risk-averse building owners to commit to greening their buildings.

WHAT TO LOOK OUT FOR

- Increase in nature parks and skyrise greenery in Singapore
- Temperature change in each area of Singapore
- Additional programmes and policies to promote urban greenery, especially for private building owners and developers

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