URBAN FRONTIERS

ORF OBSERVER RESEARCH FOUNDATION

CONFRONTING THE CLIMATE CRISIS

Pathways to Urban Resilience

DHAVAL D DESAI
Editor

Attribution: Dhaval D Desai, Ed., *Confronting the Climate Crisis: Pathways to Urban Resilience,* December 2023, Observer Research Foundation.

Observer Research Foundation
20 Rouse Avenue, Institutional Area
New Delhi 110002
India
contactus@orfonline.org
www.orfonline.org

Design & Layout: Rahil Miya Shaikh

ISBN: 978-81-19656-91-2
ISBN Digital: 978-81-19656-13-4

Contents

Editor's Note

As the world rapidly urbanises, the imperative to forge resilient cities capable of withstanding the formidable challenges posed by climate change has never been more urgent. Climate-resilient cities are not merely a conceptual framework; they embody our collective commitment to creating sustainable, adaptable, and equitable urban spaces that can endure the unpredictable and extreme impacts of a changing climate.

We are publishing this compendium, *Confronting the Climate Crisis: Pathways to Urban Resilience,* at a pivotal moment in human history—an inflection point where life on earth confronts an unprecedented climate challenge. The escalating threats of extreme weather events, rising sea levels, and a myriad of climatic uncertainties call for a paradigm

shift in our approach to city planning and development. The task at hand is multifaceted and complex. It requires a holistic approach that considers the intricacies and interconnectedness of urban ecosystems and the environment, the vulnerabilities of marginalised populations, and the dynamic nature of climate change itself.

The contributors to this volume are catalysts for change, offering a mosaic of insights, strategies, and case studies that illuminate the path toward resilient urban futures. The following pages delve into the intricate tapestry of challenges and opportunities that define the quest for urban climate resilience. From innovative implementation strategies of climate action plans and sustainable infrastructure to social sustainability and smart tech for future cities to green energy and the urgent need to prioritise public and non-motorised transport to civil society-driven initiatives fostering multi-stakeholder approaches for social cohesion and nature-based solutions—each chapter triumphs the power of innovative thinking and collective action. The authors draw from their diverse disciplines, bridging the realms of scholarship, policymaking, and grassroots mobilisations to present a holistic perspective on the delicate balance between cities and climate.

Climate-resilient cities are not a distant utopia; they are a tangible manifestation of our capacity to adapt, innovate, and collaborate. By integrating sustainability, inclusivity, and foresight, we can cultivate urban environments that thrive in the face of adversity. This anthology is the first of a series of reports that will tackle the different urban challenges of inclusive and equitable cities for all, the much-needed reforms to municipal governance architectures, the need to relook at city finances and how cities must safeguard the future of their past by preserving their built and natural heritage amid the onslaught of urban infrastructure development and increasing populations.

More than a collection of essays, this volume would like to be a call to action that will encourage policymakers, urban planners, researchers, and citizens alike to join the conversation, explore the multifaceted dimensions of climate resilience, and embrace the shared responsibility of safeguarding

our cities for future generations. A future where we reimagine our urban landscapes, where our cities stand not only as symbols of human perseverance and achievement but as harmonious ecosystems offering resilient and sustainable quality of living to all.

The destiny of cities is interwoven with the fate of our planet. The journey toward climate-resilient cities should be a collective endeavour requiring the collaboration of governments, communities, businesses, and individuals. As we navigate the uncharted territories of the Anthropocene Epoch, this collection is an attempt to create a compass, guiding us toward resilient cities that stand as a silver lining amid the dark clouds of ever-changing forces of nature.

More than a collection of essays, this volume would like to be a call to action for policymakers, urban planners, researchers, and citizens alike to explore the multifaceted dimensions of climate resilience, and embrace the shared responsibility of safeguarding our cities for future generations.

Putting Climate Action at the Centre of Urban Planning

Ramanath Jha

Data and analyses from the Indian Meteorological Department (IMD)[a] show that the country's cities are facing worsening threats of extreme weather events,[1] including heat waves, cold waves, and floods. Coastal cities, in particular, are likely to experience greater vulnerability from cyclones, extreme precipitation events, and rising sea levels.[2] International agencies such as the World Meteorological Organization (WMO) and the International Institute for Environment and Development are also sounding the alarm on the climate change-induced weather events that will increase in both frequency and severity.

---

[a] The IMD is the primary organisation of the government of India responsible for meteorological observations and weather forecasts. It publishes regular reports about weather patterns and climatic changes in the country.

In 2022, for instance, across 16 states, IMD reported a steep number of heat wave days (about 280) across the country.[3] The IMD also noted that the annual mean land surface air temperature that year averaged +0.51 ^{0}C above the long-term average in the 1981-1991 period.[4] The year 2022 was also the fifth hottest since 1901. At the same time, the country recorded 57 cold wave days in 2022, with the state of Haryana experiencing the highest number.[5] Furthermore, many cities suffered from flooding events that caused massive losses in lives and livelihoods.

With the heightened recurrence of climate-related crises in Indian cities, the challenge of building climate resilience has come to the foreground of the national urbanisation discourse. India is also projected to further urbanise in the coming years, and larger proportions of people will live in cities in the future. There is now wide agreement among scholars of urban studies, civil society, and government administrators that cities must take serious steps, informed by science and well-defined, to mitigate the daunting challenges of climate change. As the world is yet far from reaching carbon neutrality, the imperative is to place maximum emphasis on building climate resilience and adaptation.

Climate change has a huge negative fallout for cities.[6] In India, an analysis released in 2021 reported 120,000 deaths in New Delhi, Mumbai, Bengaluru, Hyderabad, Chennai and Lucknow that can be attributed to air pollution.[7] Extreme climate events spell the destruction of municipal infrastructure[8] and individual livelihoods and are huge anti-catalysts to city economies. The Reserve Bank of India (RBI) has warned that climate change-related job losses will cause India's GDP to drop by 4.5 percent by 2030.[9]

The question, therefore, is whether Indian cities are considering climate resilience as a key element in governance and preparedness planning.

Overall, India-specific city reports do not paint a rosy picture. Among the 17 Sustainable Development Goals (SDGs), the one that advocates for cities is SDG 11 ('sustainable cities and communities'), and its primary goal is to make cities and human settlements inclusive, safe, resilient and sustainable. According to the *Sustainable Development Report 2022,* India is not on-track to achieving SDG 11.[10] The degenerating scenario has been occupying the headlines in recent years, with specific reference to the air quality in India's two most important cities—the national capital, Delhi, and the financial hub, Mumbai. In the case of Delhi, the air quality has sharply dipped well in advance of extreme winter, which has been the general pattern of worsening air.[11] In the case of Mumbai, where it was earlier thought that the sea breeze protects the city, air pollution reached alarming levels beginning November 2023.[12]

The situation in cities like Delhi and Mumbai would show that these urban areas have typically paid little attention to climate resilience. This is despite initiatives such as the National Clean Air Mission (CAM-INDIA), which aims to reduce PM2.5 by about one-third in five years in 100 of India's most polluted cities.[13] The response of cities appears more callous given their contribution to climate change: they consume about 75 percent of global primary energy[14] and generate about 75 percent of the worldwide global CO2 emissions.[15] It is incumbent, therefore, upon cities to take on a bigger role in the fight against climate change.

State governments have a key role to play in building climate-resilient cities. To begin with, approaching climate resilience as a worthy activity that could be taken up in earnest by cities will no longer work. It is too critical a task to be left as a mere option. The preparation and implementation of climate action plans are not mentioned in the laws that govern Indian cities, and city statutes will now need to be amended to make this a compulsory task to be undertaken by urban local bodies (ULBs).

Every city must be mandated to prepare a climate action plan (CAP) and implement it on an annual basis by providing for it in their annual budgets. This is by no means a novel, fanciful idea. Countries such as France, the United Kingdom, Slovakia and Denmark, have already made local climate plans mandatory. Many cities in the United States (San Francisco, Chicago, Boston, Los Angeles), South Korea (Seoul), Japan (Tokyo), Australia (Sydney, Melbourne), Indonesia (Jakarta), and South Africa (Cape Town, Durban) have also prepared CAPs that are compatible with the Paris Climate Agreement.[16]

In Mumbai, the Municipal Corporation (BMC) has taken the lead in preparing a CAP, and Chennai has followed suit. The MCAP 2022 aims at increasing BMC's attention on tackling climate change and strengthening Mumbai's climate resilience.[17] It identifies urban flooding, coastal risks, urban heat, landslides, and air pollution as the biggest threats and outlines ways of garnering resources to move from action planning to implementing strategic projects. The MCAP also suggests an institutional mechanism in the form of a 'Climate Cell' to coordinate the implementation and monitoring of all activities related to climate change. However, the preparation of CAP does not appear to be matched by its commitment in implementation and the BMC would have to do far more. All other cities would have to similarly prepare CAPs and lay down the institutional and financial mechanisms for its implementation.

For the smaller cities, the state governments would have to do some handholding at critical stages. All tasks that cities perform ought to be compulsorily examined through the climate lens. These include construction practices, waste management, and maximisation of green surfaces and the adoption of green technologies. At the same time, each state should erect a common platform where best practices in climate action could be shared. Educational and capacity-building institutions would have to devote their energies towards multi-stakeholder capacity-building and for the promotion of environmentally responsible behaviour. These would include the inculcation of habits that

promote water conservation, minimising waste generation, greater use of public transport, and the practice of urban agriculture in homes and buildings.

While mitigation and adaptation measures are introduced, it is vital that strategies are framed by the principles of sustainability. The larger questions of how much human density a city can sustain, what is the volume of construction that can be permissible, and how much openness must be maintained, should not be dismissed. No city can simply carry on with activities that run counter to sustainability and hope that mitigation and adaptation measures would be able to successfully deal with the negative consequences.

Dr. Ramanath Jha

Distinguished Fellow, Observer Research Foundation

Endnotes

1 India Meteorological Department, *Annual Report 2022,* Ministry of Earth Sciences, Government of India, 2022, https://mausam.imd.gov.in/imd_latest/contents/ar2022.pdf.

2 "These Indian Cities Likely to go Three Feet Underwater by Century-End, IPCC Report Rings Warning Bell," *India Today,* August 11, 2021, https://www.indiatoday.in/science/story/ipcc-climate-report-coastal-cities-in-india-sea-level-rise-environment-global-warming-indian-ocean-1839061-2021-08-10.

3 "Annual Report 2022"

4 "Annual Report 2022"

5 Erick Burgueño Salas, "Average Number of Cold Wave Days in India from 2010 to 2022,", Statista, June 28, 2023, https://www.statista.com/statistics/1006969/india-number-of-cold-waves/#:~:text=Around%2057%20cold%20wave%20days,cold%20wave%20days%20in%202022.

6 Simrin Sirur, "Over 2,700 Died in 2022 Due to Extreme Weather Conditions – IMD's State-Wise Annual Climate Report," *The Print,* April 29, 2023, https://theprint.in/india/over-2700-died-in-2022-due-to-extreme-weather-conditions-imds-first-state-wise-annual-climate-report/1545967/.

7 Vinamrata Borwankar, "Mumbai Ranks 5th in Annual Deaths Due to Air Pollution: Global Study," *Times of India,* February 19, 2021, https://timesofindia.indiatimes.com/city/mumbai/mum-ranks-5th-in-annual-deaths-due-to-air-pollution-global-study/articleshow/81099733.cms.

8 The University of Sydney, "How Climate Change Impacts Infrastructure: Experts Explain," November 27, 2019, https://www.sydney.edu.au/news-opinion/news/2019/11/27/how-climate-change-impacts-infrastructure--experts-explain.html.

9 Nasrin Sultana, "How Climate Change Can Impact GDP and Jobs," *Forbes India,* August 22, 2023, https://www.forbesindia.com/article/take-one-big-story-of-the-day/how-climate-change-can-impact-gdp-and-jobs/87673/1#:~:text=Climate%20change%20due%20to%20rising,its%20latest%20report%20on%20Currency%20%26.

10 Sustainable Development Solutions Network, *Sustainable Development Report,* Dublin University Press, 2023, https://s3.amazonaws.com/sustainabledevelopment.report/2023/sustainable-development-report-2023.pdf.

11 Anumita Roy Chowdhury, "What Delhi's Grey Sky is Hiding," *The Times of India,* November 7, 2023, https://timesofindia.indiatimes.com/city/delhi/what-delhis-grey-skys-hiding/articleshow/105046829.cms.

12 D. Stalin, "Smogged: The City by the Sea," *The Times of India,* November 2, 2023, https://timesofindia.indiatimes.com/blogs/toi-editorials/smogged-the-city-by-the-sea/.

13 Ministry of Environment, Forest and Climate Change, Government of India, *NCAP – National Clean Air Programme,* 2019, https://moef.gov.in/wp-content/uploads/2019/05/NCAP_Report.pdf.

14 UN-Habitat, "Urban Energy," https://unhabitat.org/topic/urban-energy#:~:text=To%20run%20their%20activities%2C%20cities,the%20world's%20total%20greenhouse%20gases.

15 United Nations Environment Programme, "Cities and Climate Change," https://www.unep.org/explore-topics/resource-efficiency/what-we-do/cities/cities-and-climate-change.

16 "C40 Cities with a Paris Climate Agreement Compatible CAP," October 24, 2023, https://www.google.com/maps/d/u/0/viewer?mid=1hR77I4BWAhKAb805TrazOV__2DBsxUZ7&femb=1&ll=-6.208763399999981%2C106.84559899999999&z=3.

17 Brihanmumbai Municipal Corporation, *Mumbai Climate Action Plan 2022,* https://ghhin.org/wp-content/uploads/Mumbai-Climate-Action-Plan-2022.pdf

Building Urban Resilience to Climate Change

Rumi Aijaz

Weather patterns and climatic conditions are showing unusual trends across the world. Some places are recording temperatures significantly higher than normal, while others are witnessing unexpected occurrences of excess rainfall, storms, and cyclones. These climatic changes negatively affect the earth's surface and its inhabitants. The rising temperatures cause glaciers to melt, resulting in higher sea and ocean levels. The rise in water levels threatens communities living on islands and low-lying coastal areas. Prolonged heat spells lead to droughts, water shortages, the spread of diseases, forest fires, desertification, and loss of biodiversity. Moreover, regions experiencing increased rainfall face problems of landslides and flooding.

The unusual climate changes are due to greenhouse gas (GHG) emissions from various human activities. These gases remain in the atmosphere and prevent the sun's heat from reflecting back into space. As a result, the trapped heat in the atmosphere causes the Earth to warm up.

There is growing concern over the socio-economic challenges associated with climate change. As a result, many nations are creating conditions that promote environment-friendly human behaviour. This essay outlines and evaluates four popular approaches to managing the threats posed by climate change.

India is an urbanising country with a large concentration of population and significant economic activities centred in and around its cities. Due to various factors, such as the quality of governance and people's lifestyles, city regions in India are contributing enormously to climate change. The data on air quality confirm that many Indian cities have alarmingly high levels of harmful GHG emissions, primarily caused by various urban activities, including transportation, industry, construction, and sanitation.[1]

Cities in India are dealing with the problems arising from climate change through the following approaches:

- Conservation and restoration of natural habitats and expansion of green cover
- Increased efforts to use clean sources of energy
- Functional improvements in various urban sectors and human activities
- Introduction of urban planning and governance reforms

Similar measures have been undertaken in certain urban areas of India, but there is a need to scale up these efforts. Furthermore, it is crucial that deficiencies in current approaches are dealt with urgently.

Conservation of Natural Habitats and Green Cover

Natural habitats, wetlands, water bodies, and green cover play a crucial role in mitigating the adverse impacts of climate change. The European Commission observes that "climate change will accelerate further if biodiversity and ecosystems are not effectively protected."[2] These blue-green assets help purify the air by absorbing carbon dioxide emissions from human activities, thus limiting global warming. Further, planting trees or shrubs (like mangroves) along shorelines provide protection from storms and flooding. The dense natural vegetation and trees on hillslopes also help prevent the occurrence of landslides.

A number of Indian cities, including Agra (Uttar Pradesh),[3] Bengaluru (Karnataka),[4] Chandigarh,[5] and Srinagar (Jammu and Kashmir),[6] offer examples of environment management initiatives. These include roadside plantations, development of parks, afforestation on unutilised land, and rejuvenation of lakes and rivers. However, it is important to deal with the problems of environmental degradation caused by rampant construction and inefficiencies in wastewater and solid waste management.

Transition to Clean Energy

The use of fossil fuels, such as coal, oil, and gas, to power various sectors and activities is a significant contributor to climate problems. Many nations have learnt from past mistakes and are reducing their dependence on conventional energy sources by transitioning to environment-friendly and renewable sources, also known as green energy. India, for its part, has prioritised the reduction in emissions and scaled up its efforts and investments.[7] States and local governments are receiving support through various ongoing initiatives, including the National Solar Mission, National Bioenergy Programme, National Green Hydrogen Mission, Faster Adoption and Manufacturing of (Hybrid and) Electric Vehicles (FAME) India Scheme, as well as projects for energy generation from wind, wind-solar hybrid, and small hydropower.

The solar projects implemented in Chandigarh,[8] Coimbatore (Tamil Nadu),[9] and Salem (Tamil Nadu)[10] are helping meet the electricity demand while saving conventional energy and funds. In Indore (Madhya Pradesh), the city's transport agency utilises the biogas produced from segregated wet waste to run their bus services. Moreover, there is a growing trend in Indian cities to develop the electric vehicle (EV) sector, evident in the increasing number of EV users and greater availability of charging infrastructure. In the national capital, existing buses are being replaced with electric buses, with plans to charge their batteries from renewable energy sources. To promote the widespread use of green energy and EVs, city governments must offer affordable and efficient alternatives and work towards establishing clean energy grids.

Improving the Functioning of Urban Activities

Improvements in existing activities and practices are necessary to reduce GHG emissions. For example, providing better and integrated multi-modal public transport services, facilities for non-motorised transport, and pedestrian infrastructure can help decrease ownership and use of private motor vehicles. Proper monitoring of construction sites, implementation of dust management plans, and use of environment-friendly building material like fly ash can further reduce air pollution, which is increasingly affecting urban areas in India.

Instead of relocating polluting economic activities and industries to peri-urban areas, civic agencies must assist them in adopting clean energy solutions. Further, all open burning of plastic and municipal waste, as well as dumping in landfills, must be replaced with eco-friendly waste-handling methods. Urban local governments must strictly adhere to the Solid Waste Management Rules 2016.[11] Indore serves as an example with its 100-percent door-to-door garbage collection, segregation, and treatment system. Furthermore, the problems of frequent flooding in a growing number of cities, including Delhi, Bengaluru (Karnataka), and Mumbai (Maharashtra), can be

controlled by constructing proper drainage networks, ensuring maintenance, and using flood monitoring sensors. Some of these initiatives have been undertaken in Agartala (Tripura), Davanagere (Karnataka), and Srinagar (Jammu and Kashmir).[12]

Reforming Urban Planning and Governance Practices

Urban and regional planning documents—referred to variously as master plans or metropolitan regional plans—increasingly incorporate provisions of climate mitigation and adaptation.[13] These planning interventions are considered necessary for ensuring development that is compatible with climate goals. For example, street designs and infrastructure that prioritise walkability as well as the use of electric vehicles and energy-efficient buildings can help reduce emissions. Similarly, the damage caused by flooding can be minimised by introducing changes in building designs, streets, and public spaces, including raising the level of streets using permeable material. Urban and regional planning strategies can also deal with the challenges arising from droughts and water supply shortages. Planning regulations that protect groundwater and restore flood plains, for instance, can help secure water resources for communities.[14]

Reforming urban governance is equally important for dealing with the problems of climate change. In this regard, a significant measure has been the establishment of integrated command and control centres (ICCC) in select 100 smart cities of India.[15] These centres are equipped with the technology that facilitates the collection of cyclone-related information and its dissemination to disaster management agencies. This approach has helped concerned agencies in Surat (Gujarat), for example, in making prompt decisions and taking timely action. Similar initiatives have been observed in the public health sector, where an integrated hospital management information system has been designed in Vadodara (Gujarat) to maintain the health records of registered patients. The availability of vital statistics on health indicators can help in the early detection and prevention of disease outbreaks.

Conclusion

Many nations find themselves trapped in a cycle where cities are damaging the climate, and the resulting climate change is harming the cities themselves. This leads to the suffering of large populations as precious resources necessary for maintaining a balanced ecosystem are lost or wasted. The imperative is to protect the environment, develop tailored solutions, and ensure their effective implementation.

Rumi Aijaz

Senior Fellow, Observer Research Foundation

Endnotes

1 Tanvi Mehta, "Three Indian Cities Among World's 10 Most Polluted After Diwali," *Reuters*, November 13, 2023, https://www.reuters.com/markets/commodities/three-indian-cities-amongst-worlds-10-most-polluted-after-diwali-2023-11-13/

2 European Commission, "Nature's Role in Climate Change," 2009, https://climate.ec.europa.eu/system/files/2016-11/nature_and_climate_change_en.pdf

3 National Institute of Urban Affairs, *Cities Readiness Report 2021*, New Delhi, National Institute of Urban Affairs, 2021, https://niua.in/csc/assets/pdf/key-documents/Cities-Readiness-Report.pdf

4 "Rs 100 Crore Push to Up Green Cover in Bengaluru," *The New Indian Express,* January 21, 2023, https://www.newindianexpress.com/cities/bengaluru/2023/jan/21/rs-100-crore-push-to-up-green-cover-in-bengaluru-2539834.html.

5 Chandigarh Administration, *Greening Chandigarh Action Plan 2020-21: Forest. A Heaven in the Lap of Nature,* Chandigarh, Department of Forests and Wildlife, 2020, https://chandigarhforest.gov.in/wp-content/uploads/2020/06/GCAP-2020-21-Final.pdf.

6 "Govt Proposes 2% Increase in Existing Green Space in Srinagar," *Rising Kashmir,* August 24, 2021, https://risingkashmir.com/govt-proposes-2-increase-in-existing-green-space-in-srinagar

7 Ministry of New and Renewable Energy, *Annual Report 2022-23,* New Delhi, Government of India, https://mnre.gov.in/img/documents/uploads/file_s-1683099362708.pdf

8 Munieshwar A. Sagar, "UT Sets Target to Completely Shift to Green Energy by 2030," *The Times of India,* June 29, 2023, https://timesofindia.indiatimes.com/city/chandigarh/ut-sets-target-to-completely-shift-to-green-energy-by-2030/articleshow/101353783.cms

9 M. Soundariya Preetha, "Installation of Rooftop Solar Panels Goes Up in Coimbatore," *The Hindu,* September 2, 2022, https://www.thehindu.com/news/cities/Coimbatore/installation-of-rooftop-solar-panels-goes-up-in-coimbatore/article65839975.ece

10 Kousalya Devi M., "A Study on Promotional Strategy of Solar Energy Management Company With Special References in Salem and Dharmapuri Districts," *International Journal of Multidisciplinary Research and Development 3,* no. 8 (2016): 155–163, https://www.allsubjectjournal.com/assets/archives/2016/vol3issue8/3-8-77-221.pdf.

11 Ministry of Environment, Forest and Climate Change, "Notification," April 8, 2016, https://cpcb.nic.in/uploads/MSW/SWM_2016.pdf

12 Nidhi Sharma, "Centre Highlights Cities That Have Curbed Urban Flooding," *The Economic Times,* October 9, 2022, https://economictimes.indiatimes.com/news/india/centre-highlights-cities-that-have-curbed-urban-flooding/articleshow/94746609.cms

13 Robert Steuteville, "Climate Adaptation, Mitigation, and Urban Design," Public Square, November 3, 2021, https://www.cnu.org/publicsquare/2021/11/03/climate-adaptation-mitigation-and-urban-design

14 European Commission, "Nature's Role in Climate Change"

15 Ministry of Road Transport & Highways, Government of India, https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1907135#:~:text=Under%20the%20Smart%20Cities%20Mission,of%20life%20for%20its%20citizen.

A Multistakeholder Approach to Urban Climate Action in India

Akshay Shetty and Kirti Jain

India has been experiencing rapid urbanisation in the last few decades, with more than 30 percent of its population now living in urban areas; this proportion is expected to rise to 40 percent by 2030.[1] Cities are crucial economic hubs, and in India, they generate nearly 80 percent of GDP.[2] However, the state of cities worldwide, and not just in India, is imperilled by a multitude of threats, including the climate crisis. The steady rise in extreme weather events over the past two decades has resulted in massive losses to life and property. Heavy rains in Bihar, Himachal Pradesh, and Uttarakhand in July 2021, for example, caused severe flooding and landslides.[3] Sea levels are projected to rise by 0.1–0.3 metres in the next three decades, threatening to submerge critical infrastructure in many coastal cities by 2050.[4] Severe heat waves are also becoming

more frequent, endangering the lives of people living in poorly ventilated and crowded homes.

Vulnerable communities, including low-income groups, informal settlers, women, and marginalised populations, often bear the brunt of climate change due to their limited access to basic infrastructure and services. Indeed, the climate crisis not only threatens livelihoods, but exacerbates inequalities and amplifies social vulnerabilities. What is required is to build urban resilience to multidimensional climate threats in order to ensure that no one is left behind.

Addressing inequities amid the rapidly accelerating climate crisis demands a collaborative approach that engages diverse stakeholders, including governments, civil society organisations, the philanthropy sector, and local communities. Governments and policymakers, as primary stewards of urban development, must take the lead in crafting robust policy frameworks that prioritise sustainability and equity. By integrating climate resilience principles in urban planning and governance, prioritising infrastructure development in vulnerable areas, and ensuring inclusive policies that consider the specific needs of marginalised communities, policymakers can lead Indian cities towards long-term sustainability. Local governments, in particular, can play a pivotal role in tailoring policies to the specific needs and dynamics of their urban landscapes. Evidence and community consultations have shown that city-level climate action plans can serve as effective frameworks for driving localised climate action in line with community needs.

A Multistakeholder Approach

There is no dearth in discourse on the role of national and subnational governments in leading the charge on climate action. However, it is equally important to acknowledge the role and potential of non-state actors, such as civil society organisations (CSO), philanthropists, and communities in the crusade against the defining crisis of our time.

India's civil society comprises over 3.1 million registered organisations and is an enabler in shaping the journey of the country's cities towards sustainability and equity.[5] Most of these organisations are consciously integrating climate action across programmes and interventions in consideration of the ever-increasing climate crisis impact on their legacy target groups.[6] These CSOs are uniquely positioned to be vital allies in strengthening equitable climate action across cities, with their proximity to communities, understanding of local contexts, and skills in advocacy and mobilisation.

Historically, CSOs in India have worked closely with marginalised and vulnerable communities such as the urban poor, women, those with disabilities, and migrants. These communities are the least able to prepare for or recover from the impacts of climate change-induced crises because of intersecting vulnerabilities. Moreover, CSOs are led by proximate leaders, i.e., people who belong to communities affected by marginalisation or vulnerabilities, which allows them insight into the complex root causes of the climate crisis.

These organisations work closely with communities through localised initiatives to facilitate outreach, awareness, and education. They actively strengthen community capacities and enhance climate resilience at the grassroots while ensuring that the resilience-building process is inclusive. For instance, organisations like Mahila Housing Trust,[7] Waste Warriors,[8] Saahas,[9] and Biome Environmental Trust[10] in India have successfully catalysed solutions for heat stress, integrated water management, disaster resilience, and waste management across numerous cities.

The close community access gives CSOs the comparative advantage of bridging the gap between policy and on-ground implementation. CSOs have actively advocated for including community needs and realities across urban planning and processes to ensure equitable interventions. Amid the growing need to move towards the delivery and integration of climate action policy across sectors such as transport, industry, waste

management, and housing, central-, state-, and city-level governments are seeking support from geographically spread-out CSOs in these sectors to operationalise the country's climate commitments. The CSOs are achieving this through the capacity building of officials, supporting government departments with data and research, leading innovative pilots, and bridging policy and practice. For example, Janaagraha[11] and Reap Benefit[12] are contributing to stronger climate governance through research, the curation of evidence, hyperlocal data collection, and advocacy for inclusivity.

While CSOs are at the frontlines of grassroots climate action, they are often small-scale and constrained by a lack of resources to expand programmes. Collaboration between CSOs, local governments, private sectors, and international organisations is, therefore, imperative.

The Role of Philanthropy

Philanthropy can provide crucial support to CSOs for capacity building. It can support grassroots organisations with proximate leadership on urban climate action, enabling them to cover organisational expenses and effectively adapt to their communities' needs. Philanthropy can provide patient and long-term capital to build sectoral research and knowledge infrastructure, implementing place-based pilot programmes for city resilience, increasing access and availability of climate change knowledge to these organisations and communities, supporting climate-friendly policy reforms, and providing technical assistance to implement these policies. Since philanthropy has a greater risk appetite, it can also play a catalytic role in supplementing the efforts of governments, multilateral agencies, and grassroots organisations that lead the charge in climate action. Givers are now more keen to incorporate an environmental and climate lens into their portfolios and invest more deliberately in climate solutions.

According to the *India Philanthropy Report 2023,* over 90 percent of inter-gen and now-gen donors are seeking increased

involvement with emerging causes such as climate change.[13] While this is a positive shift, philanthropy has significant room to elevate funding efforts and strengthen the narrative for adaptation and community resilience in the climate sector, which has hitherto focused on mitigation.

At present, philanthropic grants for the environment and sustainability sector amount to less than INR 200 crore (approximately US$28 million)—a small fraction of the overall philanthropic pie in the country.[14] Investments are primarily focused on mitigation, with little attention being paid to adaptation and building resilience in cities and communities. Further, philanthropic funding has typically been concentrated in more developed states such as Maharashtra, Karnataka, and Andhra Pradesh, leaving the country's more vulnerable regions in the lurch.[15] There is a critical need to fill this funding gap, and the onus is on philanthropy to realise its full potential and bridge the funding gap towards equitable climate action.

The quest for a sustainable and inclusive future for communities requires a collaborative approach. Governments, civil society, philanthropy, and communities must unite in order to leverage their unique strengths to build resilient and equitable urban landscapes. The success of sustainable cities hinges on the ability of diverse stakeholders to collaborate effectively, transcend traditional boundaries, and forge a path towards a more sustainable and resilient urban future.

Akshay Shetty

ClimateRISE team at Dasra, where he leads the organisation's collaborative-building efforts on climate action.

Kirti Jain

ClimateRISE team at Dasra, where she supports the organisation's research and knowledge-building initiatives in inclusive and equitable climate action.

Endnotes

1 "40% of Indian Population Will Live in Urban Centres by 2030: Hardeep Singh Puri," *Asian News International,* August 18, 2020, https://www.livemint.com/news/india/40-of-indian-population-will-live-in-urban-centres-by-2030-hardeep-singh-puri-11597743030787.html

2 National Institute of Urban Affairs, *Cities Insights Report,* May 2020, New Delhi, National Institute of Urban Affairs, 2020, https://niua.in/intranet/sites/default/files/198.pdf

3 Shivali Jainer and Ashwathy Anand, "'Code Red for Humanity': Sinking Indian Cities," WRI India, August 27, 2021, https://www.wricitiesindia.org/content/code-red-humanity-sinking-indian-cities

4 Dasra and Observer Research Foundation, *Our Uncommon Future: Intersectionality of Climate Change and SDGs in the Global South, July 2023,* New Delhi, Dasra and Observer Research Foundation, 2023, https://www.orfonline.org/wp-content/uploads/2023/07/ORF-DASRA_Our-UncommonFuture.pdf

5 Asian Development Bank, *Civil Society Brief: India, May 2023,* Manila, Asian Development Bank, 2023, https://www.adb.org/sites/default/files/publication/879896/civil-society-brief-india.pdf

6 "Our Uncommon Future: Intersectionality of Climate Change and SDGs in the Global South"

7 Mahila Housing Trust, "About the Organisation," https://www.mahilahousingtrust.org/about/

8 Waste Warriors, "Cleaning Up the Himalayas One Mountain at a Time," Waste Warriors, https://www.wastewarriors.org/about-us/#journey

9 SAAHAS, "Our Journey," https://www.saahas.org/about-us/our-journey

10 Biome Environmental Trust, "A Thoughtful 'Do' Tank – A Practice-to-Policy Bridge," Biome Environmental Trust, https://biometrust.org/

11 Janaagraha, "Transforming Quality of Life in India's Cities and Towns," https://www.janaagraha.org/

12 Reap Benefit, "Solve Ninja Movement: Activating 21st Century Skills of Youth to Solve Local Climate and Civic Issues," Reap Benefit, https://www.reapbenefit.org/

13 Dasra, *India Philanthropy Report 2023,* March 2023, Mumbai, Dasra, 2023, https://www.dasra.org/assets/uploads/resources/vF_India%20Philanthropy%20Report%202023_co-branded%20with%20Dasra.pdf

14 "Philanthropy Giving for Climate on the Rise in India," *Alliance Magazine,* January 15, 2023, https://www.alliancemagazine.org/blog/philanthropic-giving-for-climate-on-the-rise-in-india/

15 Dasra, *India Philanthropy Report 2022,* March 2022, Mumbai, Dasra, 2022, https://www.dasra.org/resource/india-philanthropy-report-2022

Lessons from Sweden's Response to the Urban Climate Challenge

Rupali Deshmukh and Dharal Desai

Climate change has captured greater global attention in the recent years, prompting urgent calls for action and policy changes across the world. With 56 percent of the global population living in urban areas,[1] cities have become crucial battlegrounds in the fight against climate change.[2] By 2050, 80 percent of people across the world will live in urban habitats, and cities will only become more crucial in the worldwide climate action effort.[3]

As the urban world grapples with the climate challenge, Sweden, Europe's largest Nordic country, has emerged as a global leader in reshaping urban landscapes for a more resilient, inclusive, and equitable future. Through urban planning strategies that incorporate

principles of sustainability, technological advancements, and a commitment to social equity, Sweden provides a compelling model for other nations, including those in the Global South, striving to nurture climate-resilient cities.

Transformative Policies

Underlining Sweden's resolve to abide by the Paris Agreement, its Parliament *(Riksdag)* adopted the climate policy framework in 2017.[4] The framework led to the setting of the country's national climate goals, legislation of the Climate Act, and the establishment of the Climate Policy Council. Concerted efforts under the policy framework helped Sweden draw long-term commitments from businesses and civil society to contribute to its ambitious green transition efforts.

The national commitment to climate resilience encouraged Swedish cities to frame their targeted climate strategies. Backed by robust national, provincial and city-level policies, cities in Sweden are proactively reducing carbon emissions and encouraging a shift towards sustainable living. The capital, Stockholm, for instance, has integrated a number of environment-friendly solutions into its infrastructure, such as an extensive network of bicycle lanes and a well-established public transport system powered by renewable energy sources. The city's public transport system, which includes buses, boats, metro and trams, achieved a 100-percent transition to renewable energy in 2017.[5] The city has set an ambitious target to generate its entire electricity requirement through renewable sources by 2040,[6] and is committed to having 100-percent fossil fuel-free maritime traffic by 2030.[7] The city has also pledged to use 15-percent less energy consumption per passenger kilometre than in 2011, and 75 percent reduced emissions compared to the 2009 levels.[8]

Social Sustainability as Priority

Sweden's commitment to social equity is pivotal to creating inclusive urban environments. Indeed, the concept of "social sustainability" is deeply embedded in the country's urban planning policies,[9] ensuring universal access to essential services and amenities. Efforts to provide affordable housing, quality education, and accessible healthcare services have contributed to a more inclusive society and fostered a sense of belonging and community among its residents. A legislative amendment[10] in 2011 mandated municipal housing companies to adjust to the volatile real estate market conditions and increase public housing stock. This was followed by a public investment of US$100 million to reinvigorate Sweden's "Million" public housing programme[11] implemented in the mid-20th century and which suffered setbacks following the debt crisis in the 1990s.

According to a 2019 study by IVL Swedish Environmental Research Institute, the renovation and retrofitting of the old houses built under the programme in Lund's Linero district led to a 40-percent reduction in energy consumption since the inception of the project in 2014.[12] Simultaneously, the Swedish National Board of Housing, Building and Planning implemented the cooperative building programme to construct low-cost, energy-efficient, high-quality housing. By prioritising the needs of all citizens regardless of socioeconomic status, Sweden has set a powerful example for promoting equity within urban spaces. Such efforts have also contributed to assessing and implementing neighbourhood-scale social sustainability according to local needs.[13]

Promoting Circular Economy

Sweden has set the global standard for mainstreaming the principles of 'circular economy' in its urban plans. The government established a *delegationen för cirkulär ekonomi* (advisory group for circular economy) in 2018 to integrate 360-degree circular economy mechanisms in its policies.[14] Today,

Sweden has the distinction of sending less than 1 percent of its waste to landfills—while nearly half of the total waste generated by the country is recycled, the remaining is fed to power plants to generate electricity. Though the share of power generation from waste in Sweden's energy basket is low, energy from garbage serves 1.25 million apartments[15] with central heating during winters through the district heating network and provides electricity for 680,000 households. Besides minimising the load on landfills, waste-to-energy reduces the need for burning fossil fuels, averting nearly 2.2 million tons of CO_2 emissions—equivalent to annual emissions from 700,000 petrol-powered cars. In Östergötland County, waste-based power plants produce methane biogas from 100,000 tons of food and organic waste annually—this energy powers 200 buses, the county's entire fleet of garbage collection trucks, and even some taxis and private cars.[16]

Meanwhile, in India, Jabalpur in the state of Madhya Pradesh has announced an ambitious plan to become a landfill- and bins-free city under the Smart Cities Mission. The city's 10-acre waste-to-energy plant at Kathonda uses 600 tons of waste daily to generate 11.5 megawatts of electricity.[17] The system is backed by Jabalpur Municipal Corporation's door-to-door waste collection from 276,000 RFID-tagged bins across the city.

However, the journey towards resilient and equitable cities amid worsening climate change is fraught with challenges. Rapid urbanisation, coupled with the increasing frequency of extreme weather events, presents a complex set of obstacles that demand innovative solutions. The linear to circular economy transition comes with inherent disruptions to the established value chain, which requires innovative production methods, recovery and recycling technologies, and innovative business models. Recognising the need for proactive measures, Sweden has embraced a multifaceted approach to urban development, emphasising the integration of nature-based solutions and advanced technological interventions. Initiatives such as green roofs, urban farming, and sustainable drainage systems have

enhanced the resilience of Swedish cities while contributing to the preservation of natural ecosystems within urban landscapes.

Moreover, Sweden's emphasis on research and development has led to the emergence of groundbreaking technologies that could aid climate action. The country's substantial investments in clean energy technologies and sustainable infrastructure have resulted in the development of innovative solutions, including smart grid systems, energy-efficient buildings, and integrated renewable energy networks. These technological advancements not only reduce carbon footprints but also pave the way for a more sustainable and environment-conscious urban future.

In the pursuit of climate resilience, Sweden recognises the importance of collaboration and knowledge-sharing among various stakeholders. Public-private partnerships, community engagement initiatives, and interdisciplinary research collaborations are instrumental in fostering a culture of innovation and sustainability. By encouraging active participation from citizens, businesses, and academic institutions, Sweden promotes a sense of collective responsibility in addressing the challenges posed by climate change and urban development.[18] This collaborative approach strengthens the resilience of cities, and fosters a culture of inclusivity and shared purpose within communities.

Sweden remains steadfast in its commitment to shaping urban frontiers that are not only resilient to the impacts of climate change but also inclusive and equitable for all. As other nations grapple with the complexities of urban development and climate change, Sweden's holistic approach—leveraging the power of progressive policies, innovative technologies and collaborative efforts—offers valuable insights and inspiration for building a more sustainable world for future generations.

While cities in the developing world coping with the challenge of providing for their citizens' basic needs would find it difficult to emulate Sweden's practices, they must nonetheless mainstream sustainable living in all future urban development. For example, the Lifestyle for Environment (LiFE) initiative launched by Indian Prime Minister Narendra Modi at the COP26 in 2021 underlines the need for greater awareness for encouraging changes in behavioural and consumption patterns shaped through conducive policies, infrastructure and incentives. The principles of LiFE, along with other commitments to accelerate progress on the UN Sustainable Development Goals, were also stressed by the G20 New Delhi Leaders' Declaration.[19]

With growing global consensus on making cities climate-resilient, and the Agenda 2030 deadline fast approaching, cities worldwide would do well to learn from the best practices implemented by Sweden to overcome the urban climate challenge.

Rupali Deshmukh

India Country Manager, IVL Sweden

Dhaval Desai

Senior Fellow and Vice President, Observer Research Foundation, Mumbai

Endnotes

1 World Bank, "Urban Development," April 3, 2023, https://www.worldbank.org/en/topic/urbandevelopment/overview#:~:text=Today%2C%20some%2056%25%20of%20the,people%20will%20live%20in%20cities

2 Prashant Kumar, "Climate Change and Cities: Challenges Ahead," Front.Sustain.Cities, February 25, 2021, https://www.frontiersin.org/articles/10.3389/frsc.2021.645613/full

3 Bruno Venditti, "This Chart Shows the Impact Rising Urbanization Will Have on the World," World Economic Forum, April 26, 2022, https://www.weforum.org/agenda/2022/04/global-urbanization-material-consumption/

4 "Sweden's Climate Policy Framework," Ministry of Climate and Enterprise, The Government of Sweden, March 11, 2021, https://www.government.se/articles/2021/03/swedens-climate-policy-framework/

5 "Sustainable Public Transport in Stockholm," IVL Swedish Environmental Research Institute, Smart City Sweden, https://smartcitysweden.com/best-practice/368/sustainable-public-transport-in-stockholm/#:~:text=The%20journey%20towards%20fossil%2Dfree,trains%20was%20achieved%20in%202017

6 Government Offices of Sweden, Ministry of Environment, *Sweden's Long-term Strategy for Reducing Greenhouse Gas Emissions,* Ministry of Environment, 2020, https://unfccc.int/sites/default/files/resource/LTS1_Sweden.pdf

7 "Sustainable Public Transport in Stockholm," UN Climate Technology Centre and Network, https://www.ctc-n.org/products/sustainable-public-transport-stockholm#:~:text=The%20next%20goals%20for%202030,passenger%20kilometre%20than%20in%202011.&text=For%20SL%2C%20sustainability%20is%20important,are%20heated%20using%20green%20energy

8 "Sweden's Long-term Strategy for Reducing Greenhouse Gas Emissions"

9 "Social Sustainability," IVL Swedish Environmental Research Institute, Smart City Sweden, https://smartcitysweden.com/focus-areas/social-sustainability/#:~:text=Social%20sustainability%20focuses%20on%20individuals,%2C%20sex%2C%20background%20or%20disability

10 Ryan Fox and Jason Syvixay, "Sweden's Public Housing and Rent Control Strategy," Case in Point, 2020, https://umanitoba.ca/architecture/sites/architecture/files/2023-02/CP_cip2020_Fox.pdf

11 "The 'Million' Program is Being Updated to Accommodate Both Climate and Tenants," IVL Swedish Environmental Research Institute, February 26, 2019, https://www.ivl.se/english/ivl/press/press-releases/2019-02-26-the-million-programme-is-being-updated-to-accommodate-both-the-climate-and-tenants.html

12 "The 'Million' Program is Being Updated to Accommodate Both Climate and Tenants"

13 Liv Zetterberg et al., "Neighbourhood Social Sustainable Development and Spatial Scale: A

Qualitative Case Study in Sweden," *Local Environment* 28, no. 6 (2023), https://doi.org/10.1080/13549839.2023.2179610

14 "Sweden is Aiming for Zero Waste. This Means a Commitment to Change Our Everyday Lives," *Sweden Sveige,* July 13, 2023, https://sweden.se/climate/sustainability/swedish-recycling-and-beyond

15 Amy Yee, "In Sweden, Trash Heats Homes, Powers Buses and Fuels Taxi Fleet," *The New York Times,* September 21, 2018, https://www.nytimes.com/2018/09/21/climate/sweden-garbage-used-for-fuel.html

16 Yee, "In Sweden, Trash Heats Homes, Powers Buses and Fuels Taxi Fleet"

17 National Institute of Urban Affairs, "Zero Landfill & Bin Free City: Jabalpur," https://niua.in/csc/assets/pdf/waste/CS3.pdf

18 Karin André, Linn Järnberg, and Åsa Gerger Swartling, "Co-Designing Climate Services to Support Adaptation to Natural Hazards: Two Case Studies from Sweden," Stockholm Environmental Institutei, February 2020, https://www.sei.org/wp-content/uploads/2020/01/co-designing-climate-services-two-swedish-case-studies.pdf

19 G20, "G20 New Delhi Leaders' Declaration," G2o Leaders' Summit, New Delhi, 2023, https://www.g20.org/content/dam/gtwenty/gtwenty_new/document/G20-New-Delhi-Leaders-Declaration.pdf

Heat Resilience as a Key Element of City-Level Climate Action Plans

Kamal Kumar Murari

Cities, being focal points for human activities, contribute to climate change while also suffering its dire consequences. Current estimates indicate that cities account for 75 percent of global greenhouse gas emissions, with a large share coming from the transportation and building sectors.[1] An imperative, therefore, is to position cities as integral components in climate action.

To be sure, cities across the world are taking proactive measures to mitigate the impacts of climate change, including the formulation of comprehensive Climate Action Plans (CAPs) that encompass multiple strategies such as those related to transport planning. Key components include low-carbon approaches

such as renewable energy and electric vehicles, the expansion of public transport, the implementation of water and waste management initiatives, and the formulation of climate-resilient strategies. Through such comprehensive measures, cities are positioning themselves as crucial contributors to the global fight against climate change.[2]

The challenge is true for India, too—vulnerable as it is to extreme climate events like floods and heatwaves. It ranks 10th in the Global Climate Risk Index 2021, which studies the countries most affected by climate change-induced events in terms of human casualties, infrastructure damage, and monetary losses.[3] The combination of rapid urbanisation, inadequate planning, and improper urban management practices raises the risk of Indian cities being categorised among the most vulnerable globally. Unplanned urban growth and a shortage of affordable housing have compelled approximately half of the urban population (around 25 million people) to reside in informal settlements that lack essentials such as roads, sewage systems, drainage, and ventilation.[4] This magnifies the severity of Indian cities' vulnerability to extreme climatic events.

An evident and severe consequence of climate change in India, particularly with rising temperatures, is the increasing frequency of extreme heat events. The number of days with intolerable heat during the summer is on the rise, exacerbated by the existing conditions in Indian cities—such as reduced open spaces, diminished green areas, the mismanagement of waste, and congested traffic.[5] The escalating heat creates urban heat islands (UHIs), where the microclimate is warmer than the surrounding regions.[6] The UHI effect is not confined to larger cities but is also noticeable in smaller towns. Estimates indicate that the UHI effect in Indian urban areas can go as high as 10°C.[7]

Beyond climate-related warming, cities also serve as hubs for generating anthropogenic heat. This human-made heat primarily emanates from vehicular traffic and the increased use of cooling

devices like refrigerators and air conditioners, further intensifying the UHI effect. The UHI effect is compounded by the urban design and planning, encompassing building morphology (related to spatial arrangement, design, and structure, including materials used), surface and pavement characteristics, and rooftop features. The UHI effect in Indian cities is creating an escalating challenge from the perspective of heat resistance. While some of the UHI effect results from global warming, another part is attributable to cities' planning and development aspects, which demand equally careful attention.[8]

Implementing heat-resistant interventions in urban areas involves several key measures, including the expansion of green and open spaces, promoting the use of electric vehicles and public transport, retrofitting buildings with heat-resistant designs and materials, improving housing arrangements especially for low-income households, and incorporating heat-resistant materials for pavements and surfaces. These interventions not only enhance the city's resilience to heat but also yield co-benefits such as energy conservation and management, decrease in pollution level, reduction in healthcare burden, and improved facilities; they also guide city planning authorities towards low-carbon pathways. Given the multifaceted advantages, CAPs of Indian cities must prioritise and incorporate heat action plans as integral components of their overall planning. Unfortunately, however, city planners and administrators in India have yet to adequately recognise the urgency of implementing heat action plans. An exception to this trend is the municipality of Ahmedabad in the state of Gujarat, which has been noteworthy for periodically issuing and updating its heat action plan since as far back as 2013.[9]

The formulation and execution of heat action plans in Indian urban centres require policy measures and interventions that seamlessly integrate into the country's existing urban governance framework. Many of these initiatives should be implemented at the city level in coordination with state and national policies. Within the Indian context, various policy measures and

government schemes directly or indirectly address strategies for mitigating heat. These include the National Mission for Sustainable Habitat, the Smart Cities Mission, City Development Plans, Model Building by-laws, and street design guidelines. Additionally, non-government rating agencies such as GRIHA and LEED play a crucial role by assigning relevant ratings to buildings based on their energy consumption.

Furthermore, Indian cities need to explore avenues for leveraging the potential benefits offered by emerging green and sustainable finance instruments. This aligns with directives from the Ministry of Housing and Urban Affairs for cities to raise funds from the market.[10] In this regard, Indian cities could consider tapping into opportunities presented by the ESG (Environment, Social, and Governance) framework to enhance their credentials for prospective investors.[11] Existing service-level benchmarking frameworks, in which Indian cities are already participating—such as the ease of living index,[12] *swachh sarvekshan,*[13] good governance index,[14] and municipal credit ratings[15]—should be explored for alignment with ESG frameworks. This alignment could attract funding from private investors, philanthropic organisations, and development agencies. Integrating measures related to heat resilience could be a viable approach for aligning with ESG standards.

Heat-resilience measures are emerging as an essential concern, especially given the increasing likelihood of extreme temperatures. At present, only one city in India has a heat action plan; more cities must begin developing similar strategies. A pressing requirement is to initiate dialogues on heat-resilience measures and their integration into CAPs. These measures should cover critical aspects such as land-use planning, building morphology, surface characteristics, and urban lifestyles.

The efficient coordination of policies across various departments is crucial for the successful implementation of heat action plans. This not only aids in developing heat-resilient urban systems but also contributes to Indian cities achieving their climate mitigation targets. Prioritising and implementing heat-resilience measures is vital to creating sustainable and climate-resilient urban environments.

Dr. Kamal Kumar Murari

Assistant Professor, Centre for Climate Change and Sustainability Studies, School of Habitat Studies, Tata Institute of Social Sciences, Mumbai

Endnotes

1 National Institute of Urban Affairs, "Assessment Overview," https://niua.in/csc/assessment-overview.html

2 C40 Cities Climate Leadership Group and C40 Knowledge Hub, "Why City Action is Critical in the Fight Against Climate Change," https://www.c40knowledgehub.org/s/article/Why-city-action-is-critical-in-the-fight-against-climate-change?language=en_US#:~:text=Tackling%20these%20emissions%20requires%20every,targeting%20net%20zero%20before%202035

3 David Eckstein, Vera Künzel, and Laura Schäfer, *Global Climate Risk Index 2021,* Berlin, Germanwatch e.V., 2021, https://www.germanwatch.org/sites/default/files/Global%20Climate%20Risk%20Index%202021_2.pdf

4 Statista, "Share of Urban Population Living in Slums in India from 2000 to 2020," New York, Statista Inc., 2023, https://www.statista.com/statistics/1400274/india-slum-population-as-a-share-of-urban-population/

5 Kamal K. Murari et al., "Intensification of Future Severe Heat Waves in India and Their Effect on Heat Stress and Mortality," Regional Environmental Change 15, (2015): 569-79, https://link.springer.com/article/10.1007/s10113-014-0660-6

6 Divya Sharma and Alka Bharat, "Urban Heat Island Effect – Causes, Impact, Methods of Measurement and Mitigation Options," *Institute of Town Planners, India Journal 6,* no. 2 (2009): 69-77, https://www.itpi.org.in/pdfs/apr5_09.pdf

7 Madhavi Jain, "Cities and Urban Heat Island Effect," Delhi Greens, March 23, 2023, https://delhigreens.com/2023/03/12/cities-and-urban-heat-island-effect/#:~:text=The%20temperature%20differences%20between%20the,high%20as%2010%20degrees%20Celsius.

8 Akshey Bhargava, Subodha Lakmini, and Swati Bhargava, "Urban Heat Island Effect: Its Relevance in Urban Planning," *Journal of Biodiversity & Endangered Species (2017),* http://dx.doi.org/10.4172/2332-2543.1000187

9 C40 Cities, "Ahmedabad Heat Action Plan 2019," C40 Knowledge Hub, https://www.c40knowledgehub.org/s/article/Ahmedabad-Heat-Action-Plan-2019?language=en_US

10 Press Trust of India, "Govt Encouraging ULBs to Raise Funds Through Municipal Bonds: Puri," *Business Standard,* July 23, 2018, https://www.business-standard.com/amp/article/pti-stories/govt-encouraging-ulbs-to-raise-funds-through-municipal-bonds-puri-118072301254_1.html

11 Apex ESG Enterprise, "ESG Enterprise Helps City Leaders in Delivering ESG Impact to a Low-Carbon Economy," ESG Sustainability in Cities and Municipalities, https://www.esgenterprise.com/esg-industry-sector/sustainability-city/

12 Ministry of Housing and Urban Affairs, Government of India, *Ease of Living Index 2019,* New Delhi, 2019, https://amplifi.mohua.gov.in/assets/html-landing/pdf/eol.pdf

13 Ministry of Housing and Urban Affairs, Government of India, https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1935570

14 Ministry of Personnel, Public Grievances and Pensions, Government of India, https://pib.gov.in/PressReleasePage.aspx?PRID=1785140#:~:text=The%20GGI%202020%2D21%20categorises,rank%20score%20covering%2010%20sectors.

15 CRISIL, *Rating Criteria for Municipal and Urban Local Bodies,* Mumbai, CRISIL, June 2023, https://www.crisil.com/mnt/winshare/Ratings/SectorMethodology/MethodologyDocs/criteria/Rating%20Criteria%20for%20Municipal%20and%20Urban%20Local%20Bodies.pdf

The Imperative for Climate-Ready and Sustainable Urban Transport

Nandan Dawda

The affordability and so-called 'aspirational' value of personal modes of transport in all income groups have fuelled the growth in the use of private automobiles in Indian cities. In 2019, the number of registered motor vehicles in India touched 295.8 million, recording a compounded annual growth rate (CAGR) of 9.91 percent from 2009 to 2019. In contrast, the national highway network only grew at a CAGR of 5.54 percent during the same 10-year period. Two-wheelers accounted for 75 percent of registered vehicles in 2019, with a CAGR of 10.47 percent, followed by four-wheelers at 10.29 percent. However, the registration of buses,

a primary and crucial mode of urban public transport, declined from 11.1 percent in 1951 to 0.71 percent in 2018, and further to 0.69 percent in 2019.[1]

Responding to the growing travel demand and in line with the earlier urban transport policies, local governments augmented the capacity of road infrastructure by building flyovers and widening existing streets. However, they failed to respond to the population growth and subsequent increase in mobility demand through improvements in accessibility, first- and last-mile connectivity, and frequency of public transport systems. The result was a decline in the use of public transport and an increased reliance on private modes of travel, in turn leading to traffic congestion, road accidents, poor peak-hour travel experience, overcrowding, and environmental degradation.[2]

Motorised personal transport has also led to an increase in the number of trips per person, estimated to grow from 0.8–1.55 trips in 2007 to 1–2 trips by 2030. As a result, congestion will bring down the travel speed from 26–17 km per hour to 8–6 km per hour.[3] This congestion will have negative effects on productivity, leading to economic losses and greater fuel consumption. Currently, congestion costs India's four metro cities—Delhi, Mumbai, Kolkata, and Chennai—approximately US$14.7 billion annually.[4] Easing the density would be an imperative, given the many impacts on human life, including on health and ecology.[5]

The transport sector in India accounts for 24 percent of the country's total energy consumption, with a significant 98.5 percent of it generated from fossil fuels.[6] This has resulted in the transport sector contributing 13.2 percent of the total CO_2 emissions from fuel combustion, with road transport alone accounting for 87 percent of the emissions.[7] If energy demand is not effectively managed and reduced, studies estimate, India's CO_2 emissions could triple by 2040 when compared with the rate in 2013.[8]

Moving Vehicles, Not People

India's post-Independence urban transport policies have largely prioritised the movement of vehicles, while neglecting the development of efficient public transport systems.[9] The National Urban Transport Policy (NUTP) of 2006 marked the first shift in policy focus towards passenger movement. This shift has been accelerated by various initiatives such as the Smart Cities Mission, Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Faster Adoption and Manufacturing of Electric Vehicles (FAME), Green Urban Transport Scheme (GUTS), and Move-in India (MII) schemes.[10]

However, despite the policy push, the modal share of public transport systems remains dismally low.[11] Regrettably, many of the newly implemented policies and programmes suffer from an unintegrated, unsustainable, and non-multimodal approach. Rather than fostering synergy among various public transportation modes in metropolitan areas, these policies create barriers.

Challenges to Sustainable, Multi-Modal Public Transport

An integrated and sustainable multimodal transport system (ISMTS) ensures safety, accessibility, affordability, comfort, convenience, and sustainability. It also results in fair distribution of road space, avoiding any bias towards private motor vehicles.[12]

Thus, removing the barriers to the adoption of ISMTS is crucial for dealing with the urban climate challenge. One of the main hurdles is the lack of knowledge and capacity at the state- and city-level governments. Despite the availability of funds for urban transport projects, inefficient financial management has impeded success. For example, Mumbai faces the negative consequences of overcrowding in both its public transport and road networks. During peak demand periods, its suburban trains, which are designed for 1,750 passengers, are forced to carry nearly 5,000.[13] These realities have detrimental outcomes, and result in financial

losses, compromised air quality, and severe overcrowding. Such challenges underscore the urgent need for comprehensive strategies and capacity building in urban transport planning to foster sustainable, comfortable, and easily accessible public transport with reliable operational punctuality.

ISMTS faces another significant barrier from entrenched power structures and traditional administrative arrangements. Cities are governed by a predominant decision-making authority at the central and state levels, which relegates city officials to primarily handle service delivery responsibilities. This centralisation of power is further reinforced by the enduring influence of the state political leadership and bureaucracy, who control the decision-making processes. Consequently, the selection of a particular mode of transport in cities is based on political preferences rather than an understanding of its technical feasibility and practicality.[14]

A crucial challenge faced in urban areas is the inadequate provision for non-motorised transport (NMT) for first- and last-mile connectivity. Despite the introduction of various public transportation modes through initiatives like the Jawaharlal Nehru National Urban Rejuvenation Mission (JNNURM) in 2005, and AMRUT, ten years later, the supporting infrastructure necessary to facilitate public transport and NMT remains deficient. These include unobstructed, continuous, shaded, and well-lit sidewalks as well as dedicated bus and bicycle lanes.[15] Chennai, the first city to establish the Unified Metropolitan Transport Authority (UMTA), has a low 17.03 percent of sidewalk coverage and a mere 0.26 percent allocation for cycling lanes. Other cities like Udaipur, Rajkot, and Vizag have, respectively, only 4 percent, 16 percent, and 7 percent of roads with continuous footpaths.[16]

The lack of a constitutionally and legally empowered UMTA is a barrier to the development of sustainable and integrated urban transport systems. While some cities like Bhopal, Hyderabad, and Bangalore have initiated steps to implement UMTA, the authority

suffers from operational gaps because of the fragmented division of roles among federal, state, and local agencies. Its tasks, such as land-use planning, integrating transport modes, and other pivotal functions, still remain unassigned.

The focus on mega transport projects instead of improving or optimising existing facilities and increasing the fleet size are the other barriers to the adoption of ISMTS. Many cities have committed to metro rail projects without comprehensive demand studies, resulting in costly infrastructure that fails to meet ridership goals. In 2022, Bengaluru and Mumbai achieved 64.32 percent of their estimated ridership, while Chennai, Hyderabad, Ahmedabad, Jaipur, Lucknow, Kochi, Kanpur, Nagpur, and Gurugram had ridership percentages ranging from 1.5 to 51 percent in reference to estimates made in Detailed Project Reports.[17] Delhi, Mumbai, Kolkata, Bengaluru, Chennai, Hyderabad, Ahmedabad, and Pune have 10 to 51 buses per lakh inhabitants, far below the recommended standard of 60 buses per lakh population.[18]

The Way Forward

Prioritising public transportation requires a range of policy interventions. These should include the development of realistic funding strategies to enhance public and NMT infrastructure, the establishment of city-level transport committees, and the integration of land use and transport plans.[19] It is of utmost importance to establish UMTA and ensure the creation of accessible infrastructure.

Furthermore, legal and regulatory reforms need to be realigned, with a strong focus on incorporating social equity into planning efforts. Additionally, it is essential to regulate paratransit services. In supporting the goals of ISMTS, measures such as curtailing mobility needs and imposing higher taxation on private modes of transport are pivotal.

To effectively achieve India's ambitious climate commitments, its cities must prioritise strategies that catalyse sustainable public transport and non-motorised transport. This requires a strong emphasis on translating transformative policies into action that can produce tangible results.

Nandan H Dawda

Assistant Professor, Faculty of Planning, CEPT University, Ahmedabad.

Endnotes

1 *Basic Road Statistics of India,* Ministry of Road Transport and Highways, Government of India, New Delhi, 2019, https://morth.nic.in/basic-road-statistics-india

2 Sanjay Kumar Singh, "Urban Transport in India: Issues, Challenges, and the Way Forward," *European Transport 52* (2013): 1–27, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2465552

3 Wilbur & Smith Associates and Ministry of Urban Development, *Study on Traffic & Transportation Policies and Strategies in Urban Areas in India,* Delhi, 2008, https://mohua.gov.in/upload/uploadfiles/files/final_Report.pdf

4 *Moving Forward Together: Enabling Shared Mobility in India,* NITI Ayog, Rocky Mountain Institute, and Observer Research Foundation, 2018, https://niti.gov.in/content/moving-forward-together-enabling-shared-mobility-india

5 S. Steinle et.al., "Personal Exposure Monitoring of PM2.5 in Indoor and Outdoor Microenvironments," *Science of the Total Environment 508 (2015): 383–94,* https://doi.org/10.1016/j.scitotenv.2014.12.003

6 The Energy and Resources Institute, *TERI Energy & Environment Data Diary and Yearbook (2015-16),* New Delhi, 2016, https://bookstore.teri.res.in/books/9789386530974

7 International Energy Agency & International Railway Association, *Railway Handbook 2017,* 2017, https://www.iea.org/reports/railway-handbook-2017

8 Joshua W. Busby and Sarang Shidore, "When Decarbonization Meets Development: The Sectoral Feasibility of Greenhouse Gas Mitigation in India," *Energy Research & Social Science* (2017): 60–73, https://doi.org/10.1016/j.erss.2016.11.011

9 Dawda et al., "Multimodal of Lateral Transport System: A Case Study of Successful Cities Worldwide," In Lecture Notes in *Intelligent Transportation and Infrastructure Book Series,* ed. D. Deb et al. (Singapore: Springer Nature, 2019), http://10.1007/978-981-13-2032-3_10

10 Dawda et al., "Efficiency Based Evaluation of Public Transport and Paratransit Systems with a View to Integrating Transportation," *Transportation Research Record,* no. 2675 (2020): 17–32, https://doi.org/10.1177/0361198120980322

11 Joshi et al., "Moving Ahead: Urban Mobility Reforms for Post-Covid Resilience in India," *High Volume Transport Applied Research,* 2020, https://transport-links.com/hvt-publications/moving-ahead-urban-mobility-reforms-for-post-covid-resilience-in-india

12 Asian Development Bank, *Mumbai Metro Transforming Transport: Contributing Toward an Equitable, Safer, and Cleaner City,* 2021, http://dx.doi.org/10.22617/SPR210179

13 Sami, "Building Alliances: Power and Politics in Urban India" (Ph.D. diss., University of Michigan, 2012), https://deepblue.lib.umich.edu/handle/2027.42/91422

14 *Non-Motorised Transport Network in the City Training Manual,* Ministry of Housing and Urban Affairs, Government of India, https://niua.in/c-cube/sites/all/themes/zap/pdf/Non-MT_Final.pdf

15 Geetam Tiwari and Deepti Jain, *NMT Infrastructure in India: Investment, Policy and Design,* 2013, https://wedocs.unep.org/20.500.11822/31383

16 Meher and Shivanand Swamy, "Are Cities in India Investing 'Right' in Public Transport?" (MTech diss., CEPT University, 2022), https://portfolio.cept.ac.in/2023/S/fp/drp/ut4051-drp000524-spring-2023

17 Ministry of Housing and Urban Affairs Government of India, "Non-Motorised Transport Network in the City Training Manual," https://niua.in/c-cube/sites/all/themes/zap/pdf/Non-MT_Final.pdf

18 Ministry of Housing and Urban Affairs Government of India, "Non-Motorised Transport Network in The City Training Manual"

19 United Nations, *Integrating Land Use Planning and Urban Transport for Low Carbon Cities,* UNCRD Environmentally Sustainable Transport (UST) Forum, Mongolia, 2018.

The Long Overdue Attention to Urbanisation in India's Hills

Snehashish Mitra

Estimates suggest that by 2050, India's cities will have 404 million inhabitants—the highest urban population in the world.[1] India's economic growth is closely tied to its cities, where jobs are generated and which contribute to three-fifths of the country's Gross Domestic Product (GDP).[2] Some of India's more recent policies related to urbanisation—such as the Smart Cities Mission (SCM) and the Atal Mission for Rejuvenation and Urban Transformation (AMRUT), both launched in 2015, have been framed keeping the urban reality in mind. These policies aim to pay greater attention to increasing the number of tier-2 and tier-3 cities and reduce the pressure on the four existing metropolitan cities of New Delhi, Kolkata, Mumbai, and Chennai.

The growth of cities in India has, however, been marred by the consequences of poor management of the urban environment, ecology and natural resources. Multiple studies have highlighted how the urban expansion in the country has come at the expense of air quality, green cover, and ecological health.[3] Policy analysts and scholars of urban studies have delved into how urban environmental governance needs a sustained focus to achieve global environment and climate targets.[4] A primary challenge is to balance the imperative of ecological protection with goals of socio-economic justice through long-term, structural shifts and transformation. Cities in India and in other developing nations are already reeling from climate change-induced environmental issues, such as increasing heat and humidity and rising sea levels. Urban policy interventions must aim for climate-smart solutions that will consider the requirements of cities based on their unique geographical and demographic features.

Hills in Indian Cities

In India, vibrant discussions about the multiple ecological challenges faced by Indian cities often neglect the issue of governing the hill regions. Much of India's urbanism discourse focuses on the major cities (such as Delhi, Mumbai and Kolkata), which are mostly located on plain and flat lands. Yet, a significant number of towns and cities in India, such as Shimla in Himachal Pradesh, Darjeeling (West Bengal), Gangtok (Sikkim), Shillong (Meghalaya) and Srinagar (Jammu & Kashmir), are located on hilly and mountainous terrain, mostly within the Indian Himalayan Region (IHR). Even certain Indian cities on plain lands, like Mumbai in Maharashtra, Guwahati (Assam), and Bangalore (Karnataka), have hilly and undulating topographies.

In the past few years, towns and cities in India's mountainous terrain, such as Haridwar (Uttarakhand), Gangtok, and Darjeeling, have suffered natural disasters such as excessive rains, flash floods, and landslides—some of them unprecedented in scale.[5] In Uttarakhand's Joshimath, unplanned constructions have altered

the local ecological balance, posing threat to life and property.[6] A 2023 study published in the journal, *Atmospheric Environment,* has found that West Bengal's high-altitude town, Darjeeling, could soon become one of the state's most polluted cities due to unplanned urbanisation, unauthorised land use, and biomass and combustion activities.[7]

Increased tourism pressure and infrastructure developments (hydel power projects, roads, and railways), coupled with high seismic sensitivity have exacerbated the threats faced by the hilly towns, thereby revealing the lack of judicious urban planning that should incorporate the uneven and undulating topography. Human activities have also caused a decline of the green cover in the hilly areas, loosening soil and subjecting the towns and cities to increasing threats of soil erosion and landslides.[8]

Cities on hilly terrain in the plain lands face a different set of challenges. In Guwahati and Mumbai, for example, informal settlements of largely migrants and marginalised poor families have mushroomed in the hilly regions. These settlements are growing in parallel to the lack of adequate provisions for low-income housing and receding state initiatives in urban housing. The unaffordability of the new real estate development has pushed people to settle in vulnerable, underserviced areas like the hills that also often experience landslides during heavy rainfall.[9] In India's financial hub, Mumbai, around 150,000 families live in the hill slopes, and there are some 327 dangerous zones on hill slopes across Mumbai and its suburbs.[10] Multiple areas in Mumbai, such as Vikhroli, Chembur and Mahul, are now facing the constant threat of landslides that cost human lives.[11]

In Guwahati, the hills are a contested territory between environmental groups and residents of hill settlements. As a prominent city in Northeast India, Guwahati attracts migrants from across the region and many of them find the hills the only viable option on which to settle their families. Environmental activists blame these hill settlements for the current ecological

damage observed in these areas, including the shrinking of habitats for wild animals such as leopards and the Asian elephant.[12] For their part, the hill settlers—many of whom belong to the tribal communities of the region—stake their claim to indigeneity while asserting their role as custodians of the environment, dependent as they are for their lives and livelihood on natural resources.[13] The demarcation of some parts of the hills under the Amchang Wildlife Reserve has further accentuated the legal and social conflicts over the hills of Guwahati.[14]

Towards the Sustainable Governance of Hills in Indian Cities

Making Indian cities liveable through sustainable measures could yet be India's greatest opportunity to successfully navigate the complex challenges of urbanisation. It would also advance India's commitment to the Sustainable Development Goals (SDGs), in particular Goal 11 ('Sustainable Cities and Communities') and 13 ('Climate Action').[15] To achieve the goal of sustainable urbanism, India must formulate a holistic approach to governing the hills in the towns and cities and act urgently. This would need an immediate assessment of the carrying capacity of the hill towns in terms of population and infrastructure load.

For example, in the northern states, towns such as Shimla, Dalhousie (Himachal Pradesh), and Nainital and Dehradun in Uttarakhand, were developed during the British colonial period for low-density and low-rise building patterns. They consisted of cottages for the European and the Indian elites and some business-residential buildings for the local population. Such towns were designed to cater to a specific population size: for instance, Shimla was planned and designed for a maximum of 25,000 people; the latest Census of 2011 recorded Shimla's population at 814,010.[16] Over time, the hill towns became administrative centres, attracting more people, followed by infrastructural development to cater to the expanding tourism industry. Meanwhile, building regulations have failed to catch up with the task of charting a judicious expansion of the housing

infrastructure, leading to unscientific and inappropriate planning and design solutions.[17] The case of hill settlements in the cities outside the Himalayan terrain, like Mumbai and Guwahati, shows the need for strict land demarcation and state-funded low-income housing provisions.

Overall, planning sustainable hill management in Indian cities should begin with a robust engagement mechanism among relevant stakeholders within the government (multiple departments like Forest, Land and Revenue, Urban Development) and in the grassroots (civil society organisations, community heads, and local political leaders). Lessons can be drawn from the Northeast region, where capital cities such as Shillong, Aizawl (Mizoram) and Kohima (Nagaland) are located on hilly terrains and are relatively better at managing landslides and other climate vulnerabilities. Outside of India, the Gamcheon Cultural Village in Busan, South Korea, can be a useful reference for fostering a participatory cultural transformation of hill settlements.[18]

India must shift its urban planning away from a plains-focused framework and acknowledge that hills require a different policy outlook. Failure to appreciate this reality has led to political instability in many hilly terrains in India over time, stemming from discontent about the development path or its lack thereof.[19] Addressing the issues faced by the hills through equitable and sustainable principles in Indian cities will have cascading impacts on the overall development discourse.

Snehashish Mitra

Fellow, Observer Research Foundation

Endnotes

1 N. Abhishek, Mamata Jenamani, and Biswajit Mahanty, "Urban Growth in Indian Cities: Are the Driving Forces Really Changing?" *Habitat International* 69 (2017): 48–57, https://doi.org/10.1016/j.habitatint.2017.08.002.

2 R. B. Bhagat, "Urbanization in India: A Demographic Reappraisal," *International Union for Scientific Study of Population* (2003): 1-17, https://www.iipsindia.ac.in/sites/default/files/IIPS_Working_Paper_No_17.pdf.

3 Lalitha Kamath and Anushri Tiwari, "Ambivalent Governance and Slow Violence in Mumbai's Mithi River," *International Journal of Urban and Regional Research 46,* no. 4 (2022): 674–686; Ananya Roy, "Urban Informality: Toward an Epistemology of Planning," Journal of the American Planning Association 71, no. 2 (2005): 147–158.

4 Diane Archer and Adelina Charrlotte, "Social-Ecological Transformation in Asian Cities," Friedrich-Ebert-Stiftung, 2022; Anne M. Rademacher and Kalyanakrishnan Sivaramakrishnan, *Ecologies of Urbanism in India: Metropolitan Civility and Sustainability,* Vol. 1 (Hong Kong University Press, 2013).

5 "Uttarakhand Rain: Rescue Operation Continues Amid Landslide, Roadblock; Over ₹11 Crore Given to Flood Victims," *Livemint*, August 19, 2023, https://www.livemint.com/news/india/uttarakhand-rain-rescue-operation-landslide-road-block-rs-11-crore-to-flood-victims-rishikesh-badrinath-nhjakhna-11692441761744.html

6 Kavita Upadhya, "How Heavy, Unplanned Construction and Complex Geology is Sinking Joshimath," *India Today,* January 16, 2023, https://www.indiatoday.in/news-analysis/story/how-heavy-unplanned-construction-complex-geology-sinking-joshimath-uttarakhand-2319530-2023-01-10

7 Shiv Sahay Singh, "Darjeeling to Join the List of Polluted Cities of West Bengal, Reveals Study," *The Hindu,* May 26, 2023, https://www.thehindu.com/sci-tech/energy-and-environment/darjeeling-to-join-the-list-of-polluted-cities-of-west-bengal-reveals-study/article66897237.ece

8 Krishnendu Bandyopadhyay, "Ground is Slipping under Darjeeling's Growing Feet," *Times of India,* January 15, 2023, https://timesofindia.indiatimes.com/india/ground-is-slipping-under-darjeelings-growing-feet/articleshow/96999966.cms

9 Hannah Ellis-Petersen, "Dozens Dead in Mumbai after 'Monstrous' Monsoon Rains Cause Landslide," *The Guardian,* July 19, 2021, https://www.theguardian.com/world/2021/jul/19/deaths-mumbai-monsoon-rains-landslide-india

10 Chaitanya Marpakwar, "300 Lives Lost to Landslides in 20 Years, 1.5 Lakh Families Still Live on Mumbai Hill Slopes," *Times of India,* July 22, 2021, http://timesofindia.indiatimes.com/articleshow/84624135.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

11 Richa Pinto, "Mumbai: Three Families Lose 10 Members in their Sleep in Vikhroli Crash," *Times of India,* July 19, 2021, https://timesofindia.indiatimes.com/city/mumbai/mumbai-3-families-lose-10-members-in-their-sleep-in-vikhroli-crash/articleshow/84535546.cms

12 Snehashish Mitra, "Forest in the City: Contested Informal Settlements on the Hills of Guwahati," (PhD diss., The University of Trans-Disciplinary Health Sciences and Technology, 2023).

13 Darshini Mahadevia, Aseem Mishra, and Yogi Joseph, "Ecology Vs Housing and the Land Rights Movement in Guwahati," *Economic and Political Weekly* 52, no. 7 (2017): 58–65.

14 Bhasker Pegu and Manoranjan Pegu, "The Conservation Discourse in Assam Must Consider a Sustainable Rehabilitation Plan for the Mising Tribe," *Economic and Political Weekly 53,* no. 41 (2018), https://www.epw.in/engage/article/conservation-discourse-in-assam-must-consider-sustainable-rehabilitation-plan-for-mising-tribe#:~:text=and

15 United Nations, *The 2030 Agenda for Sustainable Development,* New York, 2020, https://sdgs.un.org/goals

16 Town & Country Planning Organisation, *Draft Development Plan for Shimla Planning Area 2021,* Shimla, 2011.

17 Ashwani Kumar and Pushplata, "Building Regulations for Environmental Protection in Indian Hill Towns," *International Journal of Sustainable Built Environment 2,* no. 2 (2013): 224–231.

18 Urban Sustainability Exchange, "Gamcheon Cultural Village," https://use.metropolis.org/case-studies/gamcheon-culture-village

19 Sajal Nag, "Bamboo, Rats and Famines: Famine Relief and Perceptions of British Paternalism in the Mizo Hills (India)," *Environment and History* 5, no. 2 (1999): 245–252.; Townsend Middleton, *The Demands of Recognition: State Anthropology and Ethnopolitics in Darjeeling* (Stanford University Press, 2015).

Utilising the *Panchkarma* Framework to Build Resilient Cities in India

Amrita Chowdhury and Sumit Chowdhury

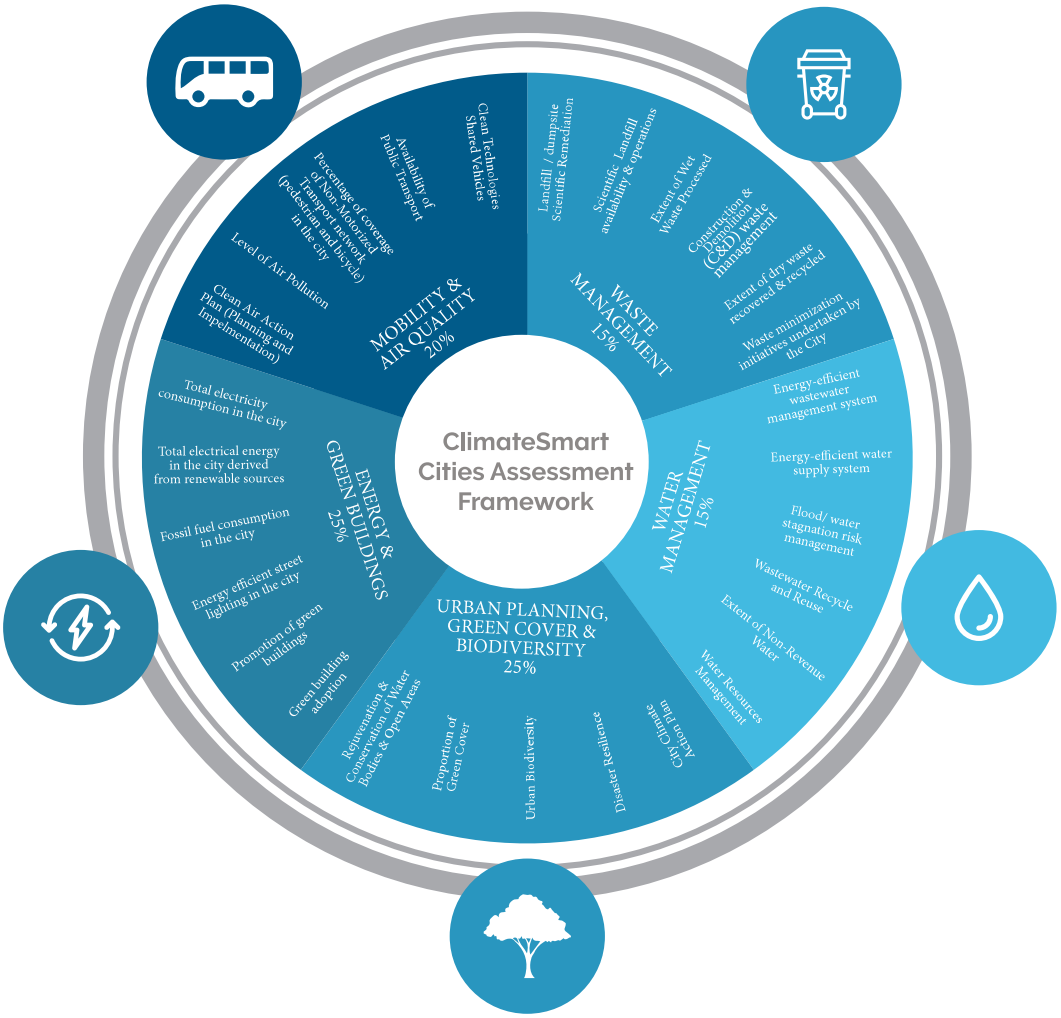
As the most populous country in the world, with close to 50 percent of the population below the age of 25[1] and the expected urban migration of 400 million people set to result in the creation of ten megapolises by 2030, India needs effective and time-bound climate strategy and action. Seventy-five percent of India's districts in 27 out of 35 states and Union Territories are at climate risk,[2] and 18 of the country's smart cities are flood-prone, whereas 21 cities have near-zero groundwater.[3] Of the world's 15 hottest cities, ten are in India.[4] India is also the third-largest source of greenhouse gases (GHG) in the world, with cities contributing to 70–80 percent

of the national GHG emission.[5] Poor planning and urban management are expected to cost Indian cities between US$2.6 and US$13 billion annually.[6]

Cities are acutely impacted by climate change due to the heat island effect, with rapid urbanisation and construction engulfing farmlands and fields, thus causing a reduction in green cover. Land and water contamination are already impacting the health and well-being of city residents. Critical infrastructure, such as hospitals, roads, bridges, and water supply systems are vulnerable to extreme weather shocks. These impacts increase the vulnerability of cities in protecting the physical, economic, food, and health security of residents and visitors, with migrant and low-income populations particularly vulnerable.

India created the National Action Plan on Climate Change (NAPCC) in 2008. In 2021, the National Institute of Urban Affairs set up the Climate Centre for Cities (C-Cube) to assess the effects of climate change in 28 indicators in five thematic areas across cities and to outline a roadmap for action under the Climate Smart Cities Assessment Framework (CSCAF). The CSCAF 3.0 Framework ranks cities on waste management; water management; urban planning, green cover, and biodiversity; energy and green buildings; and mobility and air quality.

Figure 1: CSCAF 3.0 Framework by the Ministry of Housing and Urban Affairs, National Institute of Urban Affairs



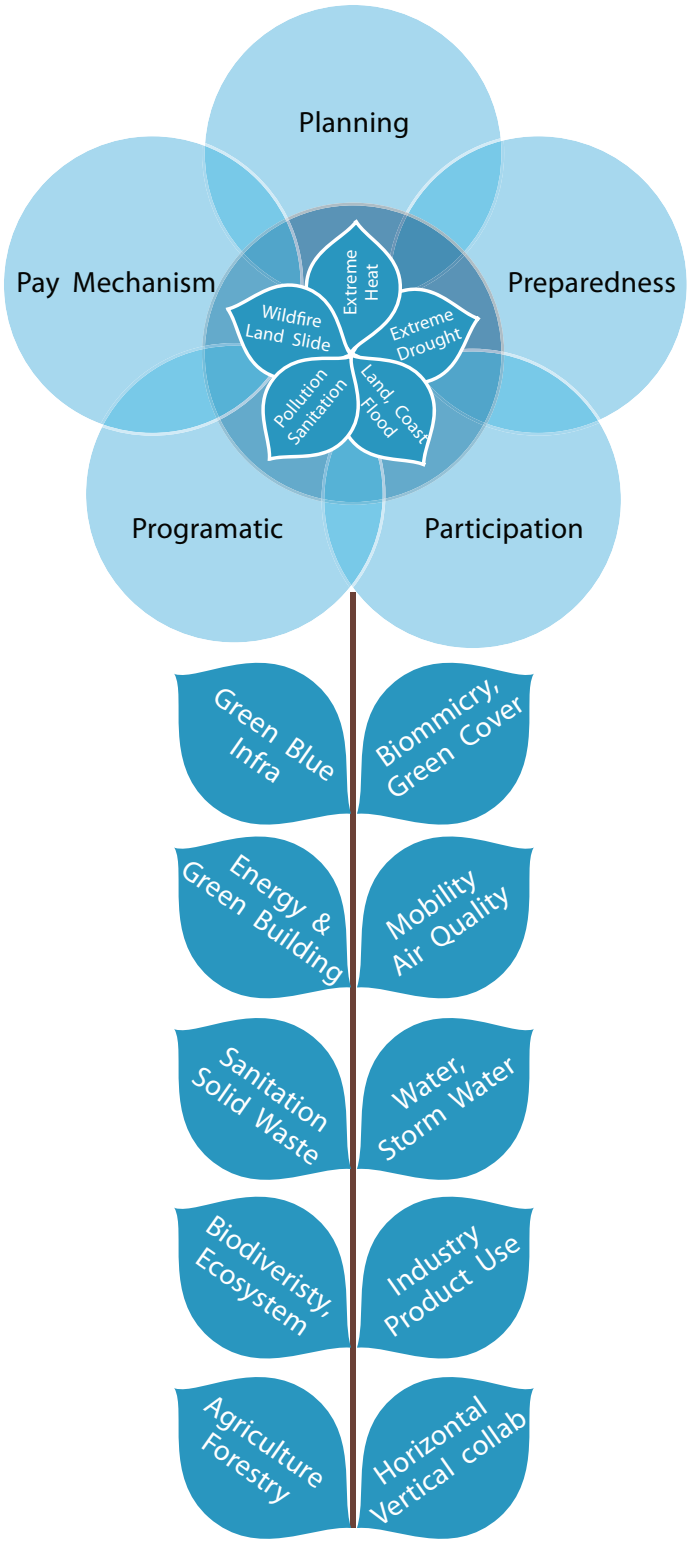
Source: NIUA[7]

Gaia's 5P Model for Climate-Resilient Cities

The Panchkarma Framework for Climate Action for Sustainable Prapancha (5P Model) supplements the CSCAF by addressing five critical areas of concern through thematic interventions.[a]

[a] The authors of this essay have worked in the smart cities space for the past decade, crafting frameworks based on Design Thinking and Systems Thinking since 2017. These frameworks have evolved into the Panchkarma Framework in the past year.

Figure 2: The Gaia Panchakarma Framework for Climate Action for a Sustainable Universe



Source: Gaia[8]

Planning

Cities require coordinated planning at the city and city-system levels as well as peri-urban and transnational linkages to ensure ecosystem-level planning to address climate change. Transport, energy, water, and food systems rely on areas beyond a city's spatial spread and administrative mandate; for instance, transport issues may be linked with housing, whereas green and blue covers may impact water tables and supply. An integrated, holistic system design approach allows cities to derive deeper benefits through horizontal and vertical collaborations within city departments as well as with entities outside the city. Cities must create risk plans that cover infrastructure, ecology, livelihoods, and health hazards.

Preparedness

India has pledged to become carbon-neutral by 2070 and is instituting a number of initiatives to foster climate-conscious development. These include the National Solar Mission, the National Mission for Enhanced Energy Efficiency, National Mission on Sustainable Habitat, National Water Mission, National Mission for Sustaining the Himalayan Ecosystem, National Mission for a Green India, National Mission for Sustainable Agriculture, and National Mission on Strategic Knowledge for Climate Change. However, there is a lack of adequately trained workforce at the city levels as well as in governance structures and processes in local governments. The mandates and motivations for undertaking climate action or responding to climate disasters also remain unclear. This increases the vulnerability and climate risk of cities and needs to be addressed through considered capacity building.

Participation

Climate risks are collectively created due to human activity. However, in most cases, people are not suitably aware of the impact of their actions or are not included in the risk mitigation planning and action processes. Bottom-up participatory planning will enhance the awareness and ownership of climate risks

and allow for broad-based ideation and consensus building to ensure that plans are implemented and followed through with collective action. Adopting traditional energy-efficient and sustainable practices as well as hybrid design principles through a combination of modern and indigenous approaches can reduce climate risks.

Programmatic

Each city must create targeted, interlinked interventions to address risks and needs based on its unique geography, ecology, and biodiversity. These interventions must be integrated with other initiatives and systems in the city to develop collaborative governance and tracking mechanisms to ensure the lasting impact of the analysis-to-action journey. Monitoring and showcasing impact can garner continued motivation, support, and funding for climate plans.

Pay Mechanisms

Recent reports suggest that cities across the developing world need approximately US$29.4 trillion to fulfil urban climate action plans and projects by 2030.[9] In 2021, climate finance was at US$1 trillion,[10] and there is a clear need for new funding mechanisms to reach targets. The United Nations Framework Convention on Climate Change (UNFCCC), established in 1992, initiated the climate funding framework, paving the way for institutions such as the Adaptation Fund, the Global Environment Facility (GEF), the Green Climate Fund, and specialised climate funds. Finance is channeled through regular debt, equity, and grant mechanisms via non-banking financial corporations (NBFCs), external commercial borrowings (ECBs), private equity investments, development finance institutions (DFIs), multilateral development banks, impact investors, and philanthropic organisations.

Public–private partnerships augment sovereign and government funds through market mechanisms. However, community inclusion and equity are required to expand the actions and involve grassroots organisations to plan, develop, microfinance, and implement projects with community impact. Municipal, green, and climate bonds can use public funds to finance specific projects or instruments. There is also a need for diversified financing options driven by national regulatory and institutional frameworks and supported by local governance, coordination, and fiscal prudence.

Further, cities need to build and demonstrate their technical, organisational, and financial management capabilities to attract the financing required for climate-linked projects. The government must create more integrated frameworks, programmes, events, and education for stakeholder coordination, technical assistance, and climate project planning to train city officials and build investor confidence.

This structured approach also needs to address the unique climate risks faced by cities, such as extreme heat and cold weather, droughts, inland floods, rising sea levels, coastal flooding, wildfires, landslides, and pollution. The systemic planning and programmatic design should include green-blue approaches related to waste and water management; ecology; green building practices; sustainable traditional building methods and materials; water, wastewater, and stormwater management; sanitation and waste management; soil, water, and air pollution; water effluents; transport, integrated mobility, walking, and cycling; smart irrigation and rainwater harvesting; storm drainage; renewable and local energy; green covers via parks, rooftops, and biomimicry, as well as along roads and rail lines; blue covers via water features, ponds, and water harvesting; urban and vertical farming; coordinated disaster response management; and green infrastructure such as mangroves, wetlands, and forests.

India is facing a clear and present danger from climate shocks, and a collaborative, multipronged, and multilateral approach and action through the Panchkarma framework can help address the current issues and future risks relating to the *panchabhootas* (water, fire, earth, air, space) towards building a sustainable *prapancha* (universe). These are challenges that have been created by human and market mechanisms, and a confluence of human activity and market corrections are needed to create a climate-conscious world.

Amrita Chowdhury

CEO of Gaia, a global information analytics SaaS venture and digital transformation advisory for enterprises, government, and smart cities

Sumit Chowdhury

MD and Founder of GreenEarthX Inc., a Green Hydrogen Trading Exchange and the CEO and Co-Founder of Hydreen, a Green Hydrogen and Energy Transition Company, and the MD of Gaia

Endnotes

1 United Nations Population Fund India, *Annual Report 2022,* New Delhi, UNFPA India, 2022, https://india.unfpa.org/sites/default/files/pub-pdf/unfpa_annual_report_2022_final_web_0.pdf

2 Council on Energy, Envionment and Water, *Mapping India's Climate Vulnerability: A District-Level Assessment,* New Delhi, Council on Energy, Environment and Water, 2021, https://www.ceew.in/sites/default/files/ceew-study-on-climate-change-vulnerability-index-and-district-level-risk-assessment.pdf

3 National Institute of Urban Affairs, *Cities Readiness Report: ClimateSmart Cities Assessment Framework 2.0,* New Delhi, National Institute of Urban Affairs, 2021, https://niua.in/csc/assets/pdf/key-documents/Cities-Readiness-Report.pdf

4 "Cities Readiness Report: ClimateSmart Cities Assessment Framework 2.0"

5 "Cities Readiness Report: ClimateSmart Cities Assessment Framework 2.0"

6 "Cities Readiness Report: ClimateSmart Cities Assessment Framework 2.0"

7 National Institute of Urban Affairs, *Technical Document: ClimateSmart Cities Assessment Framework 3.0,* New Delhi, National Institute of Urban Affairs, 2022, https://niua.in/c-cube/sites/all/themes/zap/assets/pdf/CSCAF_3_0_Technical_document.pdf

8 Gaia Smart City Strategy Approach, internal documents

9 World Bank, *Unleashing Sustainable Finance in Southeast Asia, Malaysia,* World Bank Group, 2022, https://documents1.worldbank.org/curated/en/099310011232220307/pdf/P177802011f7760130bc49083a7beb1ef43.pdf

10 Climate Policy Initiative, "Annual Finance for Climate Action Surpasses USD 1 Trillion, but Far from Levels Needed to Avoid Devastating Future Losses," November 2, 2023, https://www.climatepolicyinitiative.org/press-release/annual-finance-for-climate-action-surpasses-usd-1-trillion-but-far-from-levels-needed-to-avoid-devastating-future-losses/

'Cool Roof' Solutions to the Urban Heat Island Effect: The Case of Hyderabad

Sana Dharani

As cities develop, bigger areas of land get paved or covered with buildings and other infrastructure, making urban areas warmer than their rural surroundings. The resulting loss of vegetation leads to the "urban heat island (UHI) effect",[1] which is being felt worldwide with increasing frequency and intensity over the past couple of decades.

Higher built-up area and reduced vegetation because of rapid urbanisation have altered land use, transformed the microclimate in cities, and created hotspots. These changes have led to increased energy use for cooling, in turn escalating greenhouse gas (GHG)

emissions. 'Cool roof' solutions mitigate the effects of UHI by breaking this heat cycle, contributing to reduced indoor and outdoor temperatures.[2]

The Promise of 'Cool Roofs'

The Aga Khan Agency for Habitat (AKAH) India conducted a pilot project in the Garden Housing Society, a housing complex of mixed socio-economic groups in Hyderabad's Kompally neighbourhood, to study the impact of urban heat islanding and identify mitigation strategies. The project was funded by the Aga Khan Development Network (AKDN) and designed along similar lines of the Heat Island Compendium[3] of the United States Environmental Protection Agency (EPA). The project aimed at increasing solar reflectance with cool roofs and China mosaic (chipped tiles) as a community-level mitigation measure.[4] The pilot project also explored other interventions, such as increasing the vegetation cover, expanding shading with urban micro forests, and replacing concrete and paved surfaces with permeable pavers.

This intervention followed a comprehensive study of UHI in the city of Hyderabad, analysing 30-year climate data, daily and seasonal variation in land surface temperatures, land use, and land cover changes over 20 years.

Cool roof technology (high Solar Reflective Index value coating)[5] and China mosaic were applied across 16 residential buildings with a total roof area of 9,000 square metres. The objective was to enhance indoor thermal comfort while reducing the community's energy consumption. The project was conducted from 2020 to 2022 in collaboration with the International Institute of Information Technology Hyderabad (IIIT-H), focusing on temperature reduction in non-air-conditioned spaces and energy reduction in air-conditioned ones.

Methodology

The study methodology involved the following.

1. Cool Roofing: China mosaic and cool roof coating, certified as a green building material by the Confederation of Indian Industry's Green Pro,[6] was applied to the rooftops of the Garden Housing Society.
2. Surface and Indoor Temperature Analysis: IIIT-Hyderabad recorded the roof surface and indoor temperatures before and after cool roof installation in apartments with identical roof areas. Multiple sensors were installed in households and embedded in the upper surface of the terraces to monitor time and seasonal temperature variations.
3. Thermal comfort surveys: The research team measured the outcomes of these interventions by giving extensive thermal comfort surveys to residents, encompassing both short- and long-term responses.
4. Urban Heat Island Assessment of Hyderabad City: Comprehensive analysis of temperature trends, extreme heat events, and future climate projections for the city were discussed at a workshop in Hyderabad.[7] Organised by AKAH in partnership with IIIT-H and the National Institute of Urban Affairs (NIUA), the workshop was attended by officials from the urban planning, energy, and biodiversity departments of the Greater Hyderabad Municipal Corporation along with stakeholders. A case study video showcased the impact of cool roofs and spread awareness about UHI issues and solutions.

Impact

The monitoring of the cool roof experiment conducted by a team of experts in building performance from the Center for IT in Building Science, IIIT, highlighted the significant outcomes, summarised in the following points.

1. Temperature Reduction: On-site measurements conducted on roof surface temperatures before and after application showed a significant temperature drop of approximately 19.8°C on the terrace surface and a peak summer temperature drop of 3.6°C in indoor air.[8] This remarkable reduction validated the effectiveness of the cool coating solution in combating excessive heat absorption and improving thermal comfort for the residents.
2. Energy Efficiency: Energy simulation studies demonstrated substantial reductions—of between 4.2 percent and 18.8 percent—in electricity consumption for air-conditioning during peak summer months. Roofing material with high Solar Reflectance Index (SRI) coatings (0.5-0.9) proved instrumental in achieving these reductions, highlighting the promise that such energy-efficient cooling solutions holds for cities.[9]
3. Thermal Comfort Enhancement: Comprehensive thermal comfort surveys revealed a marked improvement in comfort, indicating a positive impact on the residents' daily lives.
4. Urban Heat Island in Hyderabad: The city-wide assessment for Hyderabad concluded that UHI will further intensify with more frequent spells of extreme temperatures. Decadal heating trends indicated a steady increase in the city's temperature. However, an incremental increase in green cover also showed a noticeable reduction in UHI effects. The number of extreme weather events like heatwaves, droughts and floods will increase in Hyderabad and require local-level adaptation, suggesting considerable scope for such cool roofing and vegetation interventions.[10]

The pilot study concluded that the interventions lowered energy consumption and enhanced thermal comfort within the community. These findings underscore the effectiveness of the cool-roof technology in mitigating the UHI effect which, if not addressed, will only continue to rise in the future.

Learnings and the Way Forward

Implemented within a community housing on a 10-acre site, the UHI mitigation project focused on counteracting microclimatic changes using cool-roof solutions that doubled up for waterproofing. The cool roofs led to a substantial reduction in surface and indoor temperature. The project also significantly improved residents' well-being, reduced heat-related health risks, improved thermal comfort, and increased energy efficiency by creating cooler spaces.

While the COVID-19 pandemic posed challenges to direct community involvement in the study, their feedback played a critical role in the project. Engaging the community members in the process through comprehensive surveys ensured a holistic understanding of their needs and concerns around implementation and maintenance, which guided the selection of the cool-roof solution and fostered a sense of ownership while promoting the sustainability of the UHI mitigation initiative.

Integrating comprehensive solutions for UHI mitigation in cities is crucial, even from a policy perspective. This pilot project was aligned with the Cool Roof Policy of Telangana, launched in March 2023.[11] Based on the learnings from its experiment in Hyderabad, AKAH India is now looking to scale up the UHI mitigation project through a participatory action research approach of urban habitat risk resilience in Mira-Bhayandar, a peripheral municipal area north of Mumbai, to mitigate urban heat and urban floods through cool roofs, green roofs,

permeable pavers, cooling centres, urban parks, and other nature-based solutions.[12] Germany's sponge cities[a,13] are an excellent example of how to create climate-resilient cities in India as envisioned in the Climate Action Plans of several cities and achieve the net-zero targets by 2050. These efforts align with AKDN's Environment and Climate Committee's pledge to go net-zero as a global network by 2030.[14]

---

[a] These sponge cities effectively manage rainwater through green roofs as a nature-based solution over rooftops of buildings and reduce risk of flooding while enhancing the microclimate.

Sana Dharani

Lead, Habitat Improvement, Aga Khan Agency for Habitat India

Endnotes

1 United States Environmental Protection Agency, "Reduce Urban Heat Island Effect," https://www.epa.gov/green-infrastructure/reduce-urban-heat-island-effect#:~:text=%22Urban%20heat%20islands%22%20occur%20when,heat%2Drelated%20illness%20and%20mortality

2 United States Environmental Protection Agency, "Using Cool Roofs to Reduce Heat Islands," https://www.epa.gov/heatislands/using-cool-roofs-reduce-heat-islands#:~:text=Co%2DBenefits%20of%20Cool%20Roofs,-Cool%20roofs%20provide&text=Reduced%20energy%20use%3A%20A%20cool,-demand%20by%2011%E2%80%9327%25

3 United States Environmental Protection Agency, "Heat Island Compendium," Environmental Protection Agency, https://www.epa.gov/heatislands/heat-island-compendium

4 National Disaster Management Authority, Ministry of Home Affairs, Government of India, "Heatwave Action: House Owners' Guide to Alternate Roof Cooling Solutions," 2021, https://ndma.gov.in/sites/default/files/PDF/Guidelines/Cool-Roof-Handbook.pdf

5 "Understanding the Solar Reflective Index: Calculated Value," Cool Roof Rating Council, July 2022, https://coolroofs.org/documents/CRRC-SRI-Document_2022-07-12.pdf

6 CII GreenPro, "About GreenPro," https://ciigreenpro.com/about

7 ANI, "Aga Khan Agency for Habitat (AKAH) India Organises a Workshop on Climate Action Through Urban Head Island (UHI) in Partnership with IIIT Hyderabad," *The Print,* January 6, 2023, https://theprint.in/ani-press-releases/aga-khan-agency-for-habitat-akah-india-organises-a-workshop-on-climate-action-through-urban-heat-island-uhi-mitigation-in-partnership-with-iiit-hyderabad/1301780/

8 ANI, "Aga Khan Agency for Habitat (AKAH) India Organises a Workshop on Climate Action"

9 Aga Khan Agency for Habitat India, "Urban Heat Island Mitigation Project" (presented at the Workshop on UHI Studies, Hyderabad, India, January 6, 2023), https://www.akahindia.org/wp-content/uploads/2023/06/Urban-Heat-Island-Mitigation-India-.pdf

10 Aga Khan Agency for Habitat India, "Urban Heat Island Mitigation Project"

11 Municipal Administration and Urban Development Department, Government of Telangana, "Telangana Cool Roof Policy 2023-2028," March 2023, https://www.telangana.gov.in/PDFDocuments/Telangana-Cool-Roof-Policy-2023-2028.pdf

12 OSM India, "Monitoring Urban Head Island Assessment – Mira Bhayander, Mumbai," Tasking Manager, https://tasks.hotosm.org/projects/15607

13 "Germany's Sponge Cities to Tackle Heat and Flooding", OECD, https://www.oecd.org/climate-action/ipac/practices/germany-s-sponge-cities-to-tackle-heat-and-flooding-7b6caa58/

14 "Aga Khan Companies Commit to Net-Zero Emissions by 2030," *Business Daily,* December 9, 2022, https://www.businessdailyafrica.com/bd/economy/-aga-khan-companies-commit-to-net-zero-emissions--4048558

Greening Battery Charging Infrastructure in India

Damodar Pujari

India has set ambitious targets to emerge as a global leader in sustainable energy transition through steps such as the adoption of the National Action Plan on Climate Change as well as the promotion of manufacture and use of electric vehicles (EV). Indeed, India is the only G20 member[1] on-track to fulfil its Paris Agreement commitments and aims to produce 280 GW of solar energy out of the total planned 500 GW renewable energy.[2] It has also pledged to prioritise the use of EVs by ensuring sales in at least 30 percent of private cars, 70 percent of commercial vehicles, and 80 percent of two- and three-wheelers by 2030.[3] This move will significantly reduce emissions from the transport sector, which contributes to about 12 percent of all greenhouse gas (GHG) emissions and is a primary factor for deteriorating ambient air quality in the urban regions.

These bold energy transition pledges need strong policy backing as well as changes in the country's institutional architecture. Battery charging and the power grid that will charge EVs forms a critical component of the EV value chain. Conventional wisdom states that, unless the grid is decarbonised, EVs will only shift the emission footprint without reducing emissions from the transport sector. However, grid decarbonisation is a long and tedious process.

In such a scenario, there are three options to make the EV-charging process green: maximising installed green-energy generation; procuring green energy from state power distribution companies (DISCOMs) under the green tariff; or leveraging the Green Energy Open Access (GEOA) policy to enable faster and effective green transition for battery charging.

The Electricity Act 2003 defines open access as "the non-discriminatory provision for the use of transmission lines or distribution system or associated facilities with such lines or system by any licensee or consumer or a person engaged in generation in accordance with the regulations specified by the Appropriate Commission."[4] This law thus commodifies the electricity to be generated, sold, and purchased by anyone through appropriate exchange mechanisms using existing grids. The Indian Energy Exchange, established in 2008 under the purview of the Central Regulatory Commission, facilitates this transaction between power generators and purchasers. In 2021, India became the only country in the world to facilitate green day ahead market (G-DAM) transactions in the open market.[5] G-DAM allows sellers and buyers to bid on and purchase renewable energy at mutually agreeable prices and meet their renewable energy obligations as well as gain from the competitive prices.[6] This is a useful option for charging EVs on purely green energy.

However, open access and G-DAM address only part of the supply-side transformations required for green battery charging. Unless backed by appropriate policy architecture at the central and state levels, such mechanisms cannot achieve their full

potential. Policy signals from the central governments clearly indicate the intent to encourage across-the-board GEOA adoption.

In order to eliminate bottlenecks, the GEOA rules have been amended within six months of their notification (from June 2022 to January 2023).[7,8] Some of the recent changes are crucial for the EV-charging industry. For example, the minimum threshold for accessing green open energy has now been reduced from 1 MW to 100 kW,[9] which will benefit even small-scale battery swapping units that require a few hundred kilowatt-hours of electricity. These rules also empower consumers to demand green power through DISCOMs, which are mandated to honour their demands. These rules have also streamlined the process of accessing the GEOA to bring much-needed transparency to the system. Further, the rules direct state electricity regulatory commissions (ERCs) to determine and declare various surcharges, fees, and cross-subsidies that constitute the final landed cost of electricity purchased through open access.

The success of these rules depends on whether the state regulatory commissions and DISCOMs adopt a harmonious policy outlook to enforce them. In order to facilitate policy diffusion, the Ministry of Power has been reaching out to state ERCs to ensure the alignment of green energy open access policies with the central rules. The ministry is also asking stakeholders to proactively report cases in which state governments are not adopting a favourable approach towards GEOA. However, profit concerns dictate the stance of state DISCOMs and ERCs on open access (green or otherwise); every consumer that switches to open access is lost revenue for the state utility boards, which are left with few other revenue generating options. The push from the central ministry is therefore crucial.

States do not levy additional cross-subsidy surcharges on power produced through innovative mechanisms such as green hydrogen and ammonia, as well as on power generated from waste-to-energy plants.[10,11,12] In line with central regulations, most states have lowered their contract demand and sanctioned load

threshold to the minimum 100 kW for GEOA.[13,14] They also allow GEOA to consumers who have a contract demand lower than 1 MW, with a special energy meter[a] for high-tension consumers and a time of day (ToD)[b] meter for eligible low-tension consumers.

However, there are some challenges in policy diffusion and ease of accessing GEOA. For example, in its new GEOA rules, Maharashtra has increased banking charges to 8 percent from the earlier 2 percent.[15] Moreover, although renewable energy certificates are issued for banked energy that lapses at the end of the banking cycle, the banked energy is not tradable after the cycle ends. Given the dynamic demand for EV charging, the bankability of green power needs to be flexible. Ambiguity around the definition of a 'banking cycle', even in the central government's notification, will challenge long-term power evacuation planning by generators. Depending on the duration of the infrastructure use for open access, state governments categorise open access consumers differently (Table 1). The regimes of charges and fees levied on GEOA consumers vary across states.

Table 1: Differences in Classification of Open Access Consumers in Different States

Category	Duration of open access (Karnataka and Gujarat)	Duration of open access (Maharashtra)
Short term	Up to 1 year	Not more than 1 month
Medium term	1–5 years	More than 3 months but less than 5 years
Long term	More than 5 years	More than 7 years

Source: Notifications of the governments of Maharashtra and Karnataka.[16,17]

[a] Special Energy Meter (SEM) with Data Collection device (DCD) cater to the metering requirements of bulk power tariff structure, paving the way ABT (Availability Based Tariff) implementation in India. SEM/DCD was, therefore, a special metering package, aimed at fulfilling metering needs of ABT. See: https://nrldc.in/wp-content/uploads/2017/01/SEM_Hand_book.pdf

[b] Instead of a universal tariff for energy usage, the ToD meter allows power distribution companies to recover variable charges from consumers depending on the time of the day as per the demand load. Source: Ministry of Power, https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1934673

Karnataka's GEOA rules are also ambiguous because of their stance on the utilisation of banked energy during peak and non-peak hours; the rules impose banking charges (8 percent) and additional charges (2 percent) if the power banked during off-peak hours is consumed during peak hours (i.e., 6 a.m.–10 p.m. and 6 p.m.–10 p.m.). Such conditions deny the necessary flexibility for EV charging. However, there is no exemption in the GEOA frameworks of different states or the centre from banking surcharges levied on EV charging.

State utility boards cannot decarbonise the grid quickly due to the high debt burden of the boards. Thus, a meaningful transition to the green transportation sector will largely have to come from open-access modalities. The roadmap for this shift must, therefore, include the following components:

1. State GEOA rules need to be made flexible to accommodate the dynamic demand of EV battery charging.
2. State DISCOMs and ERCs should prioritise EV charging through special subsidies and by forgoing certain charges such as the standby charge.
3. Policy diffusion across the country must be made harmonious so that businesses can develop scalable EV-charging models that can be used across the country.

Damodar Pujari

Manages policies and partnerships for Yulu Bikes in Maharashtra

Endnotes

1 "India Only G20 Country That Kept its Promise it Took in Paris to Protect the Environment: PM Modi," *The Times of India,* June 23, 2023, https://timesofindia.indiatimes.com/india/india-only-g20-country-that-kept-the-promise-it-took-in-paris-to-protect-the-environment-pm-modi/articleshow/101200001.cms?from=mdr

2 Press Information Bureau, Government of India, https://pib.gov.in/FeaturesDeatils.aspx?NoteId=151141&ModuleId%20=%202

3 Irfan Khan, "Vision of Electric Vehicle Industry by 2030," *The Times of India,* October 9, 2022, https://timesofindia.indiatimes.com/blogs/voices/vision-of-electric-vehicle-industry-by-2030/

4 Ministry of Law and Justice, Government of India, *The Electricity Act 2003 (No. 36 of 2003),* https://cercind.gov.in/Act-with-amendment.pdf

5 Press Information Bureau, Government of India, https://pib.gov.in/PressReleseDetail.aspx?PRID=1785488

6 Ministry of Power, Government of India, https://pib.gov.in/PressReleseDetail.aspx?PRID=1785488

7 Ministry of Power, Government of India, https://greenopenaccess.in/assets/files/Electricity_Promoting_Renewable_Energy_Through_Green_Energy_Open_Access_Second_Amendment_Rules_2023.pdf

8 Ministry of Power, Government of India, https://greenopenaccess.in/assets/files/Electricity_Promoting_Renewable_Energy_Through_Green_Energy_Open_Access_Second_Amendment_Rules_2023.pdf

9 Press Information Bureau, Government of India, https://pib.gov.in/PressReleasePage.aspx?PRID=1923863

10 Government of Haryana, https://herc.gov.in/WriteReadData/Pdf/R20230424.pdf

11 Government of Punjab, https://pserc.gov.in/pages/Regulation%20No.%20177.pdf

12 Government of Karnataka, https://kerc.karnataka.gov.in/uploads/media_to_upload1660888724.pdf

13 Government of Maharashtra, https://merc.gov.in/wp-content/uploads/2023/11/Gazette_DOA_second-amendment-Regulations-2023.pdf

14 Government of Karnataka, https://kerc.karnataka.gov.in/uploads/media_to_upload1660888724.pdf

15 Government of Maharashtra, https://merc.gov.in/wp-content/uploads/2023/11/Gazette_DOA_second-amendment-Regulations-2023.pdf

16 Government of Maharashtra, https://merc.gov.in/wp-content/uploads/2023/11/Gazette_DOA_second-amendment-Regulations-2023.pdf

17 Government of Karnataka, https://kerc.karnataka.gov.in/uploads/media_to_upload1660888724.pdf

Mainstreaming Nature-Based Solutions to the Urban Climate Challenge

Dhaval Desai

Cities beckon for many reasons: jobs, business opportunities, infrastructure, services, amenities, and leisure. However, with ever-increasing densities and socioeconomic disparities, unplanned development, and unequal distribution of resources, urban centres—especially in the developing world—have become environmentally fragile and unable to offer significant proportions of their residents a good quality of life. In recent years, extreme weather events and natural calamities have magnified the multifarious impacts of climate change, and cities are finding themselves at the frontlines of the mitigation and adaptation battles.

Urban expansion that will spur the growth of high-density cities will need US$90 trillion by 2030 for new infrastructures alone, requiring the doubling of annual global infrastructure investments to US$6 trillion.[1] Yet, despite the enormous investment opportunities, climate risks to global infrastructure could potentially lead to a 14-percent loss in global GDP.[2] Low- and middle-income countries are exposed to half of this risk.

As the emerging economies of Asia and Africa propel the next wave of urbanisation,[3] the achievement of the UN Sustainable Development Goals[4] and the Habitat III New Urban Agenda[5] will remain pipe dreams if the cities of tomorrow are built with continued disregard for the world's natural wealth. How can energy-efficient, environment-friendly, sustainable, and resilient cities be created? How can we continue leveraging cities as engines of economic growth while reversing the environmental damage they have caused, and avoiding even further ruin? Can new urban growth safeguard people's well-being while accounting for the planet's finite natural resources?

Some of the critical answers lie in mainstreaming Nature-Based Solutions (NBS) in resilience strategies, at each stage of development.

Nature-Based Solutions for Urban Resilience

The European Commission defines NBS as unifying and cost-effective solutions "inspired and supported by nature" that "provide environmental, social and economic benefits"[6] in climate-resilient ways. They are locally adapted, resource-efficient interventions that integrate diverse natural features and aid sustainable growth. NBS thus attempts to transform the process of urban development that has hitherto relied on a model that paves urban blue-green assets to build in concrete, creating cities susceptible to climate change and environmental hazards.

NBS are gaining increasing recognition for their role in nurturing urban climate resilience. Over the past decade, multinational platforms, including the Habitat III New Urban Agenda, the Intergovernmental Panel on Climate Change, and successive editions of the Conference of the Parties (COP), have included NBS in their agendas. COP25 in Madrid adopted the NBS for Climate Manifesto,[7] and the UN Environment Programme's report[8] highlighted the viability of NBS. In May 2021, the Italian government proposed the integration of NBS in the G20's post-pandemic recovery efforts.[9] Though not explicitly mentioned, NBS also underpins most of the climate and sustainability priorities of the G20 New Delhi Leaders' Declaration of September 2023.[10]

Many cities in the developed economies have adopted NBS in their urban planning processes. The International Union for Conservation of Nature (IUCN) has initiated a €2.5-million NBS project, 'ADAPT', in the Western Balkans to build decision-making capacities among the local governments and integrate NBS into their disaster response policies.[11] The project aims to establish a regional framework with participating economies and local partners.

Cities in China,[12] Germany[13] and the United States,[14] meanwhile, have adopted the 'sponge city' concept to improve, enhance and expand their existing green spaces and replace concretised land with permeable green surfaces. These interventions use the existing natural habitat features to prevent flooding and mitigate the 'heat island' effect. In 2014, for example, China directed city governments to recycle 80 percent of rainwater runoff by 2030.[15] It awarded 600 million yuan to municipal cities, 500 million yuan to provincial capitals, and 400 million yuan to other cities across China to launch the sponge city initiatives. Concerted efforts have proven to be successful. For example, Chongqing[16] witnessed a 24 percent green transformation of its built spaces by 2020 and is on-track to add another 45 percent by 2025.[17]

NBS interventions in Malmö, Sweden, are interdisciplinary projects designed and implemented by members of various city departments, researchers, and partners from private industry, working with public entities. The projects aim to create open stormwater drains to prevent floods, with other primary goals of green-blue infrastructure, such as preserving biodiversity and promoting recreation.[18]

Brazil's Belo Horizonte and Mexico City NBS show how cities across countries can collaborate to strengthen and accelerate climate mitigation strategies. The City Tandem[19] initiative, for one, provides a platform for cities to collaborate in the promotion of capacity building and exchange of knowledge and best practices about urban forests and farming. The co-created NBS strategies aim to tackle extreme weather events, improve air quality, and protect other natural resources from the vagaries of climate change.[20]

The Scenario in India

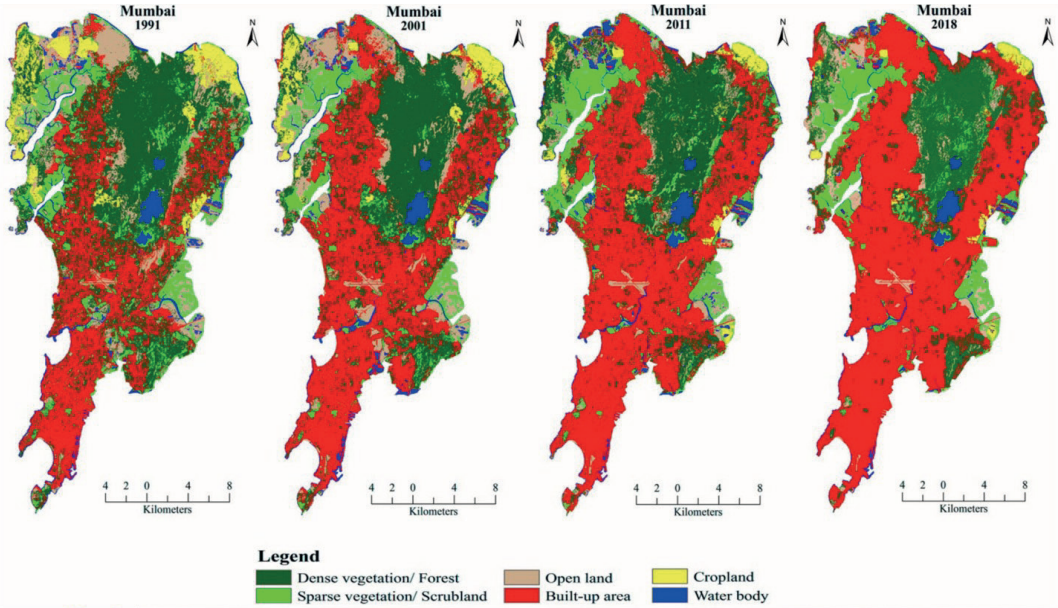
While nature-based solutions are mentioned in most city climate action plans in India and the National Institute of Urban Affairs has prepared a coalition platform to encourage NBS adoption, only a few cities have prioritised their implementation. Many ongoing interventions are of pilot scale, merely indicating their benefits if replicated at a municipal level. For example, in 2022, WRI India initiated nine NBS interventions in Jaipur in Rajasthan, including the enhancement of urban forests in the Jaipur Engineering College and Research Centre (JECRC) University campus, urban and rooftop farming practices in the Jaipur Central Jail premises, and a water body restoration project at the Rajasthan State Institute of Public Affairs.[21]

Ahmedabad, for its part, is planning to revive 19 lakes in the city using treated sewage water.[22] The project envisions a dedicated stormwater drainage network, bioremediation aeration, solid waste management, afforestation, and ecological development of the surrounding areas. It could prove to be one

of India's most significant city-wide implementations of nature-based solutions to climate challenges. Such success appears distant, however, if one were to consider the downsides of similar interventions as outlined in reports on the city's earlier lake interlinking project meant to reduce flooding. While many of these lakes did enhance city aesthetics and recreational quotient, they have remained nothing more than concretised tanks with stagnant water, catering to the real estate market and not to environmental conservation.[23]

NBS are yet to find any operational push beyond plans and policies, and the challenge for urban India is to stop and reverse the human and economic activity-induced harm to its cities. For example, the lake revival project in Ahmedabad will make little sense if the city continues to witness a rapid erosion of its green cover. According to the *Indian State of Forest Report 2021*, Ahmedabad lost nearly half its green cover from 17.96 sq km to 9.41 sq km between 2011 and 2021.[24]

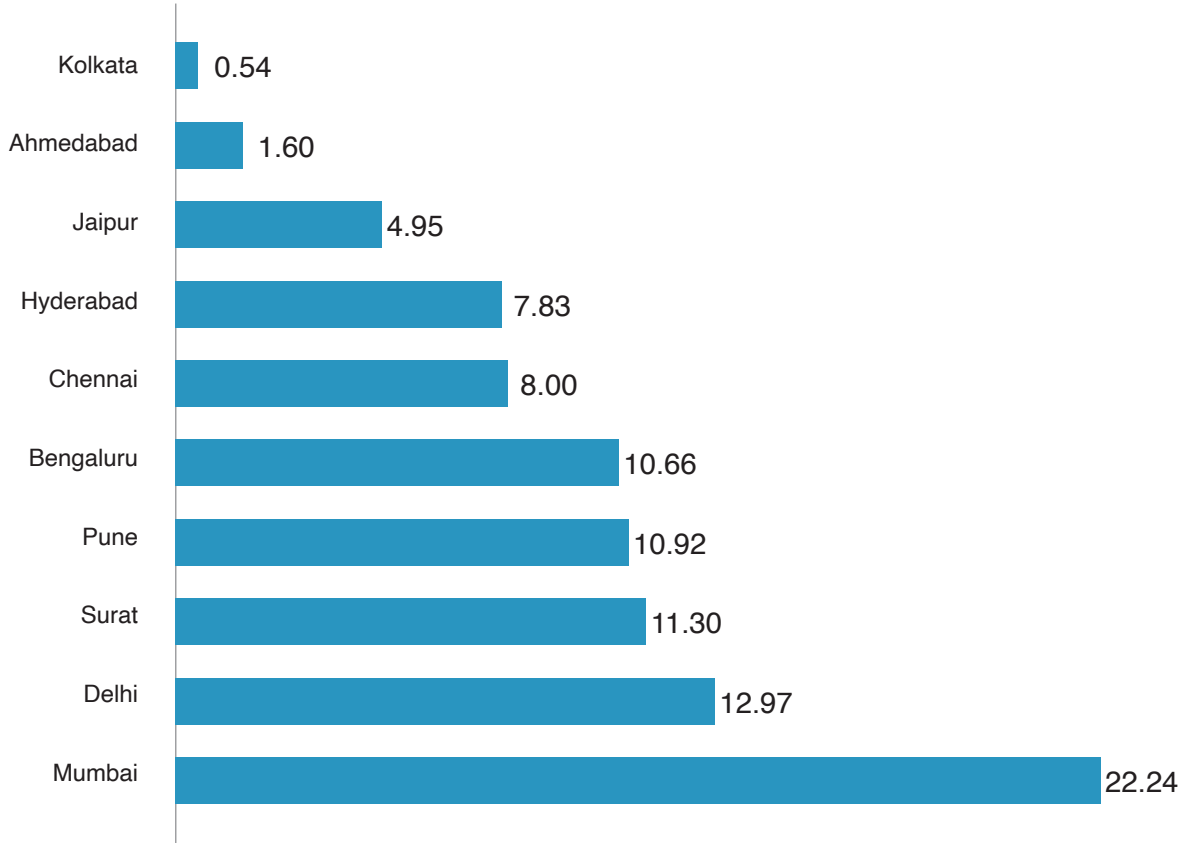
Fig. 1: 'Urban Heat Island' Dynamics and Loss of Green Cover in Mumbai



Source: Shahfahad et al.[25]

Indian cities, with an average green cover of 16.4 percent[26] of their landmass, score poorly against the 36 percent[27] average tree and green cover of the land area of European capitals. While Mumbai has the most extensive forest cover relative to its area, a study has shown that spatial green coverage decreased from 36 percent to 21.4 percent during the period 1991-2008.[28] The city's built-up area increased from 29 percent to 57.3 percent during the same period. The cities of Kolkata, Ahmedabad, Jaipur, Hyderabad and Chennai have less than 10 percent of their areas under green cover.

Fig. 2. Green Cover as Percentage of Total City Area



Source: Forest Survey of India 2021[29]

Mainstreaming NBS

Adopting NBS requires bridging knowledge gaps with in-depth and evidence-based research about how the approach can accelerate urban climate resilience at scale and encourage capacity building. The European Commission's 'Evaluating the Impact of Nature-Based Solutions' handbook, based on 12 climate threats, provides a template for other nations and regions to adopt NBS in different urban geographies by including local, city-specific knowledge.

Importantly, NBS must sync with the complexities of existing urban infrastructures to deliver results. For example, in global megacities like Shanghai, London, New York, Tokyo and London, city-wide NBS adoption will depend on how they can integrate with and work around existing infrastructures.[30]

Despite their promise, NBS will not be a panacea to all urban challenges, especially in cities of the Global South. However, they offer enormous advantages that can help achieve the SDGs and the New Urban Agenda. Cities in India, particularly, will have to approach NBS as a collaborative toolkit for urban climate adaptation and resilience.

Dhaval Desai

Senior Fellow and Vice President, Observer Research Foundation, Mumbai

Endnotes

1 Inter-American Development Bank, *Crossing the Bridge to Sustainable Infrastructure Investing*, 2017, Washington DC, Inter-American Development Bank, 2017, https://www.un.org/pga/71/wp-content/uploads/sites/40/2017/06/IADB-and-Mercer-Crossing-the-Bridge-to-Sustainable-Infrastructure-Investing-Exploring-Ways-to-Make-it-Across.pdf

2 Coalition for Disaster Resilient Infrastructure, *Global Infrastructure Resilience: Capturing the Resilience Dividend*, 2023, New Delhi, Coalition for Disaster Resilient Infrastructure, 2023 https://cdri.world/upload/biennial/CDRI_Global_Infrastructure_Resilience_Report.pdf

3 "Africa and Asia to Lead Urban Population Growth in Next 40 Years – UN Report," *UN News*, April 5, 2012, https://news.un.org/en/story/2012/04/408132

4 Department of Economic and Social Affairs, United Nations, "The 17 Goals," https://sdgs.un.org/goals

5 UNDP, The New Urban Agenda (adopted at the United Nations Conference on Housing and Sustainable Urban Development (Habitat III), Quito, Ecuador, October 20, 2016), https://habitat3.org/wp-content/uploads/NUA-English.pdf

6 European Commission, Research and Innovation, "Nature-Based Solutions," https://research-and-innovation.ec.europa.eu/research-area/environment/nature-based-solutions_en

7 Sandeep Sengupta, "The Role of Nature-Based Solutions in Addressing Climate Change" (presentation, International Union for Conservation of Nature), https://www.riob.org/sites/default/files/SENGUPTA.pdf

8 United Nations Environment Programme, *Nature-Based Solutions for Climate Mitigation*, Nairobi, 2021, https://wedocs.unep.org/xmlui/bitstream/handle/20.500.11822/37318/NBSCCM.pdf

9 Niki Frantzeskaki and Timon McPhearson, "Mainstream Nature-Based Solutions for Urban Climate Resilience," BioScience 72, no. 2 (February 2022): 113–15, https://doi.org/10.1093/biosci/biab105

10 "G20 New Delhi Leaders' Declaration," G20, September 9-10, 2023, https://www.g20.org/content/dam/gtwenty/gtwenty_new/document/G20-New-Delhi-Leaders-Declaration.pdf

11 International Union for Conservation of Nature, "ADAPT: Nature-Based Solutions in the Western Balkans," https://www.iucn.org/our-work/region/eastern-europe-and-central-asia/our-work/adapt-nature-based-solutions-western

12 Robert C. Thornett, "Becoming a 'Sponge City' at Shenzhen Speed," *The Diplomat*, January 27, 2023, https://thediplomat.com/2023/01/becoming-a-sponge-city-at-shenzhen-speed/

13 OECD, "German Sponge Cities to Tackle Heat and Flooding," November 7, 2022, https://www.oecd.org/climate-action/ipac/practices/germany-s-sponge-cities-to-tackle-heat-and-flooding-7b6caa58/

14 Seattle Public Utilities, "South Thornton Natural Drainage System (NDS) Project," https://www.seattle.gov/utilities/neighborhood-projects/south-thornton-natural-drainage-system

15 Emily Wang Fujiyama, "As Climate Warms, a China Planner Advocates "Sponge Cities"," *AP*, November 15, 2022, https://apnews.com/article/floods-entertainment-asia-beijing-climate-and-environment-54f2b3282cad5ce8f165914f38023bdb

16 SUEZ Group, "Design New Urban Models Like Sponge City Like in Chongqing, China – SUEZ," YouTube video, 2:39 min, October 16, 2018, https://www.youtube.com/watch?v=x_jditnDVwQ

17 Leah Hamilton, "Urbanism 101: What is a Sponge City?", *The Urbanist*, February 8, 2023, https://www.theurbanist.org/2023/02/08/urbanism-101-what-is-a-sponge-city/

18 Melissa Alane Batron, "Nature-Based Solutions in Urban Contexts: A Case Study of Malmö, Sweden," (Master's diss., Lund University – University of Manchester, 2016), https://lup.lub.lu.se/luur/download?func=downloadFile&recordOId=8890909&fileOId=8890910

19 Clearing House, "Call for City Tandem," https://www.metropolis.org/sites/default/files/call-city-tandem.pdf

20 "Belo Horizonte, Bogota and Mexico City Go for Nature-Based Solutions," *Metropolis*, September 27, 2022, https://www.metropolis.org/news/belo-horizonte-bogota-and-mexico-city-go-nature-based-solutions

21 Himanshi Kapoor and Siddharth Thyagarajan, "Pink City to Green City: Building Jaipur's Climate Resilience Through Nature-Based Solutions," WRI India, August 31, 2023, https://wri-india.org/blog/pink-city-green-city-building-jaipurs-climate-resilience-through-nature-based-solutions

22 Jignesh Parmar, "Civic Body to Revive 19 Lakes Using Sewage Treated to Tertiary Level," *The Times of India*, August 18, 2023, https://timesofindia.indiatimes.com/city/ahmedabad/civic-body-to-revive-19-lakes-using-sewage-treated-to-tertiary-level/articleshow/102817605.cms

23 Darshan Desai, "From 630 to 122: Where did Ahmedabad's Lakes Disappear?" *Citizen Matters*, October 19, 2020, https://citizenmatters.in/ahmedabad-vanishing-water-bodies-21853

24 Ministry of Environment and Climate Change, Government of India, *India State of Forest Report 2021*, Ministry of Health, 2023, https://fsi.nic.in/isfr-2021/chapter-13.pdf

25 Shahfahad et al., "Urban Heat Island Dynamics in Response to Land-Use/Land-Cover Change in the Coastal City of Mumbai," *Journal of the Indian Society of Remote Sensing* 49 (2021), https://link.springer.com/article/10.1007/s12524-021-01394-7

26 Arefa Johri, "Why the Reported Increase in Forest Cover Should Be a Cause of Worry," *Scroll.in*, July 10, 2014, https://scroll.in/article/669850/why-the-reported-increase-in-forest-cover-should-be-a-cause-for-worry

27 European Environmental Agency, "Percentage of Total Green Infrastructure, Urban Green Space and Urban Tree Cover in the Area of EEA-38 Capital Cities (Excluding Leichtenstein)," January 13, 2022, https://www.eea.europa.eu/data-and-maps/daviz/percentage-of-total-green-infrastructure#tab-googlechartid_chart_11

28 Shahfahad et al., "Urban Heat Island Dynamics in Response to Land-Use/Land-Cover Change in the Coastal City of Mumbai"

29 "India State of Forest Report 2021"

30 Niki Frantzeskaki et al., "Nature-Based Solutions for Urban Climate Change Adaptation: Linking Science, Policy, and Practice Communities for Evidence-Based Decision-Making," *BioScience* 69, no. 6 (June 2019): 455–66, https://doi.org/10.1093/biosci/biz042

OBSERVER RESEARCH FOUNDATION

Ideas • Forums • Leadership • Impact

20, Rouse Avenue Institutional Area
New Delhi - 110 002, INDIA
+91-11-35332000 Fax: +91-11-35332005
contactus@orfonline.org
www.orfonline.org