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Developing climate resilient cities

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DEVELOPING CLIMATE-RESILIENT CITIES



We need to be quicker.

by **Winston Chow**

A family of four enjoys their picnic on a gently sloping, grassy riverbank. One of the children skips down to the gurgling stream, places her paper boat on it and watches in fascination as the water slowly carries it away. Nearby, two other children jump from one flat rock to another that lay across the water. It's a beautiful sight and no, it's not from a movie—it is taking place in the 62-hectare Bishan-Ang Mo Kio (AMK) Park, complete with a naturalised stream, right in the middle of one of Singapore's most popular urban heartland areas. The park is a shining example of what is possible when efforts are put in place to ensure cities become more climate-resilient. However, initiatives like this need to be carried out faster. This is because we are witnessing first-hand the collision of two burgeoning processes: climate change and urbanisation.

While the two are separate processes, their combined effects, when they occur concurrently, can lead to substantial urban climate consequences affecting every aspect of our lives. Climate change—or, as some would call climate disruption and a climate emergency—is caused by the worrying combination of increasing greenhouse gas (GHG) emissions like carbon dioxide and methane, and the growing loss of vegetation cover due to deforestation. Add urbanisation to the mix, which involves the population shift from rural to urban areas, and we see highly concentrated groups, representing nearly 57 percent of the global population, settling in cities that cover only three percent of the world's surface area. As a result, the world is faced with a seemingly inexhaustible demand for energy and resources that is fast outpacing how our physical environment copes.

In this article, I shall explain the two processes and how their coming together signifies an unprecedented

urgency for us to do more in double-quick time. I will also point out how cities can become more climate-resilient by applying nature-based solutions and implementing planning and social policies, all of which have proven to be more effective than our existing approaches. Finally, I turn to Singapore and another Southeast Asian city, Semarang in Indonesia, to show the promise of the two approaches.

CLIMATE CHANGE—IMPENDING DOOM OR AVOIDABLE DISASTER?

Much of the data we have on climate change focuses on global temperature changes over the last 150 years, or from the beginning of the pre-industrial era around 1850. Since then, average global temperatures have increased by nearly 1.1°C, driven up by the effects from GHG emissions and the loss of forested land area.¹

To stem the seemingly unstoppable rise in average global temperatures, representatives from 195 United Nations (UN) member states convened in 2015 and signed the Paris Agreement, pledging to cut down on GHG emissions within their territories. The Agreement states the importance of restricting global average temperature increases to 2°C above pre-industrial levels, and preferably no higher than 1.5°C, “recognizing that this would significantly reduce the risks and impacts of climate change”.²

Forecasts, however, are not optimistic. At the current rate of human-induced global warming, temperatures will likely breach the 1.5°C limit by 2035. By 2100, even with current Paris Agreement pledges, there will likely be an overall increase of 2.7°C based on expected GHG emissions. It seems more and more unlikely that our children and their children will ever see a world cooler than when we were born.

THE URBANISATION STORY

As of 2022, nearly 4.4 billion people—or more than half the world's population—live in settlements and it is projected that by 2050, this proportion will grow to 70 percent. The world has seen a large uptick in urbanisation since the 1950s. In fact, 2007 was a landmark year as half of humanity was living in urban instead of rural areas. The biggest and fastest-growing cities have also progressively moved away from North America and Europe, toward the Global South—South America, Africa, and Asia.

If we look to the not-too-distant future, it is projected that 'new' urbanisation will mostly occur in two continents: Africa and Asia. These regions will house some of the largest megacities in the world, as well as some of the fastest growing settlements. If we zoom in, we see that Southeast Asia's urban population is estimated to effectively double by 2050. Delving even deeper into these projections, while the major primary cities and engines of growth in Southeast Asia—Bangkok, Jakarta, and Metro Manila—will continue to expand in size and population, it is the secondary cities such as Chiang Mai, Da Nang, and Surabaya that will see much more rapid growth. These areas will become the foci for economic growth via industrialisation and tourism, which will attract migrants to develop and maintain the critical infrastructure supporting these economic growth engines in the decades to come.

THE URBANISATION AND CLIMATE CHANGE COLLISION

The drastic rural-to-urban population shift since the 20th century has had severe repercussions on not only causing climate change, but also magnifying its impacts to the detriment of humanity.

Ascertaining how bad these impacts are is something that the Intragovernmental Panel on Climate Change (IPCC), has been tasked to do by the UN. As part of the author team for the Sixth Assessment Report cycle that concluded in early 2022, we have assessed several resulting key climate risks that will affect cities, including floods and droughts, air pollution, rising sea levels, and tropical cyclones.

The ubiquitous effects are warmer urban temperatures caused by climate change and the urban heat island effect. The latter occurs when city infrastructure such as buildings, pavements, and other heat-absorbing surfaces replace environmental flora and drive local temperatures in cities—especially at night—to be higher than those of their 'rural' surroundings. Consequently, there is greater exposure

to higher temperatures that significantly increases the likelihood of heat-related injuries in cities, especially in humid climates. In fact, one of the scenarios that the IPCC is examining is a world where temperatures have risen by 2°C above pre-industrial levels. In that situation, people in cities located in parts of South and Southeast Asia, the Arabian Peninsula, West Africa, and South America will face more frequent conditions where heat exposure will lead to potentially fatal consequences if no additional preventative measures are put in place. Furthermore, we should be worried about certain demographic groups that are most at risk when faced with increased heat conditions. The elderly and very young, the disabled, and outdoor workers, such as those in the construction sector, are particularly susceptible to heat stress and stroke.

The IPCC has also assessed that it is not just people's physical health that is most at risk from extreme heat. The impacts of prolonged and extreme heat conditions could also cascade onto the healthcare infrastructure in cities. For instance, how would burdened medical facilities cope with more vulnerable populations demanding medical care, while hospitals and clinics are also at risk from potential power outages as the grid struggles to handle high air conditioning demand from other parts of the city? This cascading heat disaster was precisely what happened in Chicago in 1995, and most of Western Europe in 2003, when scores of people perished from heatwaves. During the summer of 2022, we also saw record-breaking scorching heat waves in Europe. The fear is that we may see history repeat itself in the near future.

COMMITTING TO PATHWAYS THAT REDUCE CLIMATE RISK

It is not all doom and gloom though. We must realise that there is still time—albeit a small and rapidly shrinking window—to choose another way out of this climate mess to breach the 1.5°C limit. We must ask ourselves as a society—what are the pathways we can take to reduce climate risk in the most efficient and effective manner, while encouraging regeneration and development?

While it may appear an impossible task to achieve in a relatively short period of time, there are viable paths forward that are both science-based and policy-relevant. Based on our IPCC assessment, four things can be done simultaneously.

First, we need to reduce or mitigate GHG emissions through measures like burning less fossil fuels or switching

to renewable energy generation. Second, we need to reduce climate risks by utilising approaches that protect society from a warming climate. Third, we need to reduce and eventually halt biodiversity loss on this planet from deforestation on land and under water. Fourth, we need to improve peoples' well-being by reducing poverty and hunger, improving health and livelihoods, and providing more people with clean energy and water, all of which accord with the UN Sustainable Development Goals that all nations agreed upon in 2015.

This integrative approach, whereby policymakers implement science-based policies to reduce climate risks, is what the IPCC terms as Climate Resilient Development (CRD).

SO WHICH CRD APPROACHES ARE MOST EFFECTIVE?

In our IPCC report, we looked at 21 different approaches that enabled CRD based on evidence from numerous cities exposed to climate impacts and risks.³ What we found was that most cities had a major and disproportionate focus on physical infrastructure—such as sea walls, increased air conditioning, and enhanced water, transport, and sanitation infrastructure—as a protective remedy for climate risk.

While popular, these options are not necessarily the best approach for CRD. Instead, we found two particularly effective approaches in enhancing resilience: nature-based solutions, and planning and social policies.

Nature-based solutions, such as designing urban green spaces, community gardens, and managed floodplains (like the Bishan-AMK Park), were found to be just as effective for enhancing resilience as comparative physical infrastructure. For example, most coastal regions face the problem of flooding due to coastal erosion and tidal surges. The most common solution to this is to build physical infrastructure such as dikes and sea walls. However, the evidence is that building and maintaining such infrastructure is likely to be expensive, while being destructive to the surrounding environment. Instead, an alternative solution to the flooding problem would be to plant trees that are native to coastal areas, such as mangroves. This not only reduces the impact of flooding and prevents coastal erosion, but also acts as a natural barrier against tidal surges, encourages the area's biodiversity, and provides a potential recreational space for urban residents.⁴

Planning and social policies also need to come into play to ensure that all pillars of society are taken care of and included in CRD efforts. This includes land-use planning to minimise exposure to climate impacts, climate



We need to reduce or mitigate GHG emissions through measures like burning less fossil fuels or switching to renewable energy generation.



education and information-sharing with key stakeholders in business and policy communities, creating enhanced social safety nets for the climate-vulnerable to reduce exposure to hazards like heat and floods, and efficient relocation and protection strategies based on early warning systems. Such strategies were assessed to have strong, if not stronger, potential to enable CRD for cities, especially in the Global South.

CRD IN THE CITY: FOUR PRINCIPLES

These approaches which enable CRD are underpinned by four key science-based principles that drive and enhance resilience to climate impacts. Understanding these can yield insights into why they are effective, especially in urban contexts.

1. Implementing nature-based and planned social urban adaptation approaches

As stated above, climate risks are reduced by exploring not just physical infrastructure implementation, but also nature-based solutions in combination with planning and social policies. This can be done in multiple ways by policymakers, such as providing the security of land tenure to vulnerable groups residing in informal settlements, or by mandating or encouraging green standards for new or retrofitted buildings, which are more efficient in energy use, or utilising low carbon intensity means of building construction such as substituting concrete with mass engineered timber (as was done with the new Connexion

building at Singapore Management University, which has been recognised as a certified Net-Zero Energy Building—the first located within Singapore’s urban core⁵).

2. Reducing carbon-intensive behaviour from the demand side

While implementing new technologies and mandating CRD-friendly policies are effective, they can be augmented with demand-side changes like moving towards a low-carbon lifestyle. These can be put in place by communities and organisations to bring about significant carbon emission reductions (of between 40 and 80 percent of global sectoral GHG emissions in a recent study) when done *en masse* across the globe.⁶ One example can be found in Singapore, where major policy shifts in the transportation sector are aimed at encouraging public transportation use in combination with car-lite policies in controlling the country’s vehicle population, whilst phasing out cars powered by petrol and diesel in favour of electric vehicles, and installing charging infrastructure for private vehicle use.

3. Improving green employment transition by ensuring no one gets left behind

When the motorcar first appeared in the early 20th century, operators of horse-drawn carriages became obsolete as they could not adapt to these technological advancements. Similarly, with the move toward green technologies, it becomes imperative to retrain or reskill those who have been trained in older, fossil fuel-intensive industries to avoid leaving them behind in this transition towards a new economy. For example, engineers familiar with internal combustion engines and petrol station operators can be retrained to maintain electric vehicles or operate alternative renewable energy technologies in other related economic sectors. Avoiding the displacement of a potentially significant urban workforce is essential towards ensuring the success of this aspect of CRD.

4. Avoiding the siloed thinking trap by applying a multi-functional approach to CRD design

Singapore’s picturesque Bishan-AMK Park is an example of how increasing urban green spaces and incorporating water-sensitive urban designs that integrate nature-based principles in an urban setting can provide a multitude of ecosystem services such as temperature regulation, flood reduction, provision of habitats for flora and fauna, and the establishment of shared recreational spaces. This multi-

Southeast Asian coastal settlements, in particular, have much at stake as they have densely packed populations living in cities that are major drivers of economic growth for their countries.

functional approach—which cuts across singular, siloed thinking—is a hallmark of good and resilient climate design.

CRD IN ACTION IN SOUTHEAST ASIA

Coastal cities are especially vulnerable to the damaging effects of intensifying global warming, such as rising sea levels and severe weather like typhoons. Southeast Asian coastal settlements, in particular, have much at stake as they have densely packed populations living in cities that are major drivers of economic growth for their countries. Indeed, these cities contribute to nearly 80 percent of the region’s GDP.

The coastal city of Semarang and the island city of Singapore are two concrete examples of Southeast Asian cities which implemented successful CRD strategies that significantly reduced urban climate risks.

Semarang, Indonesia

The coastal city of Semarang, the largest city and capital of Central Java, Indonesia, has long been affected by environmental issues that include floods, landslides, and coastal erosion. Even more worrying is that the city is sinking; scientists estimate that the city sinks nearly 10 centimetres every year. Since 2009, the Indonesian government has implemented several policies that improved the area’s CRD.⁷ The policies include identifying Semarang’s marine wildlife reserves, implementing zoning restrictions along flood-prone shorelines to avoid further coastal development, and considering indigenous knowledge from marginalised communities that are vulnerable and most affected by climate change, during the decision-making process.

To manage these risks, the government completed a city resilience study and vulnerability assessment that identified flooding, coastal erosion, landslides, and droughts as the country’s top hazards, and incorporated climate change resilience into its medium-term development plans.

It put forth a City Resilience Strategy in May 2016 that comprises initiatives to enable six pillars: sustainable water and energy, new economic opportunities, preparedness for disaster and disease outbreaks, integrated mobility, transparent public information, and governance, as well as competitive human resources. Even before the release of its city resilience strategy document, Semarang had chalked up several achievements including:

- Restoration of mangrove forests: The exercise began in 2002 and resulted in the reclamation of at least 196 hectares of lost fishpond area.
- Reduction of flooding: Semarang’s limited water supply led to the unchecked depletion of groundwater, which sped up the city’s subsidence. The building of the Jatibarang Dam reduced flooding and provided residents with clean water.
- Reduction in emissions: The city implemented a green procurement policy for government purchases, which included emission reduction goals, and this helped reduce emissions caused by air conditioners by 30 percent. It also launched an initiative to replace 30 percent of street lighting with LED (light-emitting diode) lights to reduce emissions from lighting by 33 percent.

Singapore

Singapore’s Prime Minister Lee Hsien Loong has referred to climate change as “one of the gravest challenges facing humankind” and elevated its importance to the same level as that of the country’s national defence. In 2019, he discussed the numerous approaches taken by the country to mitigate climate risk.⁸ One of these approaches is the Singapore Green Plan 2030, a whole-of-nation movement led by numerous governmental agencies working across their specific domains, which aims to drive sustainability at a national level.⁹ It is an ambitious plan; the government aims to invest S\$100 billion over 100 years, to tackle rising sea levels

and climate change.¹⁰ As part of the plan, the government developed major infrastructural additions such as sea walls to protect the low-lying island and an additional pump house to remove excess water during flooding. Amongst its many targets, the Green Plan is working toward the following:

- **City in nature:** A green liveable and sustainable home for Singapore, which includes, for instance, planting one million more trees and having every household within a 10-minute walk from a park by 2030.
- **Green government:** The public sector will lead on sustainability, such as aiming to peak public sector carbon emissions around 2025, ahead of the national target.
- **Sustainable living:** This would be achieved by strengthening green efforts in school, as well as promoting green commutes, and green citizenry. For instance, at least 20 percent of schools are to be carbon-neutral by 2030, while the cycling path network on the island will be tripled in size by 2030. The waste sent to landfill per capita per day would be reduced by 30 percent by 2030.
- **Energy reset:** There will be a drive to switch to green energy and cleaner-energy vehicles, and increase solar power deployment five-fold by 2030. In addition, there will be greater efforts to develop greener infrastructure and buildings, as well as build sustainable towns and districts.
- **Green economy:** Sustainability would be the new engine of economy growth and new investments that are carbon- and energy-efficient would be sought.
- **Resilient future:** Singapore's coastlines will be safeguarded against rising sea levels, and initiatives will be introduced to ensure food security, and keep the country cool, with S\$5 billion being dedicated to improving coastal and drainage flood protection measures.

DO WE SINK OR SWIM?

Despite the bleak state of climate affairs at this moment, we still have time—albeit very limited—to change our future trajectory. Nations everywhere are making concentrated and tangible efforts to reduce emissions and make their cities

more climate-resistant and sustainable in order to encourage the regeneration of natural resources per the tenets of CRD.

However, it would be a mistake to think that the buck stops at governments around the world. Society, including communities and organisations in the public and private sectors, plays a critical part too. Climate resilience works best when all stakeholders understand what is at stake and align themselves towards walking this path together with much-needed haste. **AM**

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