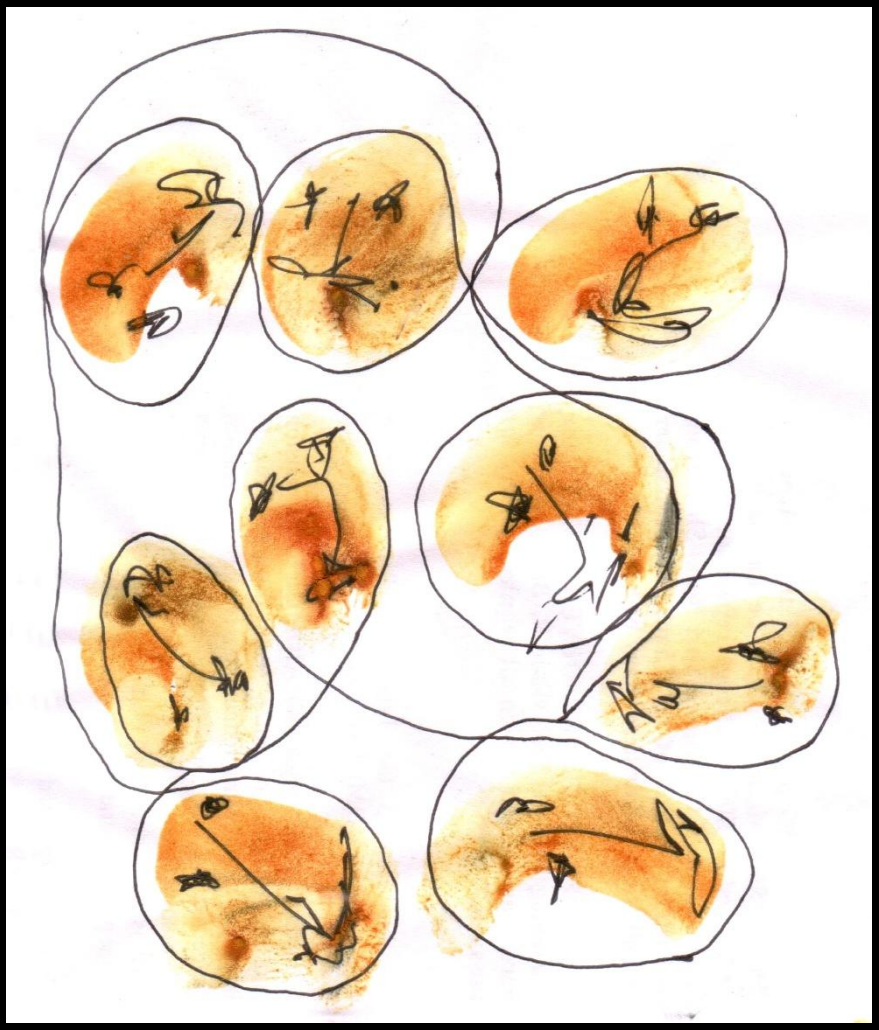
# Nature-Based Cooling Solutions for Cities

**Co-editors: Dr. Prajna Paramita Panda and Mihir R. Bhatt**



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# INTRODUCTION

*By **Dr. Prajna Paramita Panda**, Program Manager & Member, IUCN SSC AsESG, India; and **Mihir R. Bhatt**, All India Disaster Mitigation Institute (AIDMI), India*

*"Heatwaves are no longer occasional disruptions to our lives – they are recurring crises that threaten our lives, damage income, deplete natural resources, strain infrastructure, and weaken our local economies," suggests a small fruit business owner in the city of Cochin, Kerala, India.*

Cities across the world are warming at alarming rates. In South Asia, where rapid urbanisation collides with climate extremes, the stakes are particularly high. Heatwaves are no longer occasional disruptions; they have become recurring crises - threatening lives, straining infrastructure, and undermining local economies. The urban poor, informal workers, women, children, and the elderly bear the greatest burden of this warming, as they live and work in heat-stressed environments with little protection.

Nature has already given us an early warning a century ago. We are noticing this warning only now in the past few decades.

In this context, **Nature-Based Solutions (NbS)** offer a powerful, cost-effective, and sustainable pathway to building urban resilience. From tree-lined streets and shaded vending zones to restored wetlands and rooftop gardens, NbS can cool microclimates, reduce pollution, recharge groundwater, and foster biodiversity—while also enhancing livelihoods, public health, and social well-being.

*"NbS must be more than green ornamentation to city – they must be embedded into city planning, budgets, and regulations, and designed with equity at the centre to restore nature in cities," found AIDMI team member Vishal Pathak working in 11 cities of India.*

The **All India Disaster Mitigation Institute (AIDMI)** has worked for over three decades to integrate people and planet into disaster and climate resilience. Our experience shows that NbS must go beyond green ornamentation. They need to be embedded in urban planning, budgeting, and regulations, and designed with equity at their core. NbS, when combined with anticipatory action, micro-insurance, and inclusive recovery, can transform urban resilience from reactive relief into proactive regeneration.

This special issue of *Southasiadisasters.net* brings together a rich set of perspectives as an input to the IUCN World Conservation Congress 2025 at Abu Dhabi, UAE, October 9-15, 2025:

- From **India**, heritage-based architecture, bamboo plantations, and community-led NbS pilots show how traditional wisdom blends with modern needs.
- From **Nepal**, studies in Kathmandu Valley and Nepalgunj show how forests, ponds, and *kaushi kheti* (rooftop farming), along with climate-sensitive architecture and community forests, are cooling cities.
- From **Jordan**, dryland restoration principles illustrate pathways for arid cities to adapt.
- From **Bangladesh**, municipal-level studies highlight the cooling potential of wetlands and vegetation.
- From **Africa**, youth-led NbS initiatives demonstrate how the next generation is shaping greener, cooler cities.
- From **regional platforms like BIMSTEC**, collective agendas are proposed for tackling urban heat through cooperative governance.

*"Cooling our cities requires more than technology or finance – it requires trust in nature and in communities, and the courage to embed both in day-to-day local governance," emphasised the leading Municipal Corporation Official of Ahmedabad, Gujarat, India.*

Together, these contributions highlight a crucial message: **cooling our cities demands more than technology or funding—it calls for trust in both nature and communities, and the courage to embed these into how cities serve nature.** ■

**Co-editors: Dr. Prajna Paramita Panda,** Programme Manager at the IUCN SSC Asian Elephant Specialist Group (AsESG), India, works extensively on integrating ecological knowledge with inclusive climate action.

**Mihir R. Bhatt** of AIDMI is a leading practitioner and thinker in disaster risk reduction and humanitarian action. He has pioneered community micro-insurance, anticipatory action for extreme heat, and locally-led NbS pilots across South Asia.

# Reducing the People–Planet Distance: AIDMI's Path with Nature-Based Solutions

*By **Mihir R. Bhatt,** All India Disaster Mitigation Institute (AIDMI), India*

The All India Disaster Mitigation Institute (AIDMI) was born in 1989 in Ahmedabad as a grassroots response to the devastating 1987–89 droughts and recurring disasters such as cyclones and earthquakes. From the outset, it placed people and nature at the centre of its work, recognising that overuse of land and water had worsened vulnerabilities. Over three decades later, AIDMI has evolved into an autonomous action research organisation dedicated to reducing disaster risks and promoting inclusive, sustainable, and nature-positive recovery.

## AIDMI's Purpose and Approach

AIDMI works through six interconnected pillars: awareness, capacity building, policy advocacy, implementation, research and publication, and networking. Its central purpose is to make communities safer and more resilient, particularly those on the margins—street vendors, small farmers, women-led small businesses, informal workers, and children. At the heart of this mission lies an effort to erase the artificial divide between people and planet, embedding ecosystems into disaster risk reduction and recovery.

## Distinctive Contributions

What makes AIDMI unique is its seamless, community-driven approach that combines local awareness with global frameworks. Its pioneering work on disaster micro-insurance *(Afat Vimo)*, pilots on anticipatory action for extreme heat, and inclusive climate action are grounded in participation and evidence. AIDMI is among the first organisations in South Asia to operationalise loss and damage funding for extreme heat at the local level, making adaptation both practical and inclusive.

## People and Nature as Partners

For AIDMI, both people and nature are not just beneficiaries but also engines of resilience. Its initiatives support migrants, casual labourers, women entrepreneurs, female farmers, and children through livelihood recovery, community-led resilience tools, and micro-insurance. By integrating human security with environmental regeneration, AIDMI demonstrates that resilience is strongest when people and ecosystems are protected together.

## Pressing Challenges

India and South Asia face pressing challenges at the intersection of climate extremes and disasters. Heatwaves, droughts, floods, and cyclones now threaten both urban ecosystems and vulnerable livelihoods. The biggest gap remains inclusive financing for recovery—especially for nature-positive actions that conserve water, land, and vegetation. Without bridging this gap, resilience will remain uneven and temporary.

## Current Projects

Since 2014, when it contributed as a coordinating lead author to the IPCC's Managing the Risks of Extreme Events and Disasters report, AIDMI has expanded its focus on extreme heat. Current initiatives include developing tools for heat adaptation, piloting nature-based cooling strategies in cities, and supporting small businesses and farmers exposed to heat stress. It also convenes community forums on humanitarian justice across South Asia and facilitates exploratory roundtables on climate preparedness that integrate water, air, and land conservation.

## Partnerships with IUCN

AIDMI draws heavily on IUCN's frameworks and knowledge products, especially ecosystem-based disaster risk reduction (Eco-DRR) and NbS guidance. With IUCN India, AIDMI is now preparing to launch the country's first-ever nature-based urban heat solutions. This collaboration allows AIDMI to connect local action with global expertise, enhancing its ability to shape inclusive and sustainable resilience strategies.

## Looking Ahead

AIDMI hopes to see a future where each disaster restores more than it destroys—for people and for the planet. It aims to scale anticipatory and NbS-based DRR, expand disaster micro-insurance, deepen nature-positive resilience initiatives, and advance climate justice funding for vulnerable communities.

In short, AIDMI's journey is about reducing the distance between people and the planet. Its work shows that recovery can be regenerative, creating a South Asia where communities not only survive disasters but also emerge stronger and more sustainable. ■

YOUTH-LED RESILIENCE

# Youth Engagement and Nature-based Cooling Solutions: A Global Imperative for Climate Resilience

*By **Tony Nello**, Senior Programme Coordinator – Urban, IUCN, Costa Rica, USA*

As cities around the world grapple with rising temperatures and intensifying heatwaves, Nature-based Solutions (NbS) offer a powerful, cost-effective, and sustainable pathway to urban cooling. From tree-lined streets to rooftop gardens, NbS not only mitigate the urban heat island effect but also enhance biodiversity, public health, and social cohesion. Central to scaling these solutions is the active engagement of youth—who are increasingly leading the charge in transforming urban landscapes.

Scientific evidence underscores the cooling power of trees. Studies show that urban areas with dense tree cover can be up to 12–18°F (6.5–10°C) cooler than adjacent neighbourhoods with little vegetation (Hoffman et al., 2020). Trees cool cities through shading and evapotranspiration, reducing both surface and air temperatures. Yin et al. (2024) highlighted that canopy cooling benefits are most pronounced in densely built environments with high solar exposure, and that smaller trees in open public spaces can outperform artificial shade structures. In the contiguous United States, shade trees have been shown to lower near-surface air temperatures by an average of 3.06°C (Wang et al., 2018). However, their effectiveness can vary with species, canopy density, and climate conditions, especially during extreme heat events (Gao et al., 2024).

Youth play a pivotal role in protecting and enhancing these natural cooling assets. Across the globe, young people are organising tree-planting campaigns, managing urban gardens, and advocating for green infrastructure in city planning. Initiatives like Youth4Nature, Global Youth Biodiversity Network, and local programs in cities such as Detroit, Singapore, and Madrid demonstrate how youth-led action can reshape urban ecosystems.

Urban gardens, often spearheaded by youth groups, serve dual purposes: they cool the environment and improve food security. A systematic review found that community gardens enhance urban resilience, reduce food deserts, and foster environmental stewardship (Huq and Deacon, 2025). These gardens also promote healthier diets and reduce carbon footprints by encouraging local food production.

Moreover, youth are increasingly involved in urban tree stewardship—mapping tree cover, monitoring tree health, and participating in municipal greening programs. Their involvement ensures long-term care and community ownership of green spaces. In cities like Guangzhou and Baltimore, youth have contributed to NbS pilot projects that integrate ecological corridors and ventilation pathways into urban planning (World Bank, 2022).

To maximise impact, it is essential to:

- **Integrate youth into urban planning processes,** ensuring their voices shape NbS strategies.
- **Invest in education and capacity-building,** equipping young people with ecological knowledge and leadership skills.
- **Support youth-led NbS projects** through funding, mentorship, and innovation platforms.
- **Promote inclusive governance,** where youth collaborate with local authorities, civil society, and academia.

In conclusion, youth engagement is not a peripheral element—it is central to the success of NbS for urban cooling. By empowering young people to steward urban nature, we not only cool our cities but also cultivate a generation of climate leaders. Governments, civil society, and the private sector must recognise youth as strategic partners in the climate fight—and invest in nature as our most effective ally against the heat.

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LESSONS FOR URBAN HEAT

# Applying Dryland Restoration Principles to Nature-Based Cooling in Cities – A Jordanian Perspective

*By **Khaled Marafi**, Ecosystem Management Expert, Candidate - Jordan IUCN Regional Council, West Asia*

Cities across the world, including those in Jordan, are increasingly facing the challenges of **heatwaves** and the **urban heat island effect** as a result of climate change. With limited water resources and growing population density, the search for innovative and sustainable solutions for urban cooling has become an urgent priority. In this regard, **nature-based solutions** inspired by Jordan's experience in dryland restoration offer a valuable pathway forward.

Jordan is characterised by an arid and semi-arid climate and has, over the decades, developed extensive expertise in **ecosystem restoration** and **sustainable land and water management**. Programs such as afforestation with drought-resilient native species, rainwater harvesting in drylands, and the rehabilitation of degraded rangelands have provided practical lessons that can be applied to urban environments.

Key lessons from these experiences include:

1. **Planting native species**: Expanding green cover in Jordanian cities through the use of native, drought-tolerant trees and shrubs—such as acacia, sidr, and other desert-adapted species—can reduce water consumption while providing shade and cooling effects.

2. **Green infrastructure**: Rooftop gardens and vertical green walls can serve as natural insulation, reducing reliance on energy-intensive cooling systems.

3. **Sustainable water management**: Rainwater harvesting and redirection of runoff to nourish urban greenery can transform wasted water into a valuable cooling resource.

4. **Community engagement**: Just as Jordan's dryland restoration efforts have succeeded through local participation, urban cooling solutions must also be rooted in community ownership and stewardship to ensure long-term sustainability.

These principles go beyond environmental benefits; they represent investments in **public health, economic efficiency, and social well-being**. Cities that rely on nature-based cooling reduce energy consumption, cut carbon emissions, and provide healthier living conditions for their residents, particularly vulnerable groups such as children and the elderly.

Moreover, these approaches align with Jordan's international commitments under the **Paris Agreement on Climate Change** and the **2030 Agenda for Sustainable Development**, while supporting national adaptation priorities.

By linking **dryland restoration principles** with **urban cooling strategies**, Jordan has the opportunity to serve as a **regional and global model** for climate adaptation in arid and semi-arid regions. Such approaches not only address immediate urban heat challenges but also inspire transformative solutions for resilient and sustainable cities worldwide. ■

# Heritage as Heat Shield: Reviving Traditional Wisdom for Urban Cooling in India

*By **Manu Bhatnagar**, Principal Director, Natural Heritage Division, INTACH, New Delhi, India*

As Indian cities grapple with intensifying heatwaves due to climate change and rapid urbanisation, the urgency for sustainable, scalable, and context-specific cooling solutions has never been greater. While modern technology offers some respite, nature-based solutions (NBS) — particularly those rooted in India's architectural heritage — present a time-tested, climate-responsive approach to urban cooling. These traditional practices, honed over centuries, seamlessly integrate local materials, passive design strategies, and ecological principles, making them both environmentally and culturally sustainable.

*Figure 1. Chandeva ki Bawadi in Datia, built by Raja Veer Singh Judev I, is one of many traditional stepwells in the region designed to combat water scarcity and summer heat.*

Historically, Indian architecture was designed in harmony with the climate. Structures in Rajasthan, for instance, employed thick sandstone walls, jaalis (perforated screens), and courtyards to reduce heat gain and enhance ventilation. Stepwells, or *baolis*, served not just as water reservoirs but also as subterranean retreats where communities gathered to escape the scorching sun. Elsewhere, rooms had high roofs permitting hot air to rise and escape through vents. In Kerala, sloped roofs, verandahs, and wooden lattices allowed for natural airflow and shade, maintaining thermal comfort even in humid conditions. Colonial bungalows were shielded with deep verandahs, with white painted walls to reflect the heat.

These vernacular practices embody core NBS principles — using natural systems and local knowledge to enhance resilience. Urban planners and architects today can draw from this repository to combat rising urban heat. For example, incorporating elements like shaded courtyards, green roofs, and breathable facades in modern buildings echoes the traditional emphasis on passive cooling. Similarly, restoring and integrating urban wetlands, stepwells, and tree-lined avenues into cityscapes can moderate temperatures while enhancing biodiversity and community well-being.

Several Indian cities are already turning to heritage for answers. Ahmedabad's Heat Action Plan, the first of its kind in South Asia, includes cool roofing programs that promote white- painted roofs — a contemporary nod to the reflective surfaces seen in traditional desert homes. In Hyderabad, efforts are underway to restore *baolis*, recognising their dual role in water management and microclimate regulation. In Delhi, the revival of Mughal-era gardens such as Sunder Nursery shows how green heritage can act as an urban lung and a cooling refuge.

Heritage cities were pedestrian-oriented with shaded, narrow streets where the sun could not penetrate.

However, mainstreaming heritage-based NbS requires more than nostalgia. It demands interdisciplinary collaboration, policy support, and community engagement. Local governments must invest in mapping and preserving traditional assets,

integrating them into heat action plans and urban development guidelines. Equally important is empowering artisans, architects, and cultural custodians who hold indigenous knowledge — turning them into active agents of climate resilience.

In an era where air conditioning dominates the urban cooling discourse — often at the cost of increased emissions and energy inequity — India's heritage offers an alternative: one that is low-cost, inclusive, and ecologically aligned. Reviving traditional wisdom is not about reverting to the past, but reimagining its principles in alignment with new technologies for the future.

By treating heritage as a living resource rather than a relic, India can harness its cultural ingenuity to craft cities that are cooler, greener, and more resilient — proving that sometimes, the best innovations are the ones our ancestors already mastered. ■

*Figure 2: Delhi's Sundar Nursery blends Mughal-era leisure with natural cooling through thoughtful landscape design.*

RESILIENCE THROUGH NATURE

# Urban Growth and the Role of Nature-based Solutions in Shaping a Climate-Resilient Nagpur

*By **Prajakta Pimpalshende**, and **Shalini Dhyani**, CSIR-National Environmental Engineering Research Institute (NEERI), Maharashtra; Academy of Scientific and Innovative Research (AcSIR), Uttar Pradesh, India*

Urbanisation in Indian cities is accelerating rapidly, often at the cost of environmental sustainability and public well-being. The city of Nagpur is an example of this urban transformation. The city's ongoing expansion poses significant threats to its natural ecosystems, giving rise to challenges such as Urban Heat Islands (UHI), flash floods, and the degradation of urban Blue-Green Infrastructure (BGI) (Dhyani et al., 2018). The unregulated development of Nagpur's peripheral zones has led to the encroachment upon natural buffers, critical green spaces, and wetlands (Dhyani et al., 2018). This, combined with the unplanned cutting of trees for infrastructure projects such as road widening or utility installation, has intensified the UHI effect, especially during the city's already harsh summers (Dhyani et al., 2018). Despite these challenges, existing urban forest patches, such as those within the NEERI and VNIT campuses, have consistently recorded temperatures nearly 3°C lower than surrounding built-up areas, highlighting their importance in microclimate regulation and contributing to carbon sequestration (Dhyani et al., 2018, 2021). In light of these findings, Nature-based Solutions (NbS), particularly BGI, are increasingly recognised as essential strategies for climate adaptation in cities (Dhyani et al., 2021; Shukla, Pophali, et al., 2024).

Wetlands play a significant yet often overlooked role in urban ecology. Shukla, Pophali, et al., (2024) reported a drastic decline in the structure and function of several wetlands in Nagpur over the last two decades. These ecosystems serve as natural flood buffers and contribute to the regulation of ambient temperature. Their loss highlights the city's vulnerability to flash floods, particularly during extreme

rainfall events. A blue-green buffer strategy that incorporates community knowledge and restoration efforts has been recommended to improve wetland resilience and connectivity (Dhyani et al., 2020, 2022). Although there has been a policy shift toward incorporating NbS into urban design, actual implementation remains inconsistent. NbS, such as green roofs, vertical gardens, and conserved urban forests, have proven benefits, from reducing heat to boosting biodiversity and improving public health (Dhyani et al., 2022). However, these strategies require contextual adaptation and integrated planning, especially in densely populated cities like Nagpur.

Despite the existence of national guidelines, such as the URDPFI recommendations, which suggest 10-12 m² of green space per capita, the actual availability in Nagpur falls far below these standards (Shukla, Dhyani, et al., 2024). The west zone performs relatively better, owing to institutional green campuses, but disparities across urban zones persist. These inequities exacerbate environmental stress for communities in less vegetated zones. A recent study by Lahoti et al., (2025) tested the applicability of the "3-30-300 rule" in Nagpur, which advocates for visible tree cover, a neighbourhood canopy, and accessible green spaces. The results revealed that most of Nagpur's population fails to meet these thresholds. The Urban Greenness Exposure Index (UGEI), introduced in the same study, aims to measure intra-city variations in green exposure and guide targeted interventions, such as tree planting and green corridors.

Despite the efforts of the Nagpur Municipal Corporation, gaps persist in the planning, enforcement, and data availability related to green infrastructure (Dhyani et al., 2021; Shukla, Dhyani, et al., 2024). To build a climate-resilient Nagpur, it is crucial to expand the green cover, rehabilitate wetlands, and enforce ecological buffers. Tools such as the UGEI and adaptations of the 3-30-300 rule provide practical frameworks for equitable green development. As demonstrated in Nagpur, integrating NbS into urban planning is no longer optional; it is essential for a sustainable urban future.


## Acknowledgements

The authors thank Shruti Lahoti, Jayshree Shukla, Manu Thomas, Anuj Kumar Tripathi, Saranya Swaminathan, Rupali Nayal, and Radhika Sood for their extensive research and valuable contributions to urban ecology, climate resilience, and social inequalities in Nagpur. Their work has helped identify key challenges and informed effective mitigation strategies for building resilience in the urban area of Nagpur.


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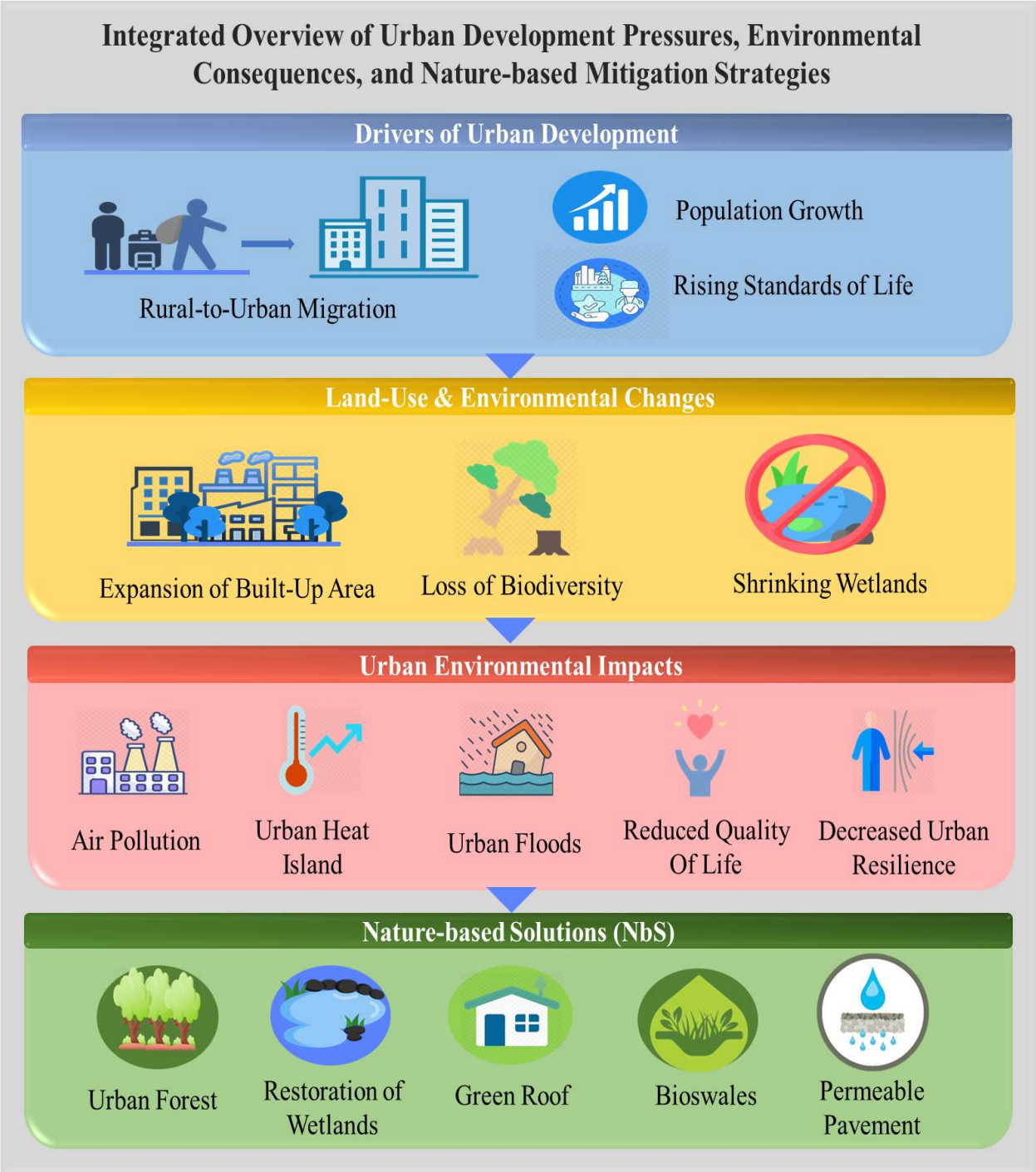

# Nature-Based Cooling as a Strategy for Heat Adaptation

By **Nupur Khanter,** *Research Associate, Transitions Research, India*

Extreme heat has become a regular feature of life in cities. Natural systems that once provided shade, moisture, and airflow have been replaced by concrete and asphalt. These materials trap heat and drive the urban heat island effect, especially in dense, poorly ventilated areas. Shrinking green spaces and water bodies further weaken a city's ability to stay cool. Without vegetation and porous surfaces, cities lose vital cooling processes like evapotranspiration and shading — both essential in tropical regions. In this context, nature-based cooling is emerging as a key strategy for heat adaptation, using ecological systems to reduce heat and improve liveability.

## Designing Nature-Based Cooling Solutions

Nature-based solutions (NbS) restore and integrate natural ecosystems into cities to address climate risks. Features such as tree-lined streets, restored wetlands, urban forests, canals with native vegetation, shaded schoolyards, and green roofs help lower local temperatures and improve comfort.

Nature-based cooling goes beyond simply planting trees. It reconnects people and cities to the ecological systems that sustain safety and resilience. Success depends on understanding local landscapes, selecting native species, and planning green cover carefully. Involving communities in design and care strengthens outcomes and keeps these spaces thriving. NbS work at a systems level: they reduce extreme heat, support water resilience, create public spaces and contribute to a city's economic vitality.

## Making Nature-Based Cooling Equitable

Nature-based cooling is closely tied to health and social equity. Urban green areas tend to be cooler than urban non-green areas[1]. Nature-based interventions can reduce exposure to pollution and heat while supporting mental health and well-being through physical activity and access to nature[2].

This is not just a climate issue, but a social one. Nature-based cooling must benefit everyone, but access is still unequal. Global South cities have only ~70% of the cooling capacity of cities in the Global North, because of differences in the amount and quality of green space[3]. Inequalities exist within cities too, as low-income and marginalised neighbourhoods often have less tree cover and fewer public green areas. To address this, nature-based solutions must prioritise these communities and guard against displacement and gentrification. Equity safeguards help ensure green spaces serve those who need them most.

*Urban trees and shaded streets reduce heat stress and create walkable, liveable neighbourhoods. Image Credit: Unsplash.*

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### Insights from Kolhapur and Panaji

Through Transitions Research's work in Kolhapur and Panaji, we explored how nature-based cooling can strengthen heat adaptation. In Kolhapur, we examined the decline of gardens and *nalas*. Interventions included blue-green filtering landscapes, native plantings, and structured festival spaces to address pollution, flooding, and heat while fostering community ties and culture. In Panaji, the loss of tree cover and natural cooling due to expanding infrastructure was a key issue. Strategies such as greening school campuses, creating biodiversity trails, and planting native species along pavements and medians can help address this issue.

Nature-based cooling is a practical, people-centred strategy for adapting to heat. It requires good design, local knowledge, and strong institutions. Our work in Kolhapur and Panaji shows how cities can restore natural assets as everyday climate infrastructure. With rising temperatures, this is no longer optional — it is essential to build safe, inclusive, and future-ready cities. ■

ADAPTING TO NATURE

# NbS and Urban Heat Adaptation in Bangladesh: A Comparative Scenario of Satkhira and Bagerhat Municipalities

*By **Muhammad Abdur Rahaman,** Director, Center for People and Environ, Dhaka, Bangladesh*

Bangladesh, which ranks among the most populous nations in the world, has experienced rapid population growth over the past century, though it has recently moderated somewhat (UNFPA, 2015). The country is going to witness a rapid spread of urbanisation over the next decade. According to an estimate, by 2050, nearly every other man, woman, and child will live in an urban area (World Bank 2020). Along with the population, the urban climate is also rapidly changing in Bangladesh.

Urbanisation in Bangladesh also led to environmental degradation, including air and water pollution, deforestation, and loss of green spaces. An increasing frequency of extreme weather events is one of the most concerning effects of climate change on urban systems. Urban life is at risk due to an increase in the frequency and severity of heat waves (Revi et al., 2014). Heatwaves can cause an increase in heat stress and mortality, especially in susceptible groups, including the elderly and people with underlying medical issues (Forster et al., 2013). Furthermore, the urban heat island effect is intensified by climate change, leading to higher temperatures in urban areas compared to their rural surroundings, which negatively affects public health (Ahmed et al., 2020).

Nature-based solutions (NbS) for cooling cities in Bangladesh involve using natural systems to mitigate the urban heat island effect and improve urban livability. These solutions include increasing green spaces, such as parks and urban forests, and blue spaces like wetlands and water bodies. Implementing these solutions can significantly reduce temperatures, improve air quality, and enhance the overall well-being of city residents. The study was conducted to find the correlation between the existence of two prominent NbS (vegetation coverage and waterbodies) and the heat island effect, as well as NbS as heat adaptation measures in Bagerhat and Satkhira Municipalities of Bangladesh.

Both municipalities have a diverse landscape with various land cover and land use, including vegetation coverage and waterbodies. In Satkhira municipality, vegetation coverage has approximately 1412.29 hectares, comprising lush greenery and indigenous flora, highlighting the region's ecological richness. Open spaces, totalling 33.59 hectares, provide recreational areas and potential sites for future development within the urban landscape. Agricultural land spans 1297.70 hectares, emphasising the area's reliance on farming for sustenance and economic activity. Water bodies covering 240.73 hectares sustain local ecosystems and livelihoods, while lowlands, spanning 16.73 hectares, contribute to the region's hydrological dynamics (Map 1).

The land use and land cover of Bagerhat Municipality are delineated into various categories. The largest portion of land, encompassing 433.66 hectares, is designated as vegetation, indicating areas primarily covered by natural flora and vegetation. Open space contributes 7.44 hectares,

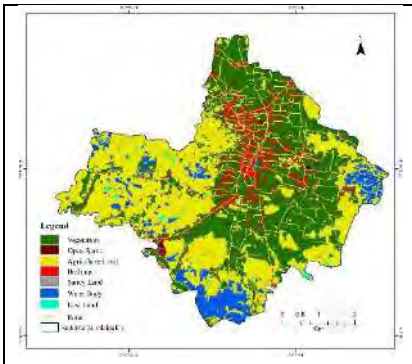
indicating areas with minimal development. Agricultural land covers 53.98 hectares, reflecting areas utilised for farming activities such as the cultivation of crops and livestock. Water bodies, covering 16.27 hectares, include canals, ponds, rivers, and other bodies of water within the municipality. In this municipality, the waterbodies are comparatively lower than those in the Satkhira Municipality; however, two rivers flow beside the municipality (Map 2).

The Land Surface Temperature (LST) of Satkhira Municipality varies from 48°C to 32°C, and in Bagerhat, it varies from 41°C to 29°C. The average temperature of Satkhira Municipality is 38.90 °C, and in Bagerhat Municipality it is 34.71 °C. Wards no.9,8,7,4 have experienced the highest temperature rather to other wards (Maps 3 and 4).

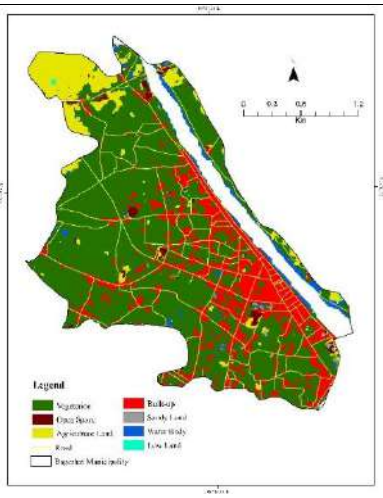
The stack profile represents the temperature variation between urban, suburban, and rural areas. The Urban areas of Satkhira and Bagerhat Municipalities have a higher temperature than the other areas. The urban maximum intensity is 26.76 (°C) and the minimum intensity is 10.02 (°C). The ward no. 9,8, and part of 7 have the highest urban heat island formation in Satkhira Municipality (Map 5).

In Bagerhat Municipality, the urban maximum intensity is 21.55 (°C) and the minimum intensity is 9.27 (°C). The ward no. 8,7,6, and 5 have the highest urban heat island formation (Map 6).

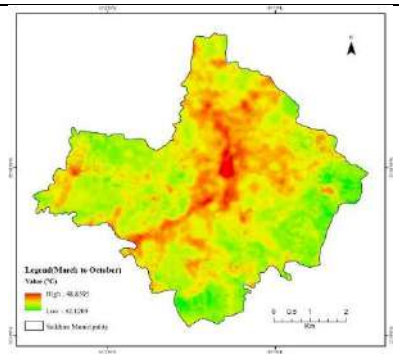
The study revealed that due to the existence of higher vegetation cover and waterbodies in the Bagerhat municipality, the land surface temperature and heat island are comparatively lower than the Satkhira municipality. It is an important part of the heat-adaptive urban system strategy; there needs to enhance green coverage and waterbodies as NbS in urban areas of Bangladesh. ■



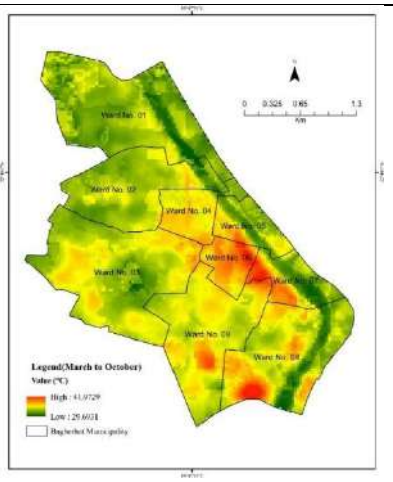
*Map 1: Existence of vegetation cover and waterbodies in the Satkhira Municipality*



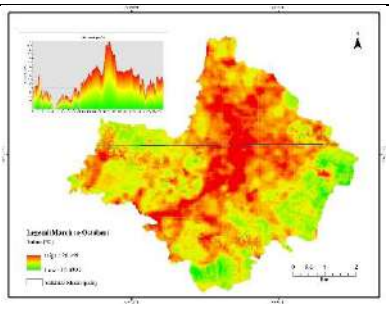
*Map 2: Existence of vegetation and waterbodies in Bagerhat Municipality*



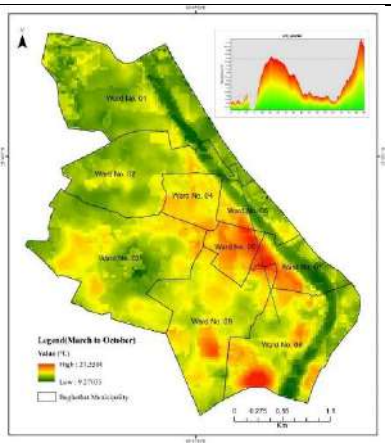
*Map 3: Land surface temperature in Satkhira Municipality*



*Map 4: Land surface temperature in Bagerhat Municipality*



*Map 5: Urban Heat Island in Satkhira Municipality*



*Map 6: Urban Heat Island in Bagerhat Municipality*

# Integrating Nature-Based Cooling Solutions for Urban Infrastructure in Bangladesh

*By **Md. Abul Kalam Azad**, Senior Environmental & Social Safeguard Specialist, Local Govt. Engineering Department (LGED), Dhaka, Bangladesh*

## Introduction

Bangladesh, one of the most climate-vulnerable countries in the world, is experiencing a rapid rise in urban temperatures due to climate change, rapid urbanisation, and loss of green cover. Cities like Dhaka, Chattogram, and Khulna are increasingly experiencing Urban Heat Island (UHI) effects, which lead to public health concerns, increased energy demands, and reduced livability. To address this, integrating nature-based cooling solutions (NbCS) into urban infrastructure offers a sustainable, cost-effective, and resilient approach.

## What is NbCS?

NbCS refer to the strategic use of natural systems, such as trees, green roofs, wetlands, and water bodies, to mitigate urban temperatures. These systems reduce heat through shading, evapotranspiration, and by reflecting solar radiation. Unlike conventional cooling systems, they offer co-benefits such as improved air quality, enhanced biodiversity, and better mental health outcomes.

## Key Strategies for Integration in Bangladesh:

1. **Urban Greening and Tree Plantation:**
   Expanding urban green cover by planting native tree species along roads, parks, and residential areas can significantly reduce surface and ambient temperatures. In Dhaka, studies show that tree-shaded areas can be 2–4°C cooler than non-shaded zones. Trees also improve air quality and reduce noise pollution.
2. **Green Roofs and Vertical Gardens:**

   In densely built-up cities, rooftop and vertical gardens offer viable cooling alternatives. They act as insulation layers, reducing indoor temperatures and minimising air conditioning use. Encouraging green roofs in public buildings, schools, and hospitals can set examples and stimulate private adoption.
3. **Blue Infrastructure and Water Bodies:**
   Restoring and integrating lakes, canals, and ponds within city planning not only enhances aesthetic appeal but also moderates local temperatures. Water bodies absorb and dissipate heat while supporting aquatic ecosystems. Cities like Rajshahi have shown success in integrating restored water bodies to combat heat.
4. **Permeable Surfaces and Urban Forests:**
   Replacing concrete pavements with permeable surfaces allows rainwater infiltration and reduces heat retention. Urban forests in underutilised public lands can serve as temperature sinks, contributing to overall thermal comfort.
5. **Policy Integration and Urban Planning:**
   For effective implementation, urban development plans must embed NbCS in building codes, zoning laws, and infrastructure design. National urban policy and city master plans should prioritise climate-resilient planning with adequate budgets and institutional support.

## Challenges and Opportunities

While land scarcity, institutional inertia, and lack of awareness pose challenges, Bangladesh's commitment to the Mujib Climate Prosperity Plan and SDGs offers a policy window for NbCS adoption. Community participation, public-private partnerships, and donor support can also accelerate implementation.

## Conclusion

Nature-based cooling solutions present a crucial opportunity for Bangladesh to create healthier, more resilient cities. By weaving nature into the urban fabric, cities can not only combat heat stress but also foster sustainable urban ecosystems for future generations. ■

# Greening Urban India: Cooling Heatwaves by Designing with Nature

*By **Prachi Gupta, Seema Mundoli** and **Harini Nagendra,** Azim Premji University, India*

Are heatwaves just a matter of seasonal discomfort, or is there more to it? In India, the answer is disturbingly clear. As global temperatures rise, heatwaves have become more frequent, intense, and deadly, disrupting lives, health, and ecosystems. In May 2016, Phalodi, Rajasthan, recorded a scorching 51°C, and in 2024 alone, India reported over 48,000 cases of heatstroke (CEEW, 2025). Vulnerable populations such as blue-collar workers, low-income populations, pregnant women, children, and the elderly are disproportionately affected. Women working in extreme heat outdoors face twice the risk of miscarriage or stillbirth (BBC News, 2024). By 2030, the country is projected to lose an equivalent of 34 million full-time jobs—not due to recession or machines—but simply because of rising temperatures (ILO, 2019).

The impact of heatwaves is more severe in cities. The urban heat island (UHI) effect can make urban areas up to 5°C to 10°C hotter than surrounding regions, as dense concrete and asphalt absorb heat by day and release it at night. Projections suggest that a 30% increase in urban vegetation could have prevented over 1.1 million heat-related deaths between 2000 and 2019, emphasising the lifesaving benefits of greening cities (Wu et al., 2025).

What if we designed our cities to live, to breathe, to cool by working with nature, not against it?

Nature-based solutions such as green (vegetation) and blue (water bodies) infrastructures can significantly mitigate the impact of heat stress. Urban green spaces such as parks, wooded groves, street trees and green roofs reduce UHI in metropolitan cities through multiple mechanisms (Figure 1). By shading paved roads and buildings, trees prevent them from absorbing and radiating heat. Simultaneously,

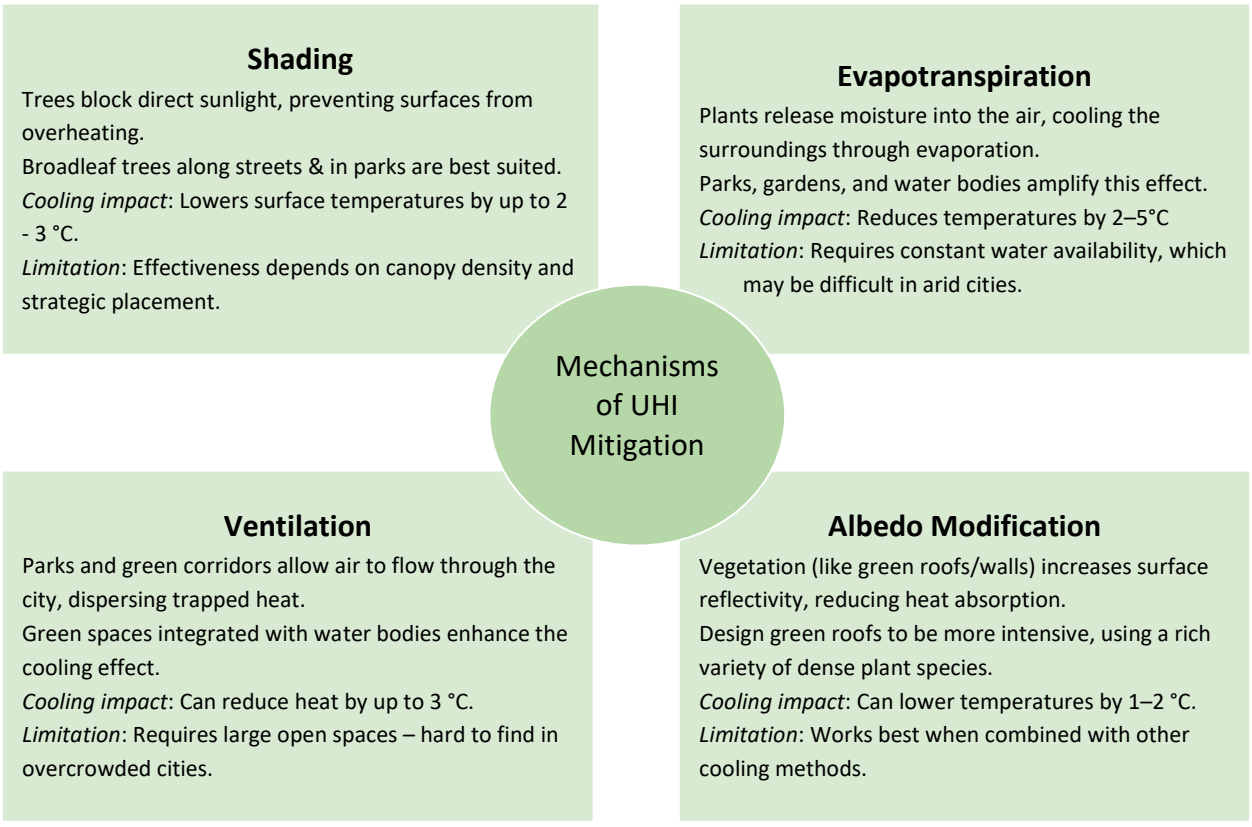



*Figure 1: Different mechanisms for UHI Mitigation in cities.*

through evapotranspiration, trees release moisture into the air, lowering the surrounding temperature (The Nature Conservancy, 2017). Moreover, greenery improves ventilation by allowing air to circulate more freely and enhances albedo, i.e., the reflectivity of surfaces. A study in Bangalore city showed that avenue trees can reduce road surface temperatures by 27.5°C and air temperatures by up to 5.6°C (Vailshery et al., 2013). In Bhubaneswar, remote sensing analysis showed that blue-green spaces were, on average, 2.1°C cooler than nearby built-up areas (Pritipadmaja et al., 2023).

The cooling effects of trees can result in energy savings of approximately 12% in residential areas (Liang and Huang, 2023). Key tree traits that influence trees' cooling potential include canopy size, leaf density, transpiration rate, and leaf area index (Liang and Huang, 2023). Green spaces with layered vegetation—comprising trees, shrubs, and herbs, along with diverse tree species—are more effective in cooling (Wang et al., 2021). Even ground cover vegetation can reduce the amount of heat absorbed and stored by paved surfaces. In cities with limited space, green walls can act as insulating barriers on buildings (Imam and Banerjee, 2016). Beyond cooling, green spaces also enhance urban liveability by providing other ecosystem services, such as air purification, carbon sequestration, flood risk mitigation, climate regulation, and improved mental well-being.

As India urbanises rapidly, with 600 million people projected to live in cities by 2036 (World Bank Group, 2024), we face a choice: do we continue building heat traps, or do we reimagine cities that breathe with nature? Greening our cities is not just a solution—it is a necessity for survival in a warming world.

Adapted from: Lin, H., & Li, X. (2025). The Role of Urban Green Spaces in Mitigating the Urban Heat Island Effect: A Systematic Review from the Perspective of Types and Mechanisms. Sustainability, 17(13), 6132.

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URBAN RESILIENCE

# Nature-Based Cooling Solutions for Cities: AIDMI's Call for Urban Resilience

*By **Vishal Pathak**, All India Disaster Mitigation Institute (AIDMI), India*

As South Asian cities confront intensifying heatwaves, All India Disaster Mitigation Institute (AIDMI) is promoting and strengthening practices of Nature-Based Solutions (NbS) to address urban heat risks while enhancing equity and resilience. These solutions are vital for protecting vulnerable populations from the growing threat of extreme temperatures, particularly in informal settlements and high-density neighbourhoods.

*Nature-based cooling in practice: a tea stall in Lucknow. Photo: AIDMI.*

Urban areas across India, Bangladesh, Pakistan, and Nepal are experiencing record-breaking temperatures, worsened by the urban heat island (UHI) effect. This phenomenon, triggered by dense built environments and limited vegetation, is especially dangerous for low-income and marginalised communities that lack access to cooling, water, or resilient infrastructure. In many Indian cities, extreme heat is now a leading seasonal hazard, exacerbating pre-existing vulnerabilities in housing, health, and livelihoods.

Nature-Based Solutions—including tree planting, green corridors, green roofs, restored urban water bodies, and permeable surfaces—not only cool the surrounding microclimate by up to 10°C but also contribute to stormwater management, air quality improvement, and mental well-being. These solutions can be integrated into existing government missions and urban development programmes to scale their impact.

Several government initiatives already offer promising pathways. The National Bamboo Mission encourages the planting of bamboo in urban parks and degraded land, which can function as rapid-growth green barriers to heat. The Atal Mission for Rejuvenation and Urban Transformation (AMRUT) supports urban green space creation and waterbody rejuvenation in 500 cities, aligning directly with cooling goals. Similarly, the National Urban Livelihoods Mission (NULM) can be leveraged to engage the urban poor, especially women and youth, in the creation and maintenance of green assets such as urban nurseries, shaded vending zones, and rooftop gardens. Additionally, the Smart Cities Mission offers digital tools for heat mapping and performance monitoring of green interventions. AIDMI's field experience across 18 states and multiple cities reinforces that such NbS are most effective when embedded in local plans of government bodies. In many cities, however, green infrastructure remains underfunded, fragmented across departments, and disconnected from climate vulnerability assessments.

AIDMI, through its work across 18 states in India, has long emphasised local strategies to reduce disaster risk. In a recent study[4] co-authored with the International Institute for Environment and Development (IIED), AIDMI documented how

[4] Guarin, A., Blackmore, E., Pathak, V., Nicolini, G., Morell-Ducos, J. and Kelly, L. (2024). Building resilience for cotton farmers in India: Evidence from Gujarat and Maharashtra. IIED and AIDMI. https://www.iied.org/22481iied.

cotton farmers in Gujarat and Maharashtra are already experiencing more frequent heatwaves, reduced rainfall, and crop losses. While the study focused on rural vulnerability, the findings are directly relevant to urban settings, where rising heat similarly threatens health and livelihoods. To move forward, AIDMI is promoting a set of interlinked actions.

First, cities must embed green cover targets and heat-resilient zoning norms into urban planning codes and enforce them through building permits and development control regulations.

Second, municipal corporations and Smart Cities should be equipped with technical and financial capacity to design and maintain NbS, especially in slums and low-income areas.

Third, the role of citizen participation must be scaled up—community groups, resident welfare associations, and school eco-clubs can play a central role in sustaining green assets.

Fourth, urban heat mapping and climate vulnerability assessments must guide the implementation of NbS, ensuring resources reach the most at-risk communities.

Fifth, developing cross-sectoral NbS Task Forces within cities to coordinate across Health, Water, Housing, and Urban Development departments can create the much-needed synergies. The agenda must be long-term and sustainability-driven—where heat resilience, livelihood generation, and urban biodiversity are simultaneously achieved through NbS.

Additionally, greater alignment with national schemes such as PMAY–Urban, HRIDAY, and Swachh Bharat Mission–Urban can amplify NbS benefits by embedding green design in affordable housing, heritage conservation, and urban sanitation. Local governments can also partner with state-level Forest and Environment Departments to unlock Green India Mission funds for NbS pilots in high-heat zones.

Nature-based cooling is not merely an environmental remedy; it is a social necessity and a climate justice tool. As cities grow, they must do so thoughtfully—ensuring that shade, water, and greenery are not luxuries for the few but rights for all. The time to act is now. With collective ambition and the right convergence of government missions, India can lead the way in building greener, cooler, and more inclusive cities. ■

## प्रकृति-आधारित उपाय: 5 प्रमुख कार्य

*By AIDMI*

### 1. शहरी संकट

- दक्षिण एशिया के शहरों में हीटवेव और शहरी ऊष्मा द्वीप (UHI) प्रभाव के कारण तापमान बढ़ रहा है। इसका सबसे अधिक असर गरीब बस्तियों और हाशिये पर रहने वाले समुदायों पर पड़ रहा है।

### 2. प्रकृति-आधारित समाधान (NbS)

- पेड़ लगाना और शहरी ग्रीन कॉरिडोर बनाना।
- ग्रीन रूफ्स और रूफटॉप गार्डन।
- पुराने जलस्रोतों का पुनर्जीवन।
- पारगम्य सतहों का उपयोग।

### 3. सह-लाभ

- स्थानीय तापमान को 5-10°C तक कम करना।
- वर्षा जल प्रबंधन और वायु गुणवत्ता में सुधार।
- मानसिक स्वास्थ्य, सामुदायिक स्थान और आजीविका में लाभ।

### 4. सरकारी अवसर

- अमृत (AMRUT): ग्रीन स्पेस और जलस्रोत पुनर्जीवन।
- राष्ट्रीय शहरी आजीविका मिशन (NULM): महिलाओं और युवाओं की भागीदारी।
- स्मार्ट सिटीज मिशन: हीट मैपिंग और डिजिटल निगरानी।
- नेशनल बैम्बू मिशन: तेजी से बढ़ने वाले हरे अवरोध।
- अन्य योजनाएँ: प्रधानमंत्री आवास योजना – शहरी (PMAY-Urban), हृदय योजना (राष्ट्रीय धरोहर शहर विकास और संवर्धन योजना) (HRIDAY), स्वच्छ भारत मिशन – शहरी (Swachh Bharat Mission- Urban), हरित भारत मिशन (GIM)|

### 5. आगे की दिशा

- ग्रीन कवर लक्ष्य और गर्मी-प्रतिरोधी कोड शामिल करना।
- गरीब बस्तियों और कमजोर इलाकों पर विशेष ध्यान।
- नागरिकों, स्कूल क्लबों और समुदायों की भागीदारी बढ़ाना।
- स्वास्थ्य, जल, आवास और शहरी विकास विभागों में NbS टास्क फोर्स बनाना।
- NbS को दीर्घकालिक और टिकाऊ रणनीति के रूप में अपनाना। ■

# Cooling Cities: Agenda for BIMSTEC in the Age of Climate Extremes

*By **Shreedhar Joshi**, Alumnus of MIT World Peace University, Pune, Maharashtra, India*

The cities of the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) region spanning South and Southeast Asia, are confronting a unique rise in temperatures, driven by both local urbanisation trends and the global climate crisis. Recent years have seen major heatwaves sweep across cities like Delhi, Dhaka, Yangon, and Bangkok, with surface temperatures often exceeding 45°C[5]. These extreme weather events are not anomalies but increasingly recurring patterns, intensified by global warming and the urban heat island effect, wherein densely built urban environments trap and retain heat. The consequences have been severe, for e.g. increased mortality due to heat strokes, higher incidence of respiratory and cardiovascular diseases, disrupted energy systems due to excessive demand for cooling, and lost economic productivity, especially among outdoor workers and the urban poor. According to the World Bank, by 2050, South Asian countries could lose up to 5% of GDP annually due to heat stress alone. These figures highlight that cooling cities is not merely an environmental imperative; it is a socio-economic necessity.

Natural and sustainable cooling solutions must become central to the planning and management of urban areas across the BIMSTEC region. Cities need to shift away from energy-intensive, artificial cooling systems and move toward nature-based interventions that offer co-benefits for health, biodiversity, and climate adaptation. Increasing urban green cover through the planting of indigenous trees, developing city forests, and restoring degraded urban wetlands can help reduce surface temperatures by 2 to 5 degrees Celsius.[6] Encouraging the adoption of green roofs, vertical gardens, and permeable surfaces for rainwater absorption not only provides thermal regulation but also improves air quality and urban aesthetics. Water bodies, such as lakes, ponds, and canals, must be revitalised and integrated into urban planning, as they play a crucial role in evaporative cooling. Furthermore, urban planning should include shaded walkways, breathable open spaces, and community gardens that allow residents to cope with heat in a more sustainable and equitable way. These measures align strongly with the environmental goals of BIMSTEC, especially under its priority areas of climate change, environment, and sustainable urban development.

As a regional bloc sharing common environmental vulnerabilities and developmental aspirations, BIMSTEC must adopt a unified and actionable agenda to address urban heat. First, there should be a collective push to establish a BIMSTEC-wide Urban Heat Resilience Framework. This would include heat vulnerability mapping using real-time meteorological data shared by agencies like the India Meteorological Department and other national weather bodies. Second, BIMSTEC should facilitate the harmonisation of urban planning policies by encouraging member states to insert minimum green space thresholds and heat-resilient building norms in their local regulations. Third, a dedicated Climate Adaptation Fund under BIMSTEC should be proposed to support cities financially in implementing green infrastructure projects. This could be developed in collaboration with multilateral climate finance mechanisms such as the Green Climate Fund. Fourth, BIMSTEC should promote cross-border knowledge exchange and capacity building. Cities like Ahmedabad, which have successfully implemented heat action plans, can provide a model for others in the region.[7] Additionally, universities and research institutions across member countries should be encouraged to jointly study and develop context-specific cooling innovations, such as using traditional architectural styles that naturally reduce heat absorption.

Looking ahead, the way forward for BIMSTEC lies in treating urban

[5] India Meteorological Department (IMD). (2024). *Annual Climate Summary 2024.*
[6] U.S. Environmental Protection Agency (EPA). (2023). *Using Trees and Vegetation to Reduce Heat Islands.*
[7] Natural Resources Defense Council (NRDC) India. (2020). *Ahmedabad Heat Action Plan: Protecting Health and Reducing Risks from Extreme Heat.*

cooling as a core regional development priority, not just an environmental add-on. As cities continue to grow, their role in mitigating the climate crisis also increases. By adopting a low-carbon, nature-centric approach to urban resilience, BIMSTEC can lead by example in the Global South. Collaborative governance, sustained political commitment, and people-centric urban policies will be key to ensuring that the region's cities remain liveable, inclusive, and climate-resilient in an increasingly warming world. In tackling the challenge of rising urban temperatures, BIMSTEC has the opportunity to not only safeguard its cities but also redefine sustainable urbanisation for the future. ■

YOUTH FOR RESILIENCE

# Nature-Based Cooling and Youth Engagement in African Cities

*By **Ben Akatch** and **Dr. Margaret Otieno**, Wildlife Clubs, Kenya*

As climate change continues to intensify, African cities are warming at an alarming rate, with heatwaves now a deadly occurrence. In the heart of this crisis lies a powerful and often underestimated solution: Nature-Based Solutions (NbS), which harness the power of natural systems to cool urban areas and enhance resilience. While city planners and governments grapple with infrastructure challenges, a new wave of youth-led initiatives is quietly transforming urban spaces through green innovation; nature-based cooling such as urban microforests, wetlands and parks to mitigate urban heat.

The solutions not only reduce surface and air temperatures but also improve air quality, support biodiversity and offer recreational benefits. In Nairobi city of Kenya, for example, the shade provided by tree canopies in areas like Karura Forest and green urban spaces can be up to 6°C cooler than the surrounding streets.

Youth across Africa are stepping up to promote these strategies. In schools around Nairobi city, Wildlife Clubs are leading the charge. These student-led clubs are reclaiming unused spaces to plant indigenous trees to form urban microforests, create vegetable gardens and protect school compounds from concrete sprawl. For instance, at Moi Forces Academy, students have developed mini-botanical gardens and vertical greening projects that contribute to local cooling and biodiversity conservation. These projects are simple but powerful, turning heat traps into havens.

Beyond schools, youth groups in informal settlements such as Mathare are constructing vertical gardens on iron sheet walls, using recycled containers and water-efficient methods. They are planting grasses and fruit trees that reduce temperatures while offering food and economic opportunities. Meanwhile, in Lagos, Kampala, and Accra, youth-led social enterprises are innovating with green rooftops, urban farming, and community-led clean-ups that double as reforestation efforts.

These efforts, though impactful, often struggle due to limited funding and policy support. Yet there has never been a more urgent time to act. With Africa's youth below 25 years making up 60% of the current population, compared to a projected 52% by 2050, their capacity to influence lasting change is peaking now. Waiting for the future to empower them would mean missing the most dynamic force for transformation we have today.

The time for token involvement is over. We must fund, train, and trust young people to scale up nature-based cooling solutions. Urban greening campaigns, school tree nurseries, wetland protection projects, and urban agriculture hubs should receive deliberate and long-term investment.

Africa's youth are not just tomorrow's leaders; they are today's implementers. If properly supported, their creative and nature-based actions can shape cooler, greener, and more liveable African cities.

Let us act now. The heat will not wait, and neither should we. ■

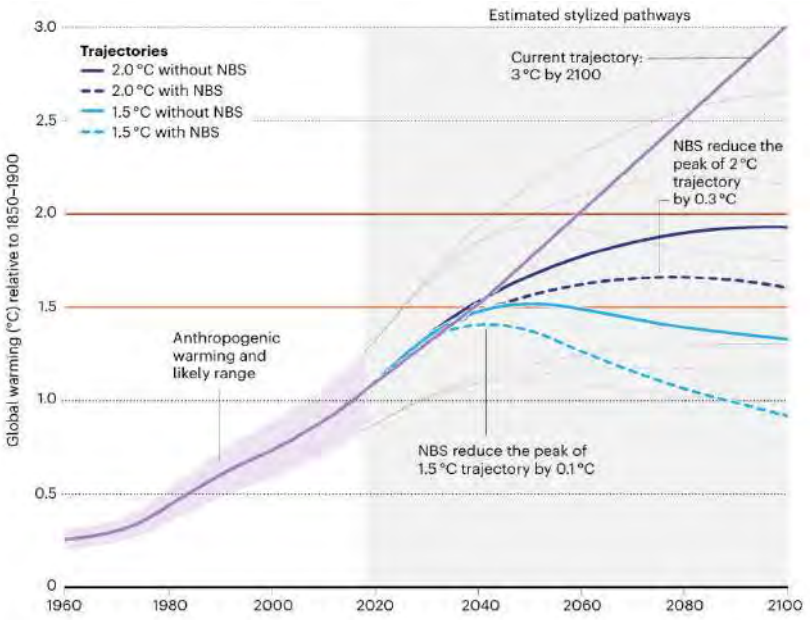
# Cooling Our Cities: Nature-Based Strategies to Beat Urban Heat

*By **Shyamji**, Research Scholar in Disaster Management, Jamsetji Tata School of Disaster Studies, Tata Institute of Social Sciences (TISS), Mumbai, Maharashtra, India*

## Introduction

Increasing temperature affects Cities or Urban centres more because of the Urban Heat Island phenomenon. According to World Bank data, 37% of India's population resides in urban cities. So, taking initiatives to cool the metropolitan cities in India is crucial. Urban cities have multiple cooling solutions (like~ Nature-Based Solutions, Design-Based Solutions, Planning-Based Solutions, Technological and Mechanical Solutions, etc.). However, nature-based solutions are better because they are climate-friendly, cost-effective, adaptive, resilient, and aligned with the SDGs. According to Jandaghian et al. (2022), there are many nature-based cooling solutions for cities, like Increased Surface Greenery (ISG) and Increased Surface Reflectivity (ISR), which are given below:

1. **Green Roofs:** Green roofs can be one of the primary cooling strategies for cooling or reducing temperature. Green roofs, often vegetated roofs, eco-roofs (due to ecological benefits), roof gardens, or living roofs, are a system of vegetation planted within a growth medium (Jandaghian et al., 2022). Extensive green roofs are the most common to install on roofs because of their lighter weight. Installing greenery on the roof can reduce the temperature by 27°F.
2. **Facades:** If we consider the current form of urban cities, vegetated facades can be a better nature-based solution to reduce the temperature of metropolitan cities. There are three categories of facades: Green Barrier Systems (GBSs), Green Coating Systems (GCSs), and Green Walls (GWs). The GCS category includes Green Climbing Barrier (GCB) and Green Climbing Coating (GCC), which help plants grow from the ground. They do not need high support, so they are cost-effective cooling solutions. Moreover, there is one added benefit of GCB and GCC systems: the vegetation can provide greater shading coverage faster than trees, which may take between 10 and 30 years to reach their cooling potential (Jandaghian et al., 2022).
3. **Reflective Solutions:** There is one more solution to use high albedo materials in construction. Typical urban materials, including asphalt and concrete, have albedos in the range of 0.05-0.1 and 0.3-0.4, respectively, where the albedo of reflective surfaces tends to be greater than 0.5 (Jandaghian et al., 2022). Moreover, Retro-reflective materials can reflect radiation along the incident direction.




*Source: Nature-based solutions can help cool the planet—if we act now, Nature, Girardin et al. (2021).*

## Conclusion

Increased temperature in Urban centres due to the Urban Heat Island phenomenon is hazardous for the residents of urban cities from the point of view of their health. Adapting nature-based solutions is better than any other solution to reduce the increased temperature. We can reduce the 27°F temperatures of the surroundings, so there is a need for policies to adapt the nature-based solutions to mitigate the effect of UHI. The following graph shows the importance of Nature-Based Solutions.

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# Nature-Inspired High-Albedo Surfaces: Cow Dung Paint for Heat-Resilient Indian Cities

*By **Era Upadhyay**, Amity Institute of Biotechnology, Amity University, Rajasthan, India*

**Abstract**

Urban Heat Islands heighten heat stress, energy demand, and health risks in Indian cities. Cow dung-based paint, a high-albedo, VOC-free coating, offers thermal insulation, antimicrobial benefits, and durability. Field trials show 3–5°C roof cooling and 10–15% energy savings, supporting SDGs-11,13 and India's National Cooling Action Plan.

## Introduction

India's expanding cities face worsening Urban Heat Islands (UHIs), where concrete and asphalt raise local temperatures by 2–6°C (Akbari et al., 2009). Ahmedabad, Bengaluru, and Jaipur report notable nocturnal heat spikes, heightening stress, cooling demand, and health risks. Conventional paints exacerbate heat absorption and emit VOCs, degrading air quality (Goyal et al., 2021).

Recent advances in green chemistry point to an innovative alternative—cow dung-based paint. Formulated from renewable bio-waste, this coating offers high reflectivity, thermal insulation, and antimicrobial benefits, while being VOC-free and non-toxic. It aligns with circular economy principles and can be produced locally, supporting rural entrepreneurship (Kumar & Upadhyay, 2025).

## Scientific Basis and Cooling Potential

Cow dung naturally contains cellulose, lignin, and mineral-rich ash, enhancing solar reflectance and lowering thermal conductivity (Singh & Sharma, 2020). Analyses by Kumar and Upadhyay (2025) show a high pH (12.2) that inhibits microbial growth, low thermal conductivity, moderate phenolic content (1.52) for antimicrobial activity, and absence of toxic heavy metals, with only trace cadmium (1 ppm), chromium (5.26 ppm), and nickel (3.8 ppm). Manganese (11.6 ppm) improves durability, while UV-Vis spectra indicate natural pigments. Microbial tests confirmed bacterial and fungal resistance. With eco-friendly binders and pigments, cow dung paint remains VOC-free, non-toxic, and suitable for indoor use.. 4.4.25

Field trials recorded summer roof temperature reductions of 3–5°C compared to conventional paints, cutting cooling energy demand by 10–15%. Natural binders and manganese strengthen resistance to monsoon rains, UV, and dust. The low Water Pollution Index (0.20) indicates minimal aquatic toxicity, though the Heavy Metal Pollution Index (900) warrants careful sourcing and waste control.

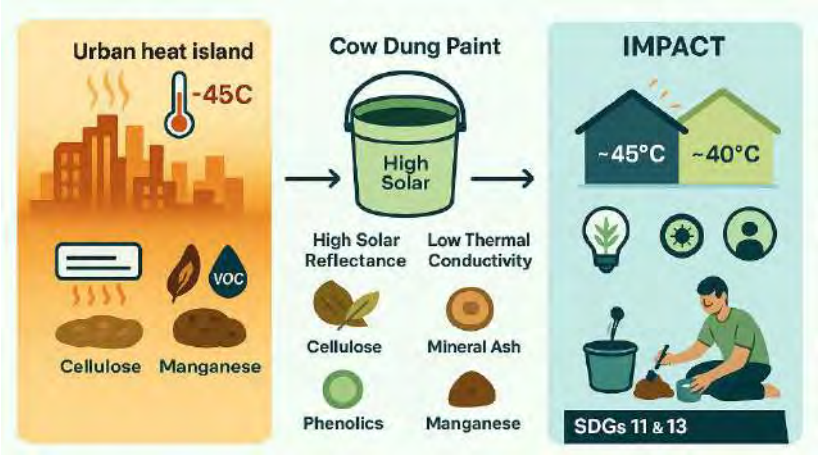


*Figure 1. Schematic diagram illustrating the role of cow dung-based high-albedo paint in mitigating Urban Heat Islands.*

## Synergy with Nature-Based Cooling Strategies

High-albedo cow dung paint can be paired with green roofs, urban greening, and reflective pavements to boost cooling effects (Santamouris, 2018). Its low cost supports retrofitting in low-income and peri-urban housing, while decentralised production can create rural livelihoods.

## Policy Relevance

The innovation aligns with SDG-11 (Sustainable Cities) and SDG-13 (Climate Action) by lowering cooling demand and promoting eco-friendly building materials. It supports India's National Cooling Action Plan targets and complements Heat Action Plans advocating passive cooling (MOEFCC, 2019).

### Scalability

Production can be established by small rural units with low investment. Policy incentives, green building integration, and pilot projects in heat-prone districts could accelerate adoption.

### Conclusion

Cow dung paint offers a low-tech, scalable, and climate-friendly alternative to conventional coatings, combining thermal efficiency, durability, and sustainability for heat-resilient urban development.

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COOLING WITH NATURE

# Nature-Based Cooling Solutions for Cities in Nepal


*By **Roshani Adhikari Pathak,** Candidate for IUCN Regional Councillor- South and East Asia from Nepal*


Nepal has been increasingly applying nature-based cooling solutions to address the growing impacts of urban heatwaves. Studies on green and blue infrastructure, such as forests, parks, and ponds in the Kathmandu Valley, have documented their considerable cooling effects. Research shows that urban forests reduced temperatures by about 1.2°C, parks by 0.9°C, and ponds by 0.85°C with impacts extending up to 300 m away from the sources. For example, the *Swoyambhu* forest in Kathmandu is currently about 4.1°C cooler than its surroundings, while the *Na Pukhu* pond in Bhaktapur is about 3°C cooler than nearby areas.

Nepalgunj, one of the hottest cities in Nepal, has been adopting a strategy to cope with rising temperatures. These include increasing roadside greenery, expanding parks, and promoting green roofs (locally known as *kaushi kheti*). Such measures provide shading, enhance evapotranspiration, and contribute to improved indoor air quality and thermal comfort. Similarly, in the capital city, Kathmandu, urban green spaces have been developed along riparian corridors on the city's edge as part of urban planning. These green spaces provide multiple benefits to urban infrastructure, including cooling, groundwater recharge, flood control, and cultural value. Traditional settlements also reflect these principles, with landscapes that harmoniously integrate trees, ponds, and courtyards, offering natural, passive cooling solutions to all.

Alongside these nature-based interventions, Nepal is also advancing much needed climate-sensitive architecture. Building designs are being redesigned to include shaded verandas and cross ventilation. Architects are also incorporating reflective surface areas to minimise heat absorption. Likewise, while thermally massive materials such as adobe, brick and stone are increasingly used to reduce heat gain, lower cooling demands, and improve energy efficiency. Furthermore, community forests and traditional land management practices play a crucial role in mitigating heat in peri-urban and rural areas. Together, these approaches underscore the necessity of integrating at a larger scale nature-based cooling into comprehensive urban planning across the Himalayas to build long-term climate resilience for people and nature, both. ■

# Way Ahead

***Dr. Prajna Paramita Panda,*** *Program Manager & Member, IUCN SSC AsESG, India and* ***Mihir R. Bhatt****, All India Disaster Mitigation Institute (AIDMI), India*

*"The path forward for South Asian cities is clear to all involved, and it demands urgency and ambition," as said by a participant at the South Asia Policy Dialogue on Early Warning and Anticipatory Action for Accelerating Risk Mitigation, Organised by Duryog Nivaran, August 28, 2025, Colombo, Sri Lanka.*

The path forward for South Asian cities is clear, but it demands urgency and ambition. The next decade will determine whether our cities become liveable, inclusive, and resilient—or continue turning into heat traps.

*"Above all, we must see nature not as an add-on but as infrastructure—more vital to cities as roads, power, and housing in the long run," underlined a member of Urban Alliance of IUCN.*

We see five priorities for action:

1. **Mainstream NbS into city planning and codes:** Urban bylaws must mandate green cover targets, permeable surfaces, and zoning norms that reduce heat stress. NbS should not remain pilot projects but must become standard practice in urban development.
2. **Finance NbS at scale:** Sustainable financing is critical. Blended models—linking public funds, Corporate Social Responsibility (CSR), international climate finance, and local enterprises—can provide long-term support for NbS projects, from mangrove regeneration to urban green corridors.

*"Investing in NbS is investing in public health, economic productivity, climate justice, and in nature itself," Kirtee Shah, INHAF, points out repeatedly in CityNet discussion series.*

3. **Empower communities as custodians:** NbS succeed when they are owned locally. Women's collectives, school eco-clubs, youth groups, and resident associations must be equipped and supported to design, implement, and monitor NbS.
4. **Strengthen cross-sectoral governance:** Departments of health, housing, water, and urban development must coordinate through NbS Task Forces, ensuring that cooling, biodiversity, and equity are pursued together - not in silos.
5. **Align with national and global agendas:** NbS must be firmly embedded within the **SDGs, the Paris Agreement, the Sendai Framework, India's National Cooling Action Plan, and National Biodiversity Action Plans**. This alignment can unlock resources, credibility, and momentum.

Above all, we must see **nature not as an add-on but as infrastructure**—as vital to cities as roads, power, and housing. Investing in NbS means investing in public health, economic productivity, and climate justice.

The road ahead is both challenging and hopeful. If South Asian cities act decisively, they can turn the threat of extreme heat into an opportunity for innovation, equity, and sustainability. With collective ambition and collaboration, we can ensure our cities not only survive the age of climate extremes - but thrive in it: cooler, greener, and more resilient.

*"If South Asian cities act decisively, they can turn the threat of heat into an opportunity for innovation, equity, sustainability, jobs, and restoring nature," advocated Major General Sampath Kotuwegoda (Retd.) ndc IG, Director General, Disaster Management Centre, Sri Lanka.*

EVENT

## IUCN World Conservation Congress, October 9-15, Abu Dhabi, UAE

The IUCN World Conservation Congress is held every four years, bringing together thousands of nature conservation experts, leaders, and decision-makers from around the world. The 2025 Congress in Abu Dhabi will play a defining role in shaping global priorities for nature conservation, climate action, and sustainable development for the coming decade and beyond.

*Read more:* https://iucncongress2025.org/

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