



URBAN GREENERY

ZAC TOH

Zac Toh is the Founder of GWS Living Art and Co-Founder of City Sprouts. Growing up immersed in the horticulture scene, he is passionate about greening cities through innovative solutions that connect communities with nature for healthier, more sustainable living. As part of his advocacy for greener cities, Zac has also been part of the World Cities Summit Young Leaders Network since 2024.

Weaving Green Threads: Building Resilient Cities from the Ground Up



Urban greening strategies such as vertical gardens exemplify how ecological systems can be reintroduced into densely built environments.

Image: GWS Living Art

This essay explores the role of urban greenery in building resilient cities and how ground-up initiatives can shape these nature-based urban solutions.

The Converging Futures of Mega-Cities

By 2050, an estimated 70% of the world's population will reside in urban settlements (UN, 2019). As global populations rise, cities face mounting pressure to accommodate the expanding needs of its citizens. This accommodation may take the form of horizontal expansion into surrounding lands or vertical densification through high-rise development and economies of scale. Each city, shaped by its cultural heritage, historical context and planning philosophy, takes on distinct physical forms, yet all are bound by a shared trajectory of rapid and unprecedented urbanisation.

This transformation, however, comes at a considerable environmental cost. Urban growth is typically marked by the proliferation of impervious surfaces and the encroachment upon surrounding forested areas. These changes trigger cascading vulnerabilities such as heightened flood risks, declining air quality, intensified urban heat island effects and deepening climate insecurity. The ecological toll of urbanisation extends beyond immediate environmental degradation to long-term climate challenges.

As global institutions and municipal authorities grapple with managing emerging mega-cities amid the climate crisis, a fundamental reorientation of urban planning is required. Planning must reconnect with its foundational elements: the land upon which cities are built, the communities for whom they are designed, and the non-human inhabitants whose ecosystems have been displaced. These "silent voices" from lost habitats represent not merely an environmental concern, but also a critical dimension of sustainable urban development.

The central challenge confronting contemporary urban centres is therefore multifold: to meet evolving human needs while simultaneously enhancing urban resilience and ecological integrity. This demands an inclusive vision of urban planning—one that serves not only human residents, but also the diverse species and ecosystems that constitute the broader urban community.

The Cities We Make

Climate Resilience Through Nature-Based Urban Solutions

As cities increasingly prioritise climate resilience in strategic planning, nature-based solutions have gained global prominence. These interventions address complex societal challenges including climate change adaptation, water security and disaster risk reduction, while delivering co-benefits for both people and ecosystems. Urban greening strategies such as green roofs and vertical gardens exemplify how ecological systems can be reintroduced into densely built environments.

Stormwater Management in High-Density Cities

Impervious surfaces are an inherent characteristic of urbanisation. Concrete rooftops, cement pathways and asphalt roads share a critical limitation: they cannot absorb rainfall. Instead, precipitation is redirected into complex drainage and catchment systems that are increasingly strained by contemporary climatic realities.

As weather patterns become more intense and unpredictable, conventional drainage infrastructure frequently proves inadequate, resulting in urban flooding and widespread disruption.

Replacing impervious surfaces with green infrastructure systems offers a substantive response to this challenge. Among such infrastructure systems,

green roofs have distinguished themselves by optimising limited urban space while directly addressing hydrological imperatives. Through substrate (or base) layers and vegetative cover, green roofs intercept and retain rainfall at source, reducing both the volume and velocity of runoff before it enters municipal drainage networks.

Beyond flood mitigation, these living systems deliver other multiple benefits. Green roofs enhance urban aesthetics, improve air quality and provide ecological refugia (or habitats) for urban fauna. In doing so, green infrastructure emerges not merely as a technical solution for stormwater management, but also as a holistic strategy for reconciling urban density with environmental stewardship.

50



Green roof GaiaMat™ installation at the Sembawang Sports and Community Centre, Bukit Canberra. Green roof was installed by GWS Living Art in 2022 using proprietary, patented, soilless GaiaMat™ that can capture 26 litres of rainwater per square metre.
Image: GWS Living Art



Large-scale vertical greenery installations, such as the 300 m² living wall at the National University of Singapore E7 building installed by GWS Living Art, establish vertical garden pockets that weave greenery into the built fabric where horizontal space is scarce.

Image: GWS Living Art

||
Strategically designed and well-maintained green spaces can support biodiversity and strengthen ecological connectivity across fragmented urban landscapes.
 ||

Creating Ecological Stepping Stones

Successful integration of green infrastructure into urban environments depends on intentional, evidence-based design that balances development efficiency and ecological-centred approaches. Urban expansion inevitably transforms complex ecosystems, displacing scavenging beetles, burrowing earthworms, nesting sunbirds and countless other species, as undeveloped land gives way to dense architectural forms.

Urban greenery therefore serves a dual function: providing refuge for both human populations and displaced ecological communities. While green installations cannot fully replicate the complexity of natural habitats, strategically designed and well-maintained green spaces can support biodiversity and strengthen

ecological connectivity across fragmented urban landscapes. Such spaces function as ecological stepping stones, offering food sources, shelter and migratory pathways for species navigating the urban matrix.

A critical distinction must be drawn between interventions that deliver genuine biodiversity outcomes and those that function primarily as aesthetic “nature-washing”. Authentic ecological value depends on deliberate design parameters: locally adapted plant species, structural complexity that mimics natural habitat layers, integration within broader green networks and design informed by species-specific requirements rather than visual appeal alone. Without these principles, urban greening risks becoming tokenistic rather than transformative.



City Sprouts community programmes bring people of diverse backgrounds together to connect, learn and relax.
 Image: City Sprouts

||

The most enduring green interventions emerge when a feedback loop between top-down support and bottom-up ownership converges. At the same time, institutions must provide continuity, technical guidance and resourcing, while communities retain agency over design and stewardship.

||

Cultivating Social Cohesion Through Community-Centred Urban Greening

The overall resilience of a city depends not only on its capacity to withstand climatic pressures, but also on the strength of its social fabric. This means robust social systems that nurture citizen engagement, strong collective identities and cultures of environmental stewardship.

Expanding cities are faced with the inevitable growing physical distances between residents. Yet spatial separation need not translate into social fragmentation. Effective city-building is simultaneously community-building, requiring spaces where social bonds can form and collective identity can flourish. Within this framework, green infrastructure serves a dual purpose: it functions not only as environmental intervention, but also as social infrastructure that brings people together and fosters shared stewardship of place.

Bridging Communities Through Shared Stewardship

Urban farming initiatives demonstrate how nature-integrated design can catalyse community cohesion. When residents actively participate in shaping these spaces, from cultivation methods to harvest-sharing protocols, these projects promote social inclusion and spatial justice while strengthening sustainability outcomes.

Community-led urban agriculture initiatives such as City Sprouts are grounded in reconnecting urban populations with food systems to build ecological literacy and resilience. Beyond food production, these spaces host workshops, educational programmes, and informal gatherings that foster knowledge exchange and social capital often diminished in high-density urban contexts. Such sustained community engagement surfaces tensions between ecological ideals and social realities, expert prescriptions and lived experiences, or initial enthusiasm and long-term maintenance capacity.

Rather than being obstacles, these tensions provide critical feedback that can inform and refine institutional practice. When institutional mandates remain responsive to insights generated through community programmes, policies and design standards evolve to better reflect on-the-ground conditions. In this way, grassroots initiatives do not merely complement top-down frameworks; they actively shape them, guiding how sustainability objectives are interpreted, prioritised and implemented at scale.

The most enduring green interventions emerge when this feedback loop is maintained. As top-down support converges with bottom-up ownership, institutions provide continuity, technical guidance and resourcing, while communities retain agency over design and stewardship. Green spaces thus become embedded within the social fabric, functioning as shared civic assets rather than ornamental installations, sustained through collective responsibility and institutional learning.



An innovative space created by City Sprouts to spark ideas and facilitate field testing and exploratory experimentation.
Image: City Sprouts

Young urbanists and community experimentalists bud from engagements and become catalysts for adaptive urban solutions.

The Experimentation Imperative

From this living foundation of engagement and enthusiasm, a sense of civic agency and latent innovation capacity emerges within communities. When residents develop ownership over their urban environment, they transition from passive beneficiaries to active co-creators, attuned to local conditions and invested in continuous improvement.

Young urbanists and community experimentalists bud from such engagement and become catalysts for adaptive urban solutions, testing interventions that respond to hyperlocal conditions while contributing to broader systemic learning. Communities transformed through participatory stewardship thus become incubators of urban innovation, where experimentation

is not imposed from above but emerges from lived experience and collective aspiration.

As cities evolve toward climate-responsive urban ecosystems, experimentation and iterative learning must become central planning principles. Innovation should not remain confined to academic institutions or corporate laboratories; it must be democratized across the civic spectrum. Citizens of all ages and backgrounds bring lived experiences essential to responsive urban innovation.

These urbanists, community innovators and citizen scientists require dedicated spaces to prototype, test, evaluate and scale solutions.

The Future of Resilient Cities

Traditional risk-averse regulatory frameworks often obstruct this adaptive learning. To overcome this, cities must adopt mechanisms such as innovation sandboxes, controlled environments that permit experimentation while maintaining safeguards. Cities that embrace calculated risks, learn from failure, and institutionalise adaptive processes position themselves at the forefront of climate resilience and sustainable development.

Innovation in Practice: Lightweight Green Roof Systems

Through innovation-driven development and market analysis, GWS Living Art has identified critical limitations in traditional soil-based green roof systems, particularly substrate weight that constrains building-load capacity and complicates transportation to inaccessible areas. In response, GWS Living Art developed a proprietary, patented soilless GaiaMat system in 2017, a lightweight solution that is three to four times lighter than conventional systems while enabling immediate green roof installation. This advancement addresses key logistical and structural barriers to widespread green roof adoption.

Cities constitute multi-layered, multidimensional systems of profound complexity, and their development necessarily demands an equivalently multifaceted approach. The creation of resilient and sustainable urban environments requires the deliberate integration of diverse elements: meaningful community engagement that cultivates civic ownership, empowerment of emerging urbanists to assume stewardship of their cities, deployment of innovative nature-based solutions for climate adaptation and preservation of ecological space for non-human inhabitants within the urban matrix. Each of these dimensions represents an essential thread in the urban fabric.

When woven together with intention and care, these elements form a complex tapestry that appears intricate, occasionally contradictory, yet ultimately coherent in its commitment to holistic urban flourishing. This tapestry acknowledges that cities are not merely built for human habitation, but are also shared ecosystems while constantly being rewoven, unpicked and expanded by new generations with budding ideas. The resulting urban form may resist simple categorisation and defy conventional planning orthodoxies, yet it is precisely this complexity that constructs cities capable of adapting to contemporary challenges while honouring their responsibility to all residents, human and non-human alike. 