TerraGreen

₹70

EARTH MATTERS

Subscriber's copy VOLUME 19 | Issue 3 | June 2026

Homes that Nurture Nature and Togetherness

Rethinking Homes through Conservation and Community

SPECIAL HIGHLIGHTS

Rising Temperatures: Drivers, Implications, and the Way Forward

Nanoparticle Waste Pollution

Rewriting the Plastic Story

IN CONVERSATION

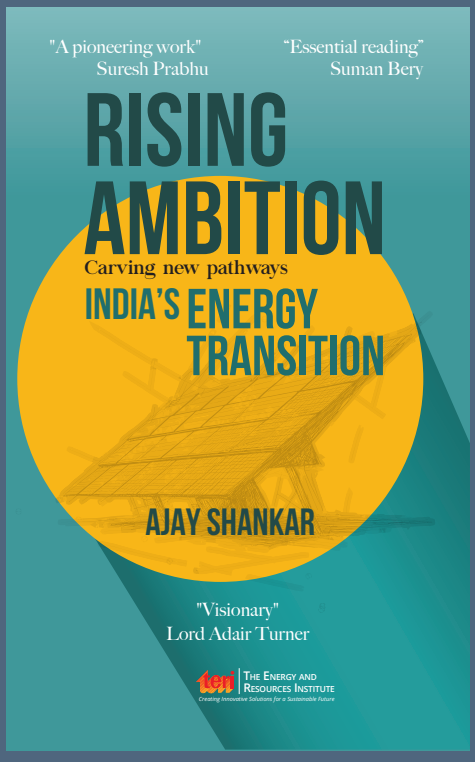
Dr Raghab Ray, Fellow & Area Convenor, The Coastal Ecology & Marine Resources Centre, Goa, TERI

TERRA YOUTH

Their Share of the Environment



teri



Rising Ambition Carving New Pathways India's Energy Transition

Ajay Shankar
Distinguished Fellow
The Energy and Resources Institute (TERI)

India aims to become net zero by 2070. This book sets out the pathways to net zero with key milestones. It suggests policy choices and ways to minimize the cost of this fundamental transition deriving lessons from the remarkable success that has been achieved in renewables. It makes the case that moving away from fossil fuels would also help India become a developed country with a competitive green economy.

Year: 2025
Size: 5 inch x 8 inch
Pages: 244
ISBN: 978-93-94657-19-9
Price: ₹495.00

"A meticulously documented analysis of India's decarbonization possibilities by one of our most thoughtful and experienced administrative scholars."

Suman Bery
Vice Chair, NITI-Aayog

"Becoming net zero while continuing to grow the economy would be one of India's critical challenges in the future. This is a pioneering work which gives an excellent and comprehensive analysis of the challenges and the best way to succeed."

Suresh Prabhu
Former Union Minister, Government of India

"Rising Ambition is analytically robust but also visionary and a critical guide to how India can both become a rich developed nation and make a major contribution to avoiding the potential catastrophe of global warming."

Lord Adair Turner
Chair Energy Transitions Commission

The Energy and Resources Institute (TERI)
Darbari Seth Block, India Habitat Centre, Lodhi Road,
New Delhi – 110 003, India
: teripress@teri.res.in • : http://bookstore.teriin.org

ADVERTISE IN...

TERRAGREEN

Circulation information

Industries, Ministries, PSUs, Corporates, Multi and Bilateral Agencies, Universities, Educational Institutions, and Research professionals.
Readership of 40,000

General information

- Monthly
- All colour
- Matte paper
- Number of pages: 56



Technical specifications

Finished size:	20.5 cm × 26.5 cm
Non-bleed ad size:	17.5 cm × 23.5 cm
Half page ad size:	17.5 cm × 11.75 cm
Bleed size (3 mm bleed on all sides):	21 cm × 27.5 cm
Artwork preference:	Print ready, minimum 300 dpi (tiff, eps, pdf, or cdr) files with all fonts with high quality print proofs and progressives for colour reference.

Advertisement tariffs (₹)

Position	Card rate for single issue(INR)	quarter contract (3 issues) (INR)	bi-annual contract (6 issues) (INR)	annual contract (12 issues) (INR)
Advertorial (per page)	100,000	255,000	480,000	900,000
Back Cover	100,000	255,000	480,000	900,000
Inside Back Cover	75,000	191,250	360,000	675,000
Inside Front cover	75,000	191,250	360,000	675,000
Inside Full Page	50,000	127,500	240,000	450,000
Inside Half page	30,000	76500	144,000	270,000

GST & taxes additional as applicable

Subscription

One year ₹840 / $122 • Two years ₹1680 / $234 • Three years ₹2520 / $302

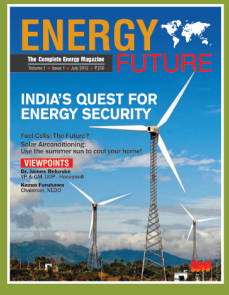
ENERGY FUTURE

Circulation information

Industries, Ministries, PSUs, Corporates, Multi and Bilateral Agencies, Universities, Educational Institutions, and Research professionals.
Readership of 25,000.

General information

- Quarterly
- All colour
- Matte paper
- Number of pages: 96



Technical specifications

Finished size:	20.5 cm × 26.5 cm
Non-bleed ad size:	17.5 cm × 23.5 cm
Half page ad size:	17.5 cm × 11.75 cm
Bleed size (3 mm bleed on all sides):	21 cm × 27.5 cm
Artwork preference:	Print ready, minimum 300 dpi (tiff, eps, pdf, or cdr) files with all fonts with high quality print proofs and progressives for colour reference.

Advertisement tariffs (₹)*

Ad location	Back cover	Inside back cover	Inside front cover	Inside full page	Inside half page	Inside quarter page	One-sixth page
Single issue	60,000	50,000	50,000	40,000	20,000	12,000	7,000
Two issues	114,000	95,000	95,000	76,000	38,000	22,800	13,300
Three issues	171,000	142,500	142,500	114,000	57,000	34,200	19,950
Four issues	228,000	190,000	190,000	151,000	76,000	45,600	26,600

Subscription

One year ₹800 / $80 • Two years ₹1600 / $160 • Three years ₹2400 / $240

Contact details

Sanjeev Sharma
Email: sanjeev.sharma@teri.res.in
<Extn 2443>

Bank details for NEFT:

The Energy and Resources Institute
Bank: State Bank of India
A/c Number: 62002345487
IFSC Code: SBIN0020511
Website:http://bookstore.teri.res.in/TerraGreen

The Energy and Resources Institute
Darbari Seth Block, IHC Complex
Lodhi Road, New Delhi – 110 003
Tel: 011 2468 2100 / 7110 2100
Fax: 011 2468 2144 / 2468 2145
Website:http://bookstore.teri.res.in

EDITORIAL



> "Urbanization has often led to the erosion of green spaces, increased resource consumption, and a growing disconnect between people and nature."

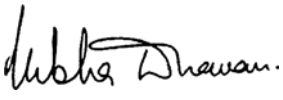
Human existence, inextricably linked with the lived environment is marked by rapid urban expansion and environmental strain. Increasingly, the question of how we inhabit our living spaces has assumed greater significance and generated a renewed sense of urgency. Homes are no longer merely shelters; they are dynamic spaces that influence ecological balance, social interactions, and individual well-being. As cities continue to grow denser and lifestyles more fragmented, the design and use of residential spaces must respond to the twin imperatives of sustainability and human connection.

The pressures shaping our built environments today are multifaceted. Urbanization has often led to the erosion of green spaces, increased resource consumption, and a growing disconnect between people and nature. At the same time, modern lifestyles, driven by efficiency and convenience, have inadvertently distanced households from traditional practices rooted in conservation, community, and shared responsibility. These shifts call for a re-examination of how homes are conceived—not just as physical structures, but as ecosystems that both shape and are shaped by their surroundings.

Against this backdrop, the cover story in this issue explores how residential design can be reimagined through a more holistic and inclusive lens. It highlights the need for what may be termed a "720-degree approach"—one that acknowledges the interconnectedness of environmental, social, and cultural factors influencing our living spaces. The article underscores that even within the constraints of urban apartments, thoughtful interventions, such as balcony gardens, the use of indigenous plants, and bird-friendly features, can help restore ecological links and invite biodiversity back into everyday life.

Equally significant is the emphasis on rethinking the internal spaces of the home. By repositioning the kitchen as a central, inclusive, and well-designed space, the narrative draws attention to the intersections of resource conservation, health, and social equity. It calls for designs that are not only functional and safe but also encourage shared participation, respect for food, and mindful consumption—values deeply embedded in cultural traditions yet often overlooked in contemporary design.

We hope this issue encourages thoughtful engagement with the challenges and opportunities ahead, and reinforces our collective commitment to building cities that are not only sustainable, but also inclusive, adaptive, and prepared for the uncertainties of a warming planet.



Vibha Dhawan
Director-General, TERI



The cover story, "The Geopolitics of Heatwaves: Energy Shocks and India's Cooling Challenge" by Dr Anil Pratap Singh, offers a refreshing and insightful perspective on India's growing heat crisis. The article rightly argues that heatwaves are no longer just environmental concerns but are increasingly linked to energy security, public health, and social equity. Particularly noteworthy is the emphasis on passive cooling solutions such as cool roofs, urban green spaces, restored water bodies, and net-zero cooling shelters. These measures can reduce dependence on energy-intensive air conditioning while protecting vulnerable communities from extreme heat. The example of the Jodhpur Net-Zero Cooling Shelter demonstrates how simple, locally appropriate innovations can deliver meaningful results. The article's call to integrate passive cooling into building codes and urban planning deserves urgent attention from policymakers. As cities continue to warm and energy systems face mounting pressure, sustainable cooling must become a central pillar of climate resilience. *TerraGreen* deserves appreciation for highlighting this critical issue.

N K Bagchi
Kolkata, West Bengal

The article "Role of Critical Minerals in Clean Energy Transition: Securing Resources for a Low Carbon Future" provides a comprehensive and timely overview of a subject that is central to the global energy transition but often remains underappreciated. As countries accelerate the deployment of electric vehicles, renewable energy systems, and battery storage technologies, the importance of minerals such as lithium, cobalt, nickel, copper, graphite, and rare earth elements cannot be overstated. The article effectively highlights both the opportunities and challenges associated with the growing demand for these resources. Particularly valuable is its emphasis on supply-chain concentration, recycling constraints, and the need for diversification and innovation. The discussion also underscores that energy security in the clean-energy era will increasingly depend on access to critical minerals. India's National Critical Mineral Mission is a welcome step in this direction. However, securing sustainable supplies must go hand in hand with responsible mining, resource efficiency, and circular economy practices. *TerraGreen* deserves appreciation for drawing attention to this crucial pillar of a low-carbon future.

Madan Gopal Sahu
Visakhapatnam, Andhra Pradesh

Published by Dr Vibha Dhawan on behalf of The Energy and Resources Institute, Darbari Seth Block, IHC Complex, Lodhi Road, New Delhi – 110 003. Editor-in-chief Dr Vibha Dhawan

© The Energy and Resources Institute. All rights reserved.



Editor-in-Chief
Vibha Dhawan

Editorial Board
K Ramanathan
S K Sarkar
Suneel Pandey

Publishing Head
Anupama Jauhry

Editorial Team
Abhas Mukherjee
Bhavya Bareja

Designer
Santosh Gautam

Production
Aman Sachdeva

Marketing, Sales & Distribution
Sanjeev Sharma

Head office
TERI
Darbari Seth Block, IHC Complex
Lodhi Road, New Delhi – 110 003
Tel. +91 (11) 2468 2100 or 7110 2100
Fax +91 (11) 2468 2144 or 2468 2145

Regional centres
Southern Regional Centre
4th Main, 2nd Cross, Domlur II Stage,
Bangalore–560 071
Tel: (+91 80) 2535 6590-94 (4 lines)
Email: terisrc@teri.res.in

North-Eastern Regional Centre
Chachal, Mahapurush Madhabdev Path,
Hengrabari, Guwahati- 781 036
Tel: (+91 361) 350 0766
Email: terine@teri.res.in

Western Regional Centre
House No. 233/GH-2, Vasudha Housing Colony,
Alto-St Cruz, Tiswadi, Goa-403 202
Tel: (+91 832) 245 9306, 245 9328
Email: teriwrc@teri.res.in

Western Regional Centre
Office No. 318, Raheja Arcade,
Sector-11, CBD-Belapur,
Navi Mumbai - 400 614
Maharashtra
Tel: (+91 22) 2758 0021, 4024 1615
Email: terimumbai@teri.res.in

TERI Himalayan Centre
Latey Bunga, Mukteshwar,
Nainital - 263 132, Uttarakhand
Tel: +91 99901 28101
Email: praveen.sharma@teri.res.in

Contents

VOLUME 19 • ISSUE 3 • JUNE 2026

4 NEWS

12 FEATURE

Rising Temperatures: Drivers, Implications, and the Way Forward

18 IN CONVERSATION

Dr Raghab Ray, Fellow & Area Convenor, The Coastal Ecology & Marine Resources Centre, Goa, TERI

22 COVER STORY

Homes that Nurture Nature and Togetherness

30 SPECIAL REPORT

Rewriting the Plastic Story

34 GREEN CHALLENGES

Beyond Outrage: Rethinking Great Nicobar

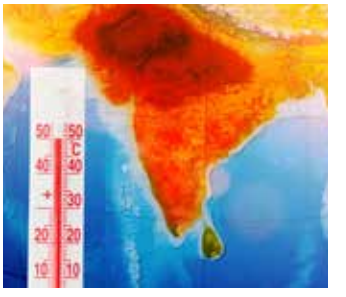
37 TERRA YOUTH

46 WILDLIFE

Exploring Atalaya Castle's Timeless Charm

49 PIONEER

56 GREEN EVENTS



12 FEATURE



30 SPECIAL REPORT



22 COVER STORY

10 22ND ANNIVERSARY

37 TERRA YOUTH







NTPC Invests ₹5,000 Crore in Battery Storage

State-run NTPC has begun installing 5 GWh of battery energy storage systems at its thermal power stations, with an investment of nearly ₹5,000 crore. The initiative aims to store excess solar and wind power that would otherwise be wasted during periods of low demand. By integrating battery systems with existing coal-fired plants, NTPC hopes to improve grid stability and facilitate greater renewable-energy penetration. The move is seen as a major step towards addressing one of the biggest challenges in clean energy—intermittency. Experts say large-scale storage will become increasingly important as India's renewable energy share continues to grow.

Source: The Economic Times, June 18, 2026

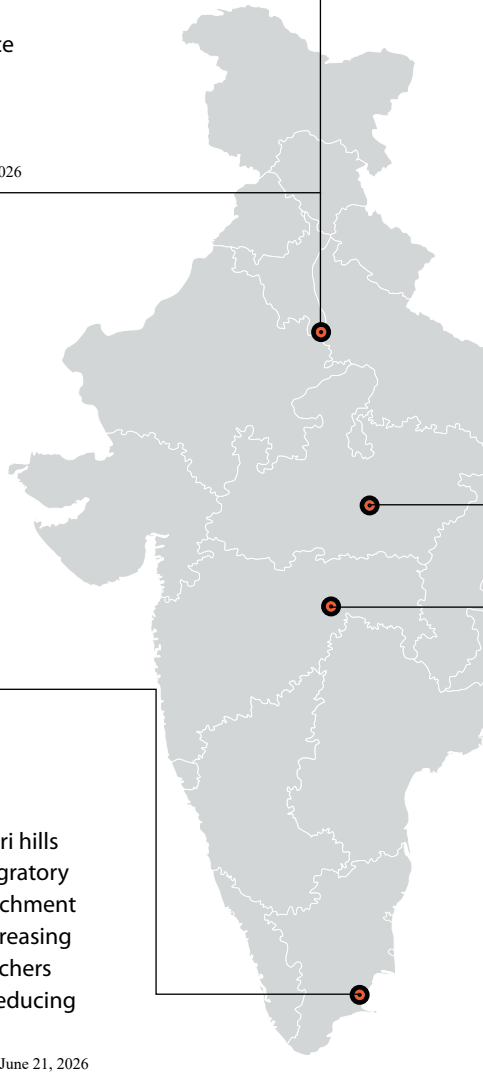
India Launches First Wind Supply-Chain Platform

To strengthen the country's wind-energy ecosystem, the Ministry of New and Renewable Energy, Government of India, has launched WT-MARUT, India's first digital platform dedicated to wind-energy supply-chain management. Introduced by Union Minister Shri Pralhad Joshi, the platform is designed to improve coordination among manufacturers, suppliers, developers and policymakers. Industry stakeholders believe the initiative will enhance transparency, reduce logistical bottlenecks and accelerate project implementation. The launch comes at a time when India is seeking to scale up wind power capacity alongside solar energy to meet climate commitments and ensure long-term energy security.

Source: The Times of India, June 15, 2026







Elephant Migration Shift Raises Ecological Concerns

Wildlife experts in Tamil Nadu are closely monitoring unusual elephant movements in the Nilgiri hills after an elephant was spotted in Ooty's upper plateau region, an area outside its traditional migratory range. Ecologists fear the movement may indicate changing habitat conditions, human encroachment or environmental stress in lower-altitude forests. The incident has reignited concerns about increasing human-wildlife interactions and the ecological consequences of habitat fragmentation. Researchers say understanding these altered movement patterns is critical for conservation planning and reducing conflict between communities and wildlife in one of India's most biodiverse landscapes.

Source: The Times of India, June 21, 2026



Kaziranga Bird Survey Reveals Rich Raptor Diversity

A rapid biodiversity survey released around World Environment Day has documented 30 species of raptors and six species of storks in Kaziranga National Park and Tiger Reserve. Conducted in collaboration with researchers from Gauhati University, the study underscores the ecological importance of the UNESCO World Heritage Site beyond its famous one-horned rhinoceroses. Conservationists say the findings reinforce Kaziranga's role as a critical habitat for birds of prey and wetland-dependent species. The survey is expected to aid future conservation planning and strengthen biodiversity monitoring efforts across the Brahmaputra floodplains.

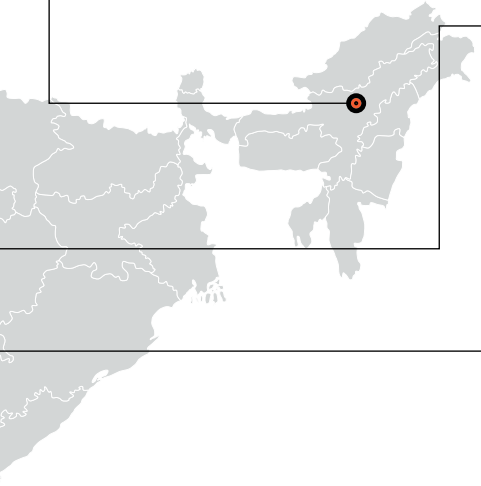
Source: Report released on World Environment Day (June 2026)

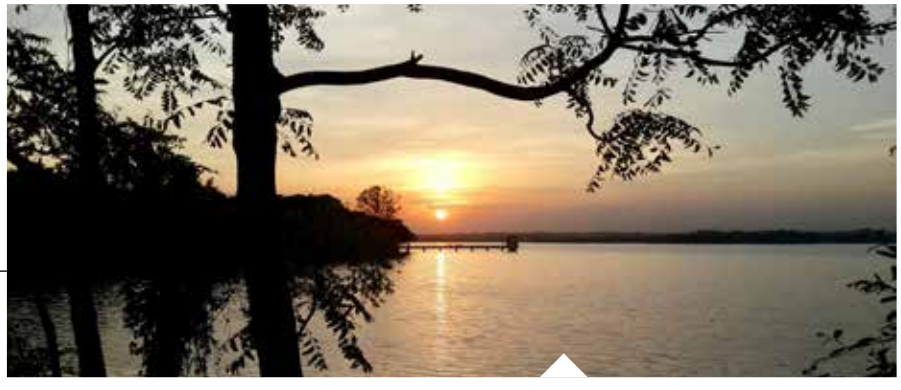
India's Wind Sector Records Historic Expansion

On the occasion of Global Wind Day, government data showed that India added a record 6.05 GW of wind power capacity during 2025–26, the highest annual addition in the country's history. India's installed wind capacity has now reached more than 56 GW, making it the world's fourth-largest wind power market. Officials noted that nearly 45 per cent of wind generation occurs during peak demand hours, complementing solar power and improving grid reliability. The achievement reflects growing investment in renewable energy and strengthens India's position as a major player in the global clean-energy transition.

Source: PIB Fact Sheet on Global Wind Day, June 2026







Nagpur Launches Major Lake Restoration Drive

The Nagpur Municipal Corporation intensified efforts to restore Ambazari Lake ahead of the monsoon, removing invasive water hyacinth and addressing untreated sewage inflows. Nearly 40 per cent of the lake has already been cleared as part of a broader urban ecosystem restoration initiative. Officials say the project aims to improve water quality, reduce flood risks, revive aquatic biodiversity and transform the lake into a healthier urban wetland. Environmental experts view the effort as an example of how Indian cities are increasingly investing in nature-based solutions to tackle pollution, water management challenges and climate resilience while enhancing urban green spaces.

Source: The Times of India, June 5–6, 2026

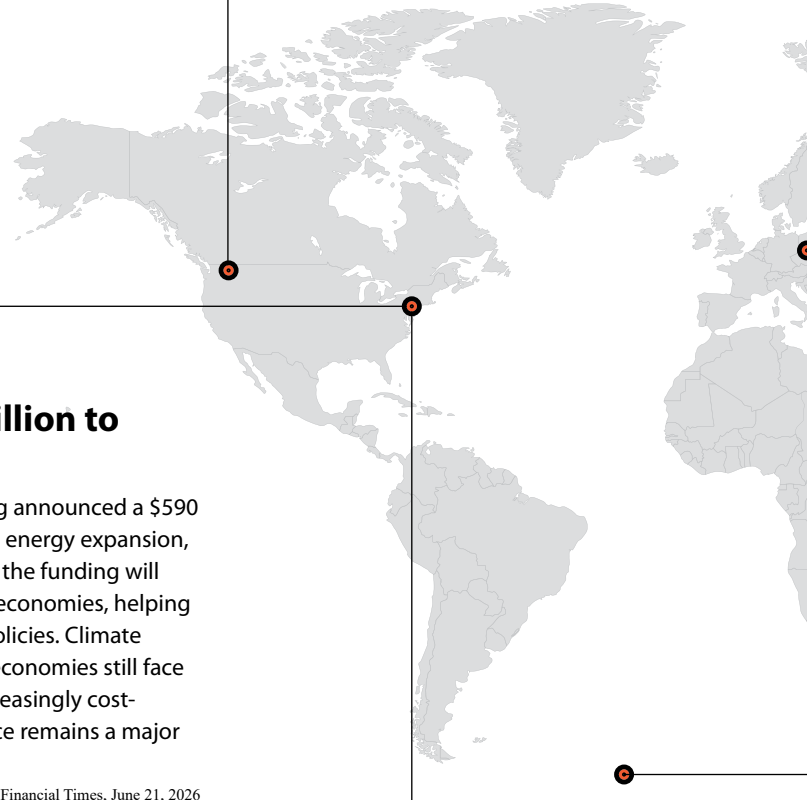


World's Largest Wildlife Crossing Nears Completion in California

Construction of the Wallis Annenberg Wildlife Crossing in California entered its final phase, with conservationists hailing it as one of the world's most ambitious efforts to reconnect fragmented habitats. Spanning a major highway near Los Angeles, the crossing is designed to allow mountain lions, deer, coyotes and other wildlife to safely move between ecosystems separated by decades of urban development. Scientists believe the project could improve genetic diversity among isolated animal populations and reduce wildlife-vehicle collisions. The initiative is increasingly being viewed as a model for biodiversity conservation in heavily urbanized landscapes worldwide.

Source: The New York Times, June 2026





Michael Bloomberg Commits $590 Million to Climate and Nature Initiatives

Philanthropist and former New York mayor Michael Bloomberg announced a $590 million environmental funding package to support renewable energy expansion, ocean conservation and air-pollution reduction. Nearly half of the funding will strengthen renewable-energy industry groups in developing economies, helping them build technical expertise and advocate for supportive policies. Climate experts welcomed the initiative, noting that many emerging economies still face institutional barriers despite renewable energy becoming increasingly cost-competitive. The funding comes at a time when climate finance remains a major issue in international environmental negotiations.

Source: Financial Times, June 21, 2026

Global Business Leaders Push for Faster Electrification

A global survey of nearly 2,000 business executives found overwhelming support for electrification as a solution to climate and energy-security challenges. More than 90 per cent of respondents said they expect significant electrification of their operations by 2035, while most viewed it as essential for reducing dependence on volatile fossil-fuel markets. Companies cited electric transport, renewable-powered manufacturing and electrified heating systems as key priorities. Business leaders also called on governments to accelerate grid modernization and provide policy certainty to support large-scale investments in clean-energy infrastructure.

Source: Reuters Sustainable Switch, June 15, 2026

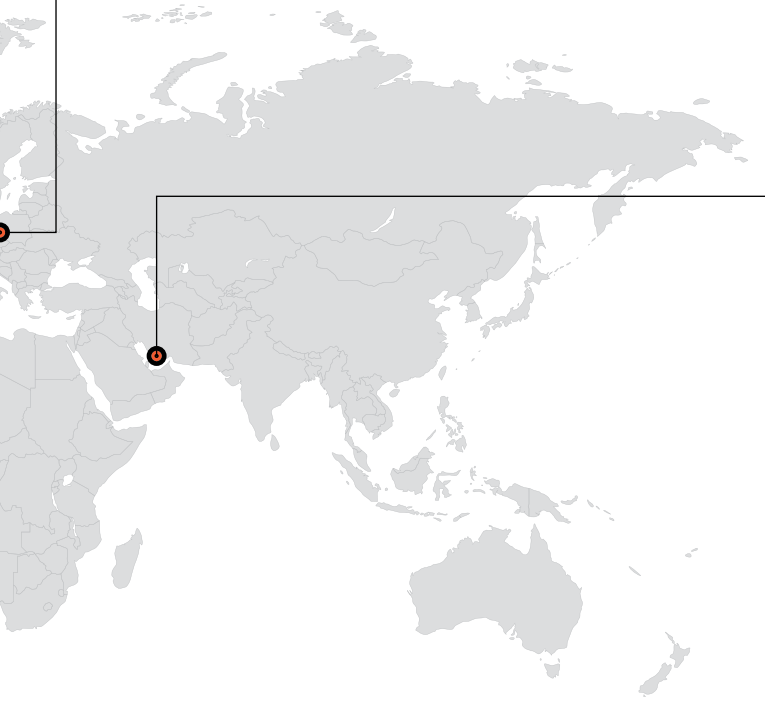




Electrification Emerges as Key Climate Strategy at Bonn Talks

Electrification became a central theme at the Bonn climate negotiations, where policymakers discussed replacing fossil fuels in transport, industry and buildings with clean electricity. Several countries backed a proposal to increase electricity's share of global final energy demand to 35 per cent by 2035. Experts argued that electrification could significantly improve energy efficiency while reducing greenhouse gas emissions. The discussions highlighted growing international recognition that renewable electricity, electric vehicles and heat pumps will play a critical role in achieving climate goals, although disagreements remain over financing and implementation pathways.

Source: The Guardian, June 20, 2026





Energy Security Concerns Renew Interest in Renewable Power

The recent Middle East conflict has triggered a renewed global focus on renewable energy as governments seek to reduce dependence on imported fossil fuels. Industry leaders argue that solar, wind and battery storage can improve national energy security by providing domestically generated power. While some countries have temporarily increased fossil-fuel use, others have accelerated investments in clean-energy technologies and electrification. Analysts say the crisis may ultimately strengthen the long-term business case for renewable energy, particularly in regions vulnerable to geopolitical disruptions in oil and gas supplies.

Source: Financial Times, June 16, 2026

Atlantic Ocean Seabird Populations Show Signs of Recovery

Marine conservation groups reported encouraging signs of recovery among several seabird populations in the North Atlantic following years of habitat restoration and invasive-species control programmes on breeding islands. Species including puffins, storm petrels and shearwaters have recorded improved nesting success in parts of Ireland, Scotland, and Iceland. Researchers caution that climate change and warming oceans continue to threaten food availability, but say the findings demonstrate that targeted conservation measures can yield measurable biodiversity gains. The recovery is being cited as a rare positive development amid broader concerns about global wildlife decline.

Source: The Guardian, June 2026



Seeing the Invisible

How Atmospheric Models Help Us Understand Air Pollution

This article by **Himangi Tripathi** explains how atmospheric models such as WRF–CMAQ help decode India's complex air pollution. By combining weather dynamics with chemical processes, these models simulate pollutant formation, transport, and transformation beyond limited monitoring data. They reveal seasonal patterns, long-range impacts, and policy scenarios, enabling more informed, science-based strategies for managing air quality and decision-making processes overall.

Every year, a grey haze settles over many Indian cities. Schools close, hospitals see a rise in respiratory cases, and public debate intensifies over who is responsible for the pollution.

Yet the air around us remains largely invisible, complex, and difficult to understand. Where exactly does the pollution come from? How far does it travel? Why does it suddenly worsen in winter and improve during other seasons?

To answer these questions, scientists rely not only on monitoring stations but also on powerful atmospheric models. Among the most important of these is the Weather Research and Forecasting-Community Multiscale Air Quality (WRF–CMAQ) modelling system, a scientific tool that helps researchers simulate how pollution forms, moves, and transforms in the atmosphere.

Monitoring stations tell us what the air quality is at a specific location. But they cannot tell the full story. It is impossible to install sensors in every village, highway, industrial cluster, or agricultural field across a country as vast as India. Nor can we measure air pollution at every height in the atmosphere. This is where models help scientists "see" what cannot be directly measured.

At the foundation of this modelling system lies WRF, or the Weather Research and Forecasting model. Weather plays a crucial role in determining how pollution behaves. Wind can disperse pollutants across large distances, rainfall can wash them out of the air, and temperature inversions during winter can trap them close to the surface. WRF simulates these meteorological conditions by dividing the atmosphere into millions of small grids and calculating how wind, temperature, humidity, clouds, and atmospheric pressure change across space and time.



Photo by Abhishek Choudhary on Unsplash

Understanding these weather dynamics is essential because air pollution does not behave randomly. Calm winds can cause pollution to accumulate, while stronger atmospheric mixing can disperse it. Without accurately representing weather patterns, it is impossible to realistically simulate air quality.

This is where the second component comes in: CMAQ, the Community Multiscale Air Quality model. While WRF simulates the weather, CMAQ simulates the chemistry and movement of pollutants. Air pollution is not simply smoke floating in the sky. It is a complex mixture of gases and microscopic particles that continuously react with sunlight and other chemicals in the atmosphere.

For example, nitrogen oxides emitted from vehicles can react under sunlight to form ground-level ozone. Sulphur dioxide released from power plants can transform into sulphate particles. Smoke from agricultural burning or forest fires can evolve into fine particulate matter ($PM_{2.5}$) and travel hundreds of kilometres away. CMAQ represents these chemical

transformations, tracks how pollutants move with the wind, and estimates how they eventually settle on land or water surfaces.

When WRF and CMAQ are combined, they provide a powerful framework to simulate real-world air pollution. WRF generates detailed meteorological fields, such as wind patterns, temperature structures, and atmospheric mixing heights, which CMAQ then uses to simulate emissions, chemical reactions, transport, and removal of pollutants.

This integration allows scientists to understand phenomena that cannot be explained by measurements alone. For instance, during winter in northern India, weak winds and shallow atmospheric mixing layers trap pollutants near the ground, often triggering severe pollution episodes. During summer, stronger vertical mixing can dilute pollution at the surface but carry pollutants to higher altitudes or distant regions. Similarly, smoke from crop residue burning or forest fires in one state can significantly influence air quality hundreds of kilometres away.

The modelling process itself involves several steps. Scientists first gather large datasets, including meteorological inputs, emission inventories from vehicles and industries, satellite observations of fires, and land-use information such as urban areas, forests, and agricultural land. WRF then simulates atmospheric conditions, and CMAQ uses this information to simulate pollutants such as $PM_{2.5}$, ozone, nitrogen dioxide, sulphur dioxide, and carbon monoxide. Finally, the results are compared with ground-based monitoring data to ensure that the simulations realistically represent observed air quality.

For a country like India, such modelling tools are especially valuable. Rapid urbanization, industrial growth, expanding transportation networks, construction activities, and seasonal biomass burning all contribute to air pollution. Monitoring networks provide critical real-time information, but they are



spatially limited. Models help bridge this gap by providing a regional perspective on how pollution spreads across cities, states, and even national boundaries.

In regions such as the Indo-Gangetic Plains, where some of the world's most severe pollution episodes occur, understanding these dynamics is crucial. Pollution levels are often influenced not only by local emissions but also by long-range transport of pollutants across multiple states.

Ultimately, models like WRF–CMAQ do more than simulate pollution; they help policymakers evaluate potential solutions. Scientists can test scenarios such as reducing vehicle emissions, controlling industrial sources, or limiting crop burning, and estimate how these measures might improve air quality.

Air pollution may be invisible, but its consequences are painfully visible in our hospitals, our economy, and the shortening of lives across the country. Tackling it requires more than reacting to daily pollution numbers, it demands a deeper understanding of how pollution forms, moves, and accumulates across regions. Tools like the WRF–CMAQ modelling system provide exactly that insight. By revealing the hidden pathways of pollution and testing the potential impact of control measures before they are implemented, such models allow policymakers to move from reactive responses to informed, science-based strategies. In the fight for clean air, seeing the invisible may be our most powerful advantage.

In the broader debate on how we understand and respond to air pollution, the choice of model is not merely a technical preference, it shapes the very evidence on which policy rests. Models like AERMOD serve an important purpose at the local scale, and WRF-Chem brings valuable real-time coupling of atmospheric processes. Yet, for regional and long-term planning, CMAQ stands out for its ability to integrate emissions, chemistry, transport, and deposition within a flexible and computationally efficient framework. Its largely offline architecture allows policymakers and researchers to test multiple scenarios without re-running complex meteorology each time, a critical advantage in a world where decisions must be both timely and evidence based. That said, no model is inherently superior in all contexts. The strength of CMAQ, like any scientific tool, ultimately depends on the quality of the data that feed it. As we move towards more informed air quality management, the focus must therefore shift not only to better models, but to better emissions inventories, better meteorological inputs, and a more thoughtful alignment between scientific tools and policy needs. ■

Himangi Tripathi, Research Associate, Air Quality Research division, TERI. The article first appeared on TERI's website: https://teriin.org/

TerraGreen at 22

Chronicling the Conversations that Shape a Sustainable Future

As *TerraGreen* completes 22 years of its journey, the occasion offers an opportunity not only to celebrate a milestone but also to reflect on the evolving sustainability discourse that continues to shape our world.

Over the past two decades, the magazine has documented emerging environmental challenges, highlighted innovative solutions, and fostered informed dialogue among policymakers, researchers, industry leaders, and citizens. The past year has been particularly significant, marked by a convergence of climate risks, technological transitions, ecological concerns, and global negotiations that are redefining humanity's relationship with the planet.

The stories featured in *TerraGreen* during the last year reveal a world standing at a critical juncture. Climate change is no longer a distant threat; it is an everyday reality. From the fragile Himalayan ecosystems to India's vulnerable coastlines, the growing frequency and intensity of disasters have underscored the urgency of strengthening resilience. Extreme rainfall events, glacial instability, coastal erosion, and rising sea levels are compelling governments and communities alike to rethink development pathways and disaster preparedness. The challenge is not merely to respond to disasters, but to anticipate them and build systems capable of withstanding an uncertain future.

At the same time, sustainability is increasingly being recognized as a question of vision, values, and collective responsibility. Development today demands more than economic growth; it requires balancing prosperity with environmental stewardship and social equity. Throughout the year, *TerraGreen* explored how leadership, community engagement, and ethical decision-making can help shape pathways towards a more sustainable future. These conversations highlighted the importance of placing people and ecosystems at the centre of development strategies.

The energy transition remained one of the defining themes of the year. As nations strive to decarbonize their economies, green hydrogen emerged as a promising pillar of the clean energy future. Its potential to transform hard-to-abate sectors, enhance energy security, and support industrial decarbonization reflects the scale of ambition required to achieve climate goals. Yet the transition is not solely about technology. It is also about creating enabling policies, building infrastructure, and ensuring that economic opportunities arising from the green economy are inclusive and sustainable.

The intersections between climate change, energy, and human well-being became increasingly evident in discussions around heatwaves. Rising temperatures are emerging not only as a public health challenge but also as a geopolitical and economic concern. Growing cooling demand, energy security considerations, and the need for climate-resilient infrastructure are reshaping policy priorities across countries. India's cooling challenge exemplifies how adaptation and mitigation must proceed hand in hand in a warming world.

Water, another recurring theme in the magazine's coverage, continues to define



the sustainability agenda. Discussions around water inequality and access highlighted the stark disparities that persist despite technological and policy advances. Water security is increasingly intertwined with issues of climate resilience, public health, food systems, and social justice. As pressures on freshwater resources intensify, equitable and sustainable water management remains central to achieving broader development goals.

The year also brought attention to environmental threats that often remain invisible until their impacts become impossible to ignore. The growing presence of biofilm-coated microplastics in food and water systems serves as a reminder that pollution is evolving in complex ways. These emerging contaminants raise critical questions about ecosystem health, human exposure, and the adequacy of existing

regulatory frameworks. Addressing such challenges demands a deeper understanding of the interconnectedness between environmental and human health.

Biodiversity and ecosystem integrity featured prominently in our exploration of ecological change. The spread of invasive species in the Himalayas demonstrated how climate change and ecological disruption can accelerate transformations in some of the world's most sensitive landscapes. Such developments are more than isolated environmental concerns; they have implications for biodiversity conservation, livelihoods, and long-term ecosystem resilience.

The oceans, too, occupied a central place in the sustainability conversation. As interest in deep-sea mining grows in response to rising demand for critical minerals, fundamental questions are being raised about the ecological costs of exploiting one of Earth's least understood environments. Oceans play a vital role in climate regulation, carbon sequestration, and sustaining biodiversity. The debate over deep-sea mining illustrates the broader challenge of balancing resource needs with ecological safeguards in an era of accelerating green transitions.

Agriculture and bioeconomy pathways emerged as another important area of focus. The readiness of India's oil palm sector to harness biomass and contribute to circular economic models reflects a growing recognition that sustainability and economic growth need not be opposing goals. Resource efficiency, waste valorization, and nature-based economic opportunities are increasingly becoming integral components of development planning.

Overlaying all these discussions was the global climate agenda, particularly the road to COP30 in Belém. Climate diplomacy continues to play a decisive role in determining how the world responds to the climate crisis. The pursuit of the 1.5°C target, debates around climate finance, adaptation support, and loss-and-damage mechanisms highlight both the opportunities and the challenges that lie ahead. As countries prepare for critical negotiations, questions of equity, accountability, and collective action remain at the forefront.

Together, these themes paint a picture of a world in transition—one confronting unprecedented risks while simultaneously unlocking new possibilities. They remind us that sustainability is not confined to a single sector, geography, or discipline. It is a multidimensional endeavour that connects energy systems, water resources, biodiversity, technology, public health, economic development, and global governance.

As *TerraGreen* celebrates its 22nd anniversary, we reaffirm our commitment to documenting these transformations, amplifying diverse perspectives, and fostering informed dialogue on the issues that matter most. The challenges before us are immense, but so too is humanity's capacity for innovation, collaboration, and resilience. In chronicling the ideas, debates, and solutions shaping our collective future, *TerraGreen* remains dedicated to its enduring mission: informing, inspiring, and advancing the pursuit of sustainable development for generations to come. ■









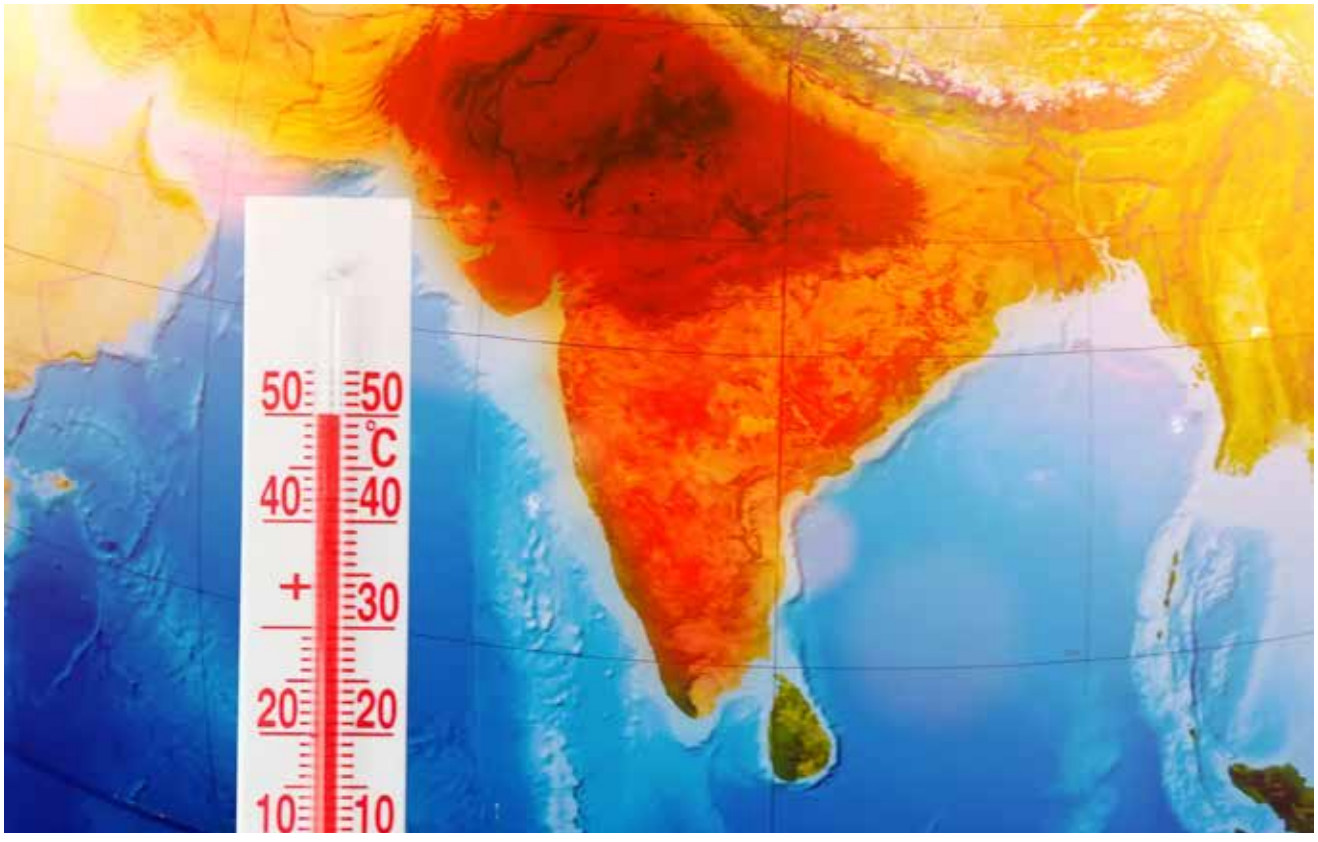




Rising Temperatures

Drivers, Implications, and the Way Forward

In this article, **Arvind Kumar** examines the rising temperatures driven by accelerated climate change, noting that recent years are the hottest on record and heatwaves are becoming more frequent and intense. He explains the role of high-pressure systems, urban heat island effects, and emissions from cooling in amplifying heat stress in cities. The article outlines impacts on agriculture, energy demand, health, and ecosystems, while advocating nature-based and technological solutions, improved urban planning, and early warning systems to build heat resilience and mitigate risks. Stressing urgency and coordinated measures.



Since the 1950s, cities across the globe have experienced large changes in the weather patterns. Global warming is one of the key symptoms of climate change. Record-breaking heatwaves with temperatures around 45 degrees Celsius have become quite common across many regions of India, with both mean and extreme temperatures rising sharply across seasons, contributing to year-round thermal stress.

Global Warming Driven by Climate Change

Science-based evidence has confirmed that recent years have been the hottest on record and the effects of climate change are intensifying—including rapid glacial melt, ocean acidification, wildfires and more frequent and intense extreme weather events. According to the Intergovernmental Panel on Climate Change (IPCC), hot extremes, which used to occur only once in every 50 years during the period (1850–1900), now occur every 10 years. The year 2024 was the Earth's warmest since at least 1850. It was the first year in which temperatures exceeded a 1.5 °C increase relative to the pre-industrial era average. However, the long-term average temperature rise still remains below 1.5 °C (WMO).

There is evidence that the temperature is rising faster. In the period 1970–2010, the temperature increased by an average of 0.18 °C per decade, but in 2010–2023 this rate almost doubled, to 0.33 °C per decade. At this rate of warming, the 2 °C threshold would be reached within the next 20 years. The acceleration of global warming is bringing climate tipping points closer. Exceeding these points could trigger large-scale, often sudden and irreversible changes. However, these negative tipping points may be avoided by taking measures to change socioeconomic systems and technologies that would have positive outcomes for the climate.

What Causes a Heatwave?

Heatwaves are primarily caused by high-pressure systems that trap warm air in a particular area, preventing it



from dissipating. These high-pressure systems, also known as anticyclones, create a dome of heat by forcing air to sink and compress, which increases temperatures at the surface. The lack of cloud cover under these high-pressure systems allows for greater solar radiation, further heating the ground and the air above it. This combination of factors can result in prolonged periods of excessively high temperatures, often lasting several days to weeks. Climate change is also a significant factor contributing to the increasing frequency and intensity of heatwaves. Other contributing factors include urbanization and land-use changes.

What is a Heatwave?

A heatwave is a prolonged period of much-warmer-than-average weather. A heatwave would typically last for several days to a few weeks, involve temperatures that are much higher than usual for the region in question, and in some regions may be accompanied by high humidity levels, which can exacerbate the effects of the heat on the human body.

Quantitatively, it is defined based on the temperature thresholds over a region in terms of actual temperature or its departure from normal. In certain countries, it is defined in terms of the heat index based on temperature and humidity or based on extreme percentile of the temperatures. There is no internationally agreed definition of a heatwave, but the term is always used in exceptional circumstances.

What is the Criterion for Declaring Heat Wave in India?

According to India Meteorological Department, heat wave is considered if maximum temperature of a station reaches at least 40 °C or more for plains and at least 30 °C or more for hilly regions.



Based on departure from normal:

- **Heat Wave**: Departure from normal is 4.5 °C to 6.4 °C
- **Severe Heat Wave**: Departure from normal is >6. 4 °C

Based on actual maximum temperature:

- **Heat Wave**: When actual maximum temperature ≥ 45 °C
- **Severe Heat Wave**: When actual maximum temperature ≥47 °C

If above criteria met at least in 2 stations in a Meteorological sub-division for at least two consecutive days and it declared on the second day.

What Drives Temperature in Cities

Cities, along with urban populations concentrated in densely built-up areas, are highly vulnerable to climate change impacts. In addition to an observed warming trend, the so-called urban heat island (UHI) effect is a typical feature associated with urban climate, which further enhances the excessive heat in cities. The UHI effect results from the interaction of different physical processes. The modifications of energy balance in the built-up environment in terms of land cover and land changes—as well as the additional release of anthropogenic heat combined with less vegetation, reduced air circulation, and reduced nocturnal cooling—contribute to cities being warmer than their surrounding rural areas and more prone to excess heat. Urban building materials often have high heat capacity and thermal conductivity, enabling a greater absorption of solar radiation. Retained heat is then released during the night as long-wave radiation, but the cooling is slowed due to urban structures. The intensity of the UHI depends on many factors: the size and structure of the city; anthropogenic emissions related to waste heat from buildings, industry and number and composition of vehicles; topography; climate zone; and meteorological conditions. Heat waves interact with urban heat islands to produce an effect greater than the sum of the background urban heat island effect and heat wave effect. This intensifies the difference between urban and rural temperatures and creates more heat stress in cities.

Weather factors that have the largest influence on the UHI intensity are wind speed and cloudiness. If incoming solar radiation is decreased by clouds, temperature differences and therefore

UHI intensity are also subsequently decreased. Such weather conditions help to improve human thermal comfort both in the city and in surroundings. Humidity plays an important role as well. Cities in regions with variable wet and dry seasons have larger temperature differences during the dry period. Due to their small share of vegetation, built-up areas also have less water evaporation, which contributes to increased surface and air temperatures.

Extreme heat increases energy consumption for mechanical cooling (especially air conditioning). This in turn raises carbon emissions from energy and contributes to global warming (further necessitating air conditioning [AC] use). Air conditioning further raises outdoor temperatures by contributing to the UHI effect and global warming. Although AC use cools indoor spaces, it further raises outdoor temperatures both directly and indirectly, creating a vicious cycle. ACs directly release heat into streets, raising outside air temperature in the range 2–4°C during intense heat waves, further intensifying the UHI effect. By increasing energy consumption, in cities, AC use can also further contribute to carbon emissions (depending on the energy source) and therefore increase warming due to global climate change. Some have described AC use as a "maladaptation" to extreme heat, because of its negative externalities.

What Needs to be Done to Cool Cities

Cities have access to many solutions to mitigate the increasing risk of heat waves and its enhancement by the UHI effect. Adaptation measures broadly fall into two categories: nature-based and technological solutions. Nature-based solutions refer to green city approaches, which increase the coverage of vegetation to provide better cooling and shading, and blue city approaches, which use water bodies and canal systems for cooling effects. Technological solutions include white city approaches, which use "cool" materials and light-coloured roofs and airflow-promoting architecture to enhance reflection and reduce the absorption of solar radiation. This can lower indoor temperatures by 3–5 °C and decrease cooling energy demand by up to 20 per cent. The success of specific measures depends on local conditions; and in many cases, combining these measures may be most appropriate and bring the highest benefits. Many of these measures also provide multiple benefits, such as space for recreation, increased energy efficiency, and human comfort.



Integration of heat resilience in urban planning and codes

Updating urban planning regulations and building codes to require green roofs, reflective materials, and increased vegetation coverage will systematically embed heat adaptation into future developments. Incentives, such as tax benefits or fast-track permitting, can help accelerate adoption.

Saving lives through early warnings and heat action planning

India Meteorological Department provides colour-coded Heat Wave warning information through its daily bulletins as well as through a GIS-based visualization platform for the next 5 days. The same can be seen at www.mausam.imd.gov.in Heat WaveGuidance.

Indian cities seeking guidance on managing heat waves and the UHI effect can make use of a vast range of data for in-depth analysis. Urban climate analysis can use extensive meteorological observation networks and data sources from remote sensing. Urban climate models can be used to quantify the effect of different adaption options while considering local climate conditions and urban structure.

Impact of Rising Temperatures

Impact on agriculture

Heatwaves can have significant environmental and socio-economic impacts, particularly when combined with prolonged periods of dry weather and drought. Periods of extreme heat can reduce soil moisture, decrease river flows,

and deplete groundwater reserves. This in turn can affect water availability for agricultural, industrial, and domestic use.

Steadily rising temperatures and heatwave extreme weather events have led to conditions conducive to forest fires in many Himalayan states of India. Forest fires cause two different kinds of losses: the GHG emissions resulting from the destruction of the carbon stock in biomass and soil and the loss of future carbon sequestration capacity.

High temperatures lead to high power consumption

Rising electricity use not only raises household bills but also increases carbon emissions. Since about 60 per cent of India's energy comes from fossil fuels, higher energy consumption leads to more CO_2 emissions, worsening air pollution and health problems. It also puts pressure on India's climate commitments, making it harder to reduce emissions.

Health impacts

For most parts of the world, heatwaves are associated with high temperatures. According to the World Health Organization (WHO), heat stress is the leading cause of weather-related deaths and can exacerbate underlying illnesses. The human body can struggle to regulate its temperature when faced with prolonged exposure to high temperatures, resulting in heat stress. Healthcare systems also come under increased pressure from the increased incidence of heat-related illnesses. Globally, extreme heat is estimated to cause approximately 500,000 deaths per year – three times the number of fatalities from tropical cyclones. Heat stress presents significant economic and labour productivity challenges, leading to reduced efficiency, increased absenteeism, higher injury rates, and lower overall output.





Conclusion

Heat waves are a familiar phenomenon to many of us in India. In particular, extreme heat negatively affects every aspect of human life. Heatwaves have become longer, more frequent, and more intense, posing serious risks to health, the economy, and critical infrastructure. Climate change is the main driver of this trend but another key factor exacerbates heat risks: the urban heat island effect in urban spaces. Built-up areas absorb and retain heat, leaving high-density areas with little green space several degrees hotter than the surrounding countryside. Inadequate housing also makes it difficult to stay cool indoors. In parallel to climate adaptation at the city level, improved preparedness and awareness are needed to tackle the risks of heat waves. ■

Arvind Kumar, Former Senior Economic Adviser, Government of India.



Treethane in the Caulosphere

Unexplored Mechanisms and Climate Implication

In this article, **Dr Raghab Ray,** Fellow & Area Convenor, The Coastal Ecology & Marine Resources Centre, Goa, TERI, explores the emerging science of methane dynamics within the caulosphere (i.e., tree stem surface), highlighting how trees can function both as sources and sinks of methane in the global carbon cycle. Drawing on recent research, he explains the role of microbial processes, stem emissions, and oxidation pathways, while also addressing measurement challenges and gaps in current climate models. The discussion underscores the need for deeper investigation, particularly in diverse ecosystems like India, to better integrate 'treethane' into climate science and policy frameworks.

While methane transport through soils and non-woody plants is well understood, why does methane emission from woody plants remain a significant gap in current climate models?

The role of soil and non-woody plants in transporting methane (CH_4) axially from rhizosphere to the atmosphere as a "passive pipe" is well understood and represented in global carbon budgets and Earth System Models (ESMs). On the other hand, CH_4 transport radially through woody plants is highly uncertain and underrepresented in ESMs. In the past few years, some important studies, particularly published in *New Phytologist*, have enriched our understanding of CH_4 dynamics within the caulosphere (i.e., tree bark, Figure 1). Radial diffusion of CH_4 from tree stems is acknowledged as «a new frontier in the global carbon cycle» and is sometimes referred to as *treethane*. Despite spanning a global surface area approximating 143 (±59) million km^2, close to the total land surface area of 149 million km^2, the caulosphere is an understudied component of soil-tree-atmosphere interactions. This is mainly because of technological limitations, and a long-standing scientific assumption that tree bark was merely an inert, structural conduit rather than a dynamic, living ecosystem. Out of over 3 trillion trees globally, more than 40 per cent occur in (sub) tropical settings that contribute to two-thirds of all natural CH_4 emissions.



Accordingly, there is growing consensus that methane dynamics in woody vegetation must be evaluated and considered in ESMs, along with process-based models.

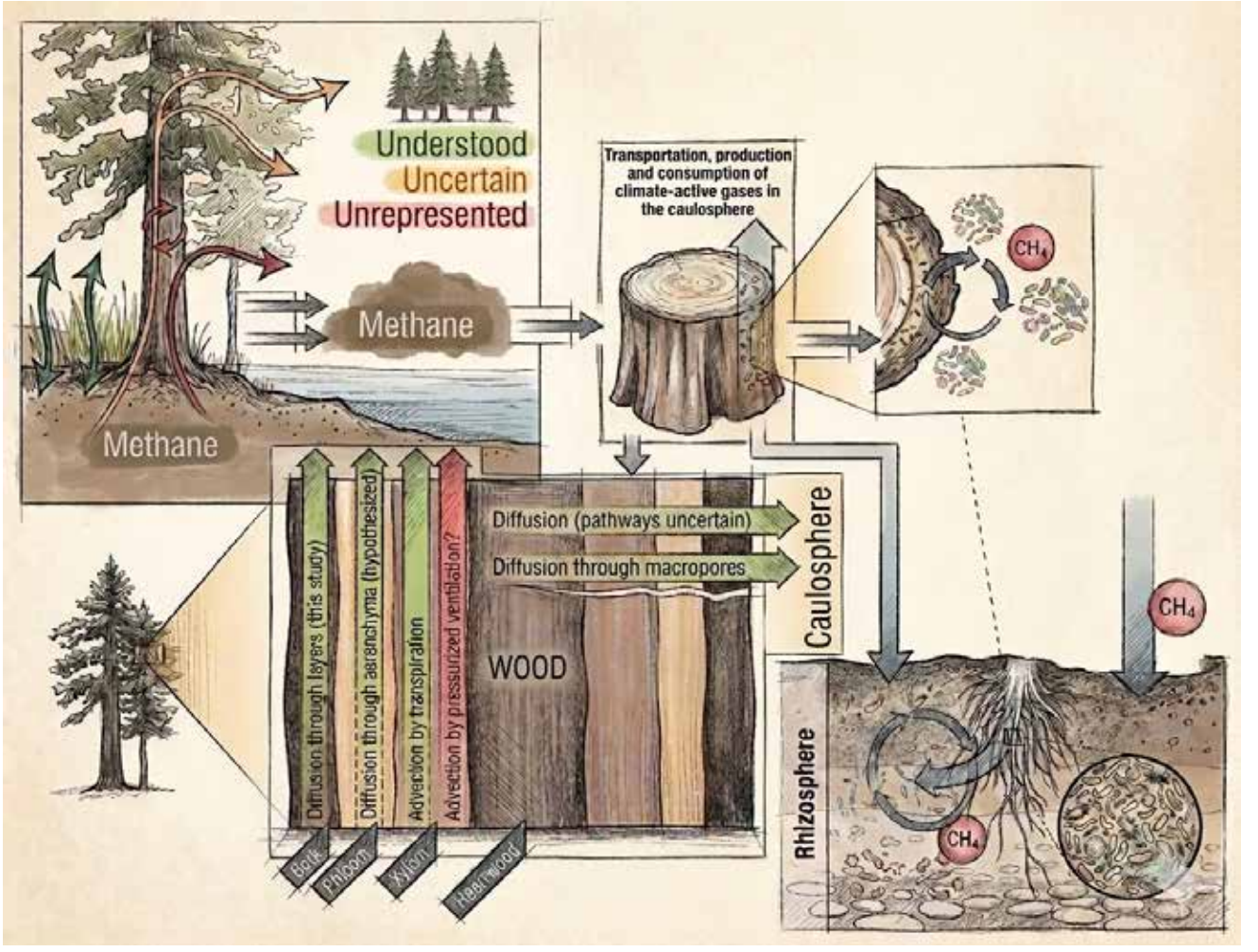


Figure 1: *Methane dynamics at the caulosphere-rhizosphere interface in woody vegetation (adopted from Ward and Megonigal, 2024; Leung et al., 2026)*

What recent scientific findings suggest that tree stems themselves can act as active sources of methane, and what biological processes drive these emissions?

In recent times, a number of investigations on methanogenesis (i.e., CH_4 production) has revealed that trees harbour active and diverse microbial communities within the bark that are capable of metabolizing a range of climate-active gases. Notably, fungal-mediated heartwood decay has been identified as a key driver of CH_4 emissions from living trees. Fungal CH_4 production is linked to chloromethane (CH_3Cl). Some submergent macrophytes such as mangroves are known to thrive under anoxic soil conditions and therefore act as CH_4 sources. Anoxia may be created through oxygen-consuming metabolic processes of tree-associated endophytic microbes, such as fungi, as well as through active stem and root respiration. Another recently discovered CH_4-producing group is cyanobacteria, which have been linked to this process both under oxic and anoxic conditions, depending on substrate availability.

How do tree stems act as sinks of CH_4?

While on one hand, tree stems emit substantial CH_4 to the atmosphere, there exists another mechanism, regulated by bark-dwelling microbes of lowland trees, that oxidizes CH_4. Though the significance of methane oxidizing bacteria (MOB) in soil and water is widely known, trees are a lesser-known reservoir, not because of the general absence of these populations, but at least partly due to underdeveloped detection methods with poor sensitivity. Acknowledging the seminal work of Luke Jeffrey and others on the discovery of MOB in *Melaleuca quinquenervia* (paperbark tree, native to Australia), George A Inglish described this finding as "bacteria in tree bark are hungry for methane. "These



methanotrophic bacteria can reduce up to one-third of total treethane emissions. According to the most recent meta-analysis, the global mean woody surface CH_4 sink is estimated at 37.2 Tg of CH_4 yr^{-1} comparable to the soil sink (30–40 Tg of CH_4 yr^{-1}, 1 Tg = 1012 g).

Since the concept of tree-stem CH4 dynamics is still emerging globally and lacks clear empirical validation in the Indian context, a structured Q&A-based knowledge-sharing framework could help generate more insights and support its development.

Is there a standard height of the stem from the soil surface for chamber deployment?

Generally, measurements are taken at about 2 m above ground level as a standard height. However, even at this level, chamber placement may overestimate methane emissions, especially in submerged vegetation like mangroves, because the lower parts of tree stems are closer to methane-rich soils. This methane can be taken up by roots and transported through the tree before being released into the air. Therefore, deployment must account for the tidal prism, particularly in the case of mangroves.

What is the contribution of tree-stem CH_4 to total emissions across forested biomes in India?

The answer is not yet well constrained, despite India hosting a diverse array of both highland and lowland floral ecosystems, including a wide range of mangroves (~0.5 million ha), cottonwood, and paperbark trees. While India encompasses a wide range of vegetated biomes, the role of tree-mediated CH_4 flux remains underexplored. Recent papers published in leading journals such as *Nature* and *Science*, highlight the global relevance of tree-stem CH_4 emissions and underscore the need for region-specific investigations. These developments should encourage Climate Scientists and Plant Biologists in India to undertake long-term monitoring of tree-stem methane fluxes and integrate such data into national trace gas inventories.



What would be the next steps for measurement?

Omics and data science: Promoting metagenomics and meta-transcriptomics to discern selective amplification and detection of CH_4 oxidizing gene in tree stems/barks (functionally detected through extensive searches of public metagenomic libraries in India, such as National Centre for Biotechnology Information-Sequence Read Archive or NCBI-SRA).

Method development: Moving beyond manual static chambers to Automated Tree Enclosure Systems paired with low to medium cost, high accuracy sensors will enable high-frequency data collection and strengthen measurement, reporting, and verification (MRV) tools. This is crucial for capturing temporal (diurnal or seasonal) pulses of CH_4 that manual sampling often misses. Omics data could be utilized to design probes for applications such as fluorescence in situ hybridization (FISH) coupled to Confocal Laser Scanning Microscopy (CLSM) to visualize the precise spatial distribution of CH_4-cycling microbes within different tree tissues.

How can this research contribute to carbon finance in the long run?

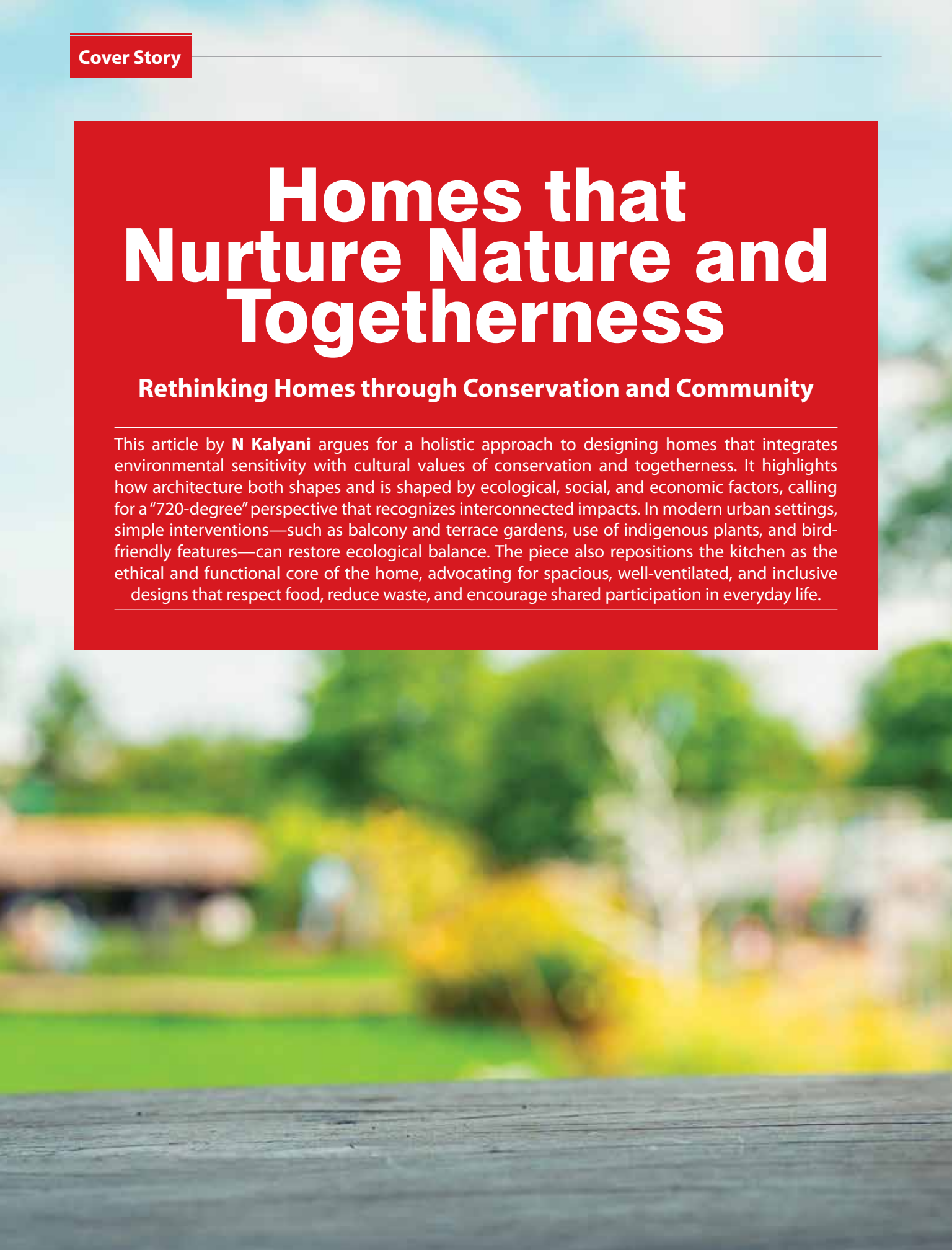
Despite being a scientifically proven phenomenon, treethane is not integrated into international carbon registries due to a lack of standardized protocols. By identifying and sustainably planting tree species rich in MOB through rigorous research, an "avoided emissions" pathway could be established, and low-cost accurate MRV tools could provide direct technical validation to unlock carbon finance for these specialized ecosystems.

By promoting carbon sequestration pathways, additionality can be demonstrated through activities such as secondary plantation of suitable tree species or the conservation and restoration of degraded lands, provided these interventions lead to measurable carbon gains beyond a defined baseline scenario. ■

Homes that Nurture Nature and Togetherness

Rethinking Homes through Conservation and Community

This article by **N Kalyani** argues for a holistic approach to designing homes that integrates environmental sensitivity with cultural values of conservation and togetherness. It highlights how architecture both shapes and is shaped by ecological, social, and economic factors, calling for a "720-degree" perspective that recognizes interconnected impacts. In modern urban settings, simple interventions—such as balcony and terrace gardens, use of indigenous plants, and bird-friendly features—can restore ecological balance. The piece also repositions the kitchen as the ethical and functional core of the home, advocating for spacious, well-ventilated, and inclusive designs that respect food, reduce waste, and encourage shared participation in everyday life.







Without being a trained architect or a design professional one can, by virtue of living in and making use of a space, come up with ideas and suggestions to improvise the space to make it more productive and beneficial to all those who use it.

It is in this sense that all stakeholders are invited to give their suggestions for any given project. Because they bring their own perspective and point of view to the table. And deliberations or improvisation can be done in a holistic manner.

Architecture and design is fundamental to the spaces we live in and use whether it is residential spaces, office spaces or spaces that host the innumerable other activities that make up our life. This includes built areas that offer facilities related to education, entertainment, shopping, healthcare, hospitality, transport, sports, worship and meditation, besides many other aspects of our life. Also included are gardens and parks that come under landscape designing.

Various elements determine the architecture and design of a building. This includes geography, topography, climate, environment, utility, aesthetics, social and cultural values, and availability of eco-friendly materials, besides other factors. There is also a financial aspect to the execution of the design. Design sense and sensibility in these respects is reflected in the design plan that is executed as the building or the space. When it comes to a factor like the environment, we find that there are two ways of looking at it. First, the environment influences building design. Second, the environment is influenced by construction—both at a micro, local level and at a broader scale, such as when existing wildlife habitats are affected by the creation of townships, railway tracks, or expressways.

Thus, there is a need for a holistic approach to architecture and design, as numerous elements both influence a design and plan, and are, in turn, influenced by a construction, building, or space used for human activity. In the absence of such an approach, the goal of optimal use and benefit for all stakeholders may be undermined.

In fact, the holistic approach goes beyond 360

degrees; it becomes a 720 degree approach. Because we find every element, every factor, every determinant as influencing and being influenced by each other. So, if we see it in terms of the two-directional impact, we could say the chain works in two directions. This makes it a 360-plus-360 approach. This takes the usual 360-degree approach to a higher order of incorporating the interconnectedness and mutual interaction inherent to life.

Let us here limit ourselves to homes and residential spaces from this perspective. How can homes of today be designed and planned from the viewpoint of being eco-conscious and environment-friendly as also promoting human, family and community values?

In today's world of concrete jungles that are residential areas with apartment towers making up most of residential dwellings, what kind of garden can we expect for each individual dwelling? Obviously nothing at all. Nevertheless, the inclusion of verandas and balconies can allow for placing and tending some potted plants. These could be ornamental flowering and non-flowering plants such as the *gulab* (rose) and coleus. It could even be a miniature kitchen garden look-alike by having plants like *tulsi*, green chilli and mustard that are amenable to growing in pots. It may also be possible to have a terrace garden. All that is required is to design and plan little open spaces in the apartments that are built in high-rise towers.

Foliage curtains can also be incorporated on facades of residential units. It not only has an aesthetic appeal but also has something of nature surrounding our life. Trailers and creepers double up as pendulous foliage. It is also known that when a habitat is created wildlife species and life forms that can inhabit the habitat arrive. For instance, this has been observed when there is a re-forestation/afforestation project developed on a piece of land.

In the context of residential spaces, having a few potted plants or, on a larger scale, a terrace garden, in our homes can invite butterflies and birds. And one can watch a flitting butterfly or listen to the twitter, chirp or chirrup of some bird species. Here we may wisely opt for local and indigenous *(desi)* plant species. For exotic plant species may, if at all, appear fantastic to see but may fail to grow well and may fail too to attract bees, butterflies, and birds.

We also learn that one of the factors causing a drop in house sparrow populations, and even their complete absence in human habitation spaces, is the lack of availability of nesting spaces. One of the reasons that is attributed to this is the modern day architecture of buildings that does not allow the house sparrows to build their nests and raise families. In the good old days when the house sparrow was oh-so-common in our surroundings we have seen them build their nests on window sills, in ventilators and fanlights, on roofs of porches and porticos, and little spaces and crevices on verandas, and in balconies. Modern-day architecture with walls rising up straight as facades with glass and shiny smooth metal does not offer nesting spaces for birds such as the house sparrow, a commensal of man for several thousands of years.





Small tweaks and minor adjustments in the architecture and design of residential spaces can make modern buildings amenable to the house sparrow finding its little space for a dwelling. It would not take much to host little bird species in residential spaces. Also, nest boxes can be used in balconies and verandas to attract bird species. This would allow birds like the bulbul and sunbird too to enjoy the hospitality. The visitor whether a bird or butterfly is welcomed and hosted respectfully and graciously.

Now we move into the home. What do we think of as the central place of the home? Is it the living room? Is it the bedroom? Is it the pooja room or study? Or is it the kitchen? While each of these spaces is of significance in our daily life it is the kitchen which hosts the activity of food preparation that is vital to our sustenance.

Food is traditionally considered a sacred resource and a sacred offering. Today's imperative need for environment and resource conservation requires an identical approach to food and water. Wasting food and water implies the waste of a great deal of natural resources. For instance, what is the amount of water used in irrigation of agricultural crops? What is the fuel consumption in the cooking of food? Do we have such unlimited natural resources?



Annam Na Nindayat is a traditional Indian dictum that tells us not to despise, complain about or condemn food. Food is to be respected. Food is to be cooked and consumed judiciously. Food portions should be offered judiciously.

We are known for our warm hospitality and live by the traditional Indian dictum, *Atithi Devo Bhava*, where even an unexpected visitor—one who arrives unannounced (atithi, meaning "without a fixed date")—is welcomed as a god. The offering of food and beverage is an integral part of this gesture of welcome. Food holds a certain sanctity, whether it is consumed within the family or shared with visitors and friends.

Principles like *Annam Na Nindayat* reflect how Indian cultural traditions are inherently oriented towards resource conservation. Such conservation is of utmost importance, as many resources may not be renewable. But what do these traditions have to do with architecture and the design of homes? Quite simply this: if food is a valuable resource—one that itself requires resources for its creation—and if conservation is vital for life on Earth, then both the human effort involved in preparing food and the space where it is made assume

significance. These two aspects, namely the extent of human effort and the space of food preparation, are closely linked to who in the family prepares the food and the kind of kitchen in which it is cooked.

One mostly finds the kitchen in homes to be a very small space. Sometimes it is not even built in a way that one can enter the kitchen and use the space well. For instance, one has observed a kitchen wherein the door opens into the kitchen dividing the kitchen into two halves. How could one even walk across the kitchen then? Sometimes kitchens are built without a window, without a chimney, and without the possibility of cross ventilation to take away the smoke and fumes that emanate especially in Indian cooking. Women who cook in such kitchens may develop lung conditions akin to tobacco smokers. Are our kitchens in homes gender insensitive given that in most cases it is the women of the household who engage in cooking and food preparation activities? Sometimes kitchens are built, whether it is the shape of a rectangle or a square, with such narrow dimensions that only one individual could be at a time in the kitchen. So it is the woman of the family, or a hired cook, whether male or female, who works in that tiny space to dish out a grand meal for the whole family or for the family and friends to relish and enjoy! How sustainable is this? How sensitive or insensitive could the designs of homes be?

When food is consumed and enjoyed by humans irrespective of their gender why should the activity of cooking have any gender bias? Respect for the human effort that goes into the activity of cooking, and due regard for the resources that are utilized in the preparation of food and the food itself can be engendered from a young age only when the whole family is involved in this most important activity of cooking. This appreciation and respect goes a long way in respecting and appreciating the efforts of each one in the family. All of this has everything to do with resource conservation because children in the family learn by watching their elders including parents when it comes to conservation of resources and respect for food. It is a matter of simple observation that when the whole family is involved in an activity it becomes a fun activity. Children enjoy the small activities related to cooking, and in the process learn a great deal. From mathematics to physics to chemistry to conservation. And most importantly they learn skills that make them self-sufficient for life.

When a house is designed with a sufficiently large kitchen, it encourages the whole family to participate in one or more of the activities involved in cooking. Given that the kitchen contains three elements that can be risky and dangerous—a source of heat (such as a flame or induction stove), cutting tools like knives,





and running water from taps—it is only logical that the space be designed to allow adequate room for each activity. For instance, ensuring sufficient space for washing fruits and vegetables, as well as for storing them neatly and hygienically, not only helps prevent disease but also reduces wastage.

The kitchen space needs to be sufficiently large, well lit with natural light and well ventilated. The whole gastronomic experience can be an immersive one. The aromas of the food, for instance, enjoyed at the dining table near or in the kitchen. And imagine, for instance, the living room space blending with the dining space, merging with the kitchen overlooking the kitchen garden.



Again, our tradition in the Indian culture speaks of *Anna Data Sukhi Bhava*. A grateful heart with a full stomach after partaking a fulfilling meal blesses and silently offers gratitude to all those who made that meal possible. From the farmer tilling the soil and harvesting the crop, to the shopkeeper who sells provisions, to the persons in the family who convert the raw materials into delicious dishes and a wholesome meal. This points to the respect for the human effort and the utilization of various non-renewable natural resources that go into the creation of food. This again revolves around the idea of conservation—and reinforces, once again, the need to design kitchens thoughtfully in our homes.

All of this ultimately points to the wisdom of adopting a more holistic approach to designing our residential spaces. ■

N Kalyani is a freelance writer, and writes on environment, nature, and wildlife. She is the author of Mysteries and Musings *(2011), a collection of her poems, and of* Make it Big *(2023), a motivational book. She loves nature and is a meditation enthusiast.*

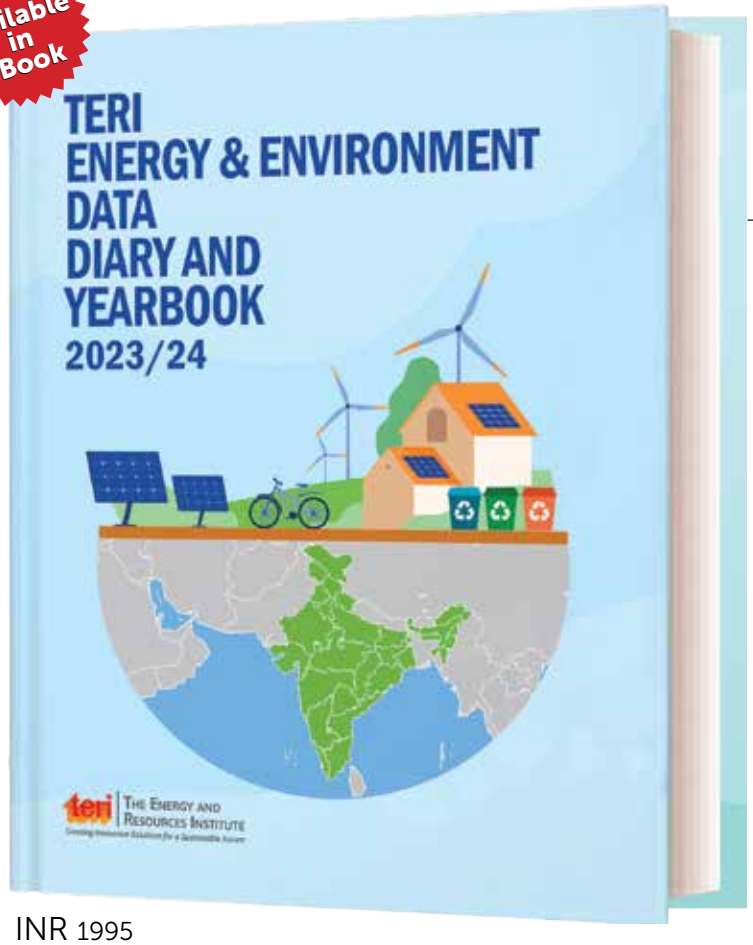
The Most Comprehensive Annual Data Diary and Yearbook on

India's Energy Sector and its Impact on Environment

Available in eBook

Order Now & Save

30% on eBook



INR 1995

- TEDDY is an annual publication brought out by The Energy and Resources Institute (TERI) since 1986, which presents latest information on energy supply, energy demand, and environment.
- It seeks to support policy research and decision-making by providing policymakers and researchers with the facts and data which can further be used to develop actionable solutions warranted by rigorous analysis.
- Each edition of TEDDY contains India's commercial energy balances that provide comprehensive information on energy flows within different sectors in the economy.

- *Institutional orders limited to 10 copies*
- *Special e-package for corporate users*

Web: http://teriin.org/projects/teddy

Place your order at teripress@teri.res.in

teri

Rewriting the Plastic Story

For a Sustainable Climate Future

In this article, **Anagha Krishnan** and **Girija K Bharat** highlight the deep link between plastics and climate change, driven by their fossil-fuel origins and emission-intensive lifecycle. Focusing on India, the article underscores how mismanaged plastic waste contributes to global pollution and GHG emissions. It also draws attention to toxic chemical additives and their environmental and health impacts. While alternatives like bioplastics offer limited relief, the authors stress the need for reduction, reuse, and circularity. Strong policies, including EPR, along with citizen participation and integrated waste management, are crucial to addressing this interconnected crisis.

Introduction: The Invisible Connection

Scenes of littered coastlines, crammed landfills, strangling marine life, trash-filled streets are still common sights in many places. Yet, beyond this visible plastic waste crisis lies the global climate hazard. Policy frameworks still largely treat plastic waste as a municipal solid waste problem. It is important to formally recognize that plastics are fossil-fuel-derived materials and mismanaged plastics generate greenhouse gases. Open burning contributes to black carbon emissions, and plastic leakage damages climate-resilient ecosystems.

A 2024 study published in the journal *Nature*, found that India emits about 9.3 million tonnes of plastic pollution annually, accounting for roughly one-fifth of global plastic waste emissions. The key findings present that India ranked first globally in unmanaged plastic emissions, followed by Nigeria and Indonesia. The study measured plastic waste emissions (plastic entering the unmanaged environment), not merely total plastic generation. It included: uncollected waste, open burning, uncontrolled disposal, littering, and leakage into the environment. The research was widely cited in environmental discussions related to the ongoing UNEP-led Global Plastics Treaty negotiations.



As per the *CPCB (2024–2025) Annual Report*, the total plastic waste generation in India in the FY 2022–23 accounts to 4.14 million tonnes with per capita generation standing at 3.6 kg. But in reality, it is not just the generation, but how plastic is handled within municipal solid waste (MSW) system really matters.

How do we tackle this problem and isn't there an end to it are the questions that still lingers in the mind of scientists,

researchers, and even the common citizens. Plastics and climate are deeply interconnected throughout the entire life cycle of plastic, from production to disposal as the global plastic production escalates, so are the emissions associated with it.

Plastic waste often gets mixed with organic, biomedical, or hazardous components, making it economically and technically difficult to recycle. Plastic pollution, an environmental crisis, is equally a social and gendered one as well where most of the women who work in the informal waste sector are significantly vulnerable due to exposure to hazardous materials and chemicals in the plastic products. The interconnectedness that prevails here depicts that plastic pollution, climate change, inefficiencies in waste management, and social inequalities are intertwined and part of a single systemic challenge that demands intervention through integrated environmental and social solutions.



Inter-linkages of Plastics with Hazardous Chemicals

The environmental challenge of plastics is not limited to visible waste; it also involves thousands of embedded chemical additives, many of which are toxic, persistent, and capable of leaching into ecosystems throughout the plastic lifecycle. These chemicals include phthalates (plasticizers), which are used to make plastics flexible and soft, especially PVC. They are common in cables, flooring, toys, packaging. They cause endocrine disruption, reproductive toxicity, developmental problems, and hormonal imbalance.

These hazardous chemicals are silent killers and are categorized as: Bisphenol A (BPA) used in polycarbonate plastics, food containers, epoxy linings, bottles. They cause hormone disruption, metabolic disorders, reproductive effects and have possible links to breast/prostate cancer. Flame retardants, such as polybrominated diphenyl ethers (PBDEs), organophosphate flame retardants, heavy metals, per- and polyfluoroalkyl substances (PFAS) ("Forever Chemicals"), UV stabilizers, antioxidants and processing stabilizers, colourants and pigments (containing cadmium, chromium, lead-based compounds), organotin compounds used especially in PVC stabilization, such as tributyltin (TBT), nonylphenols and alkylphenols (used in detergents). These chemicals and additives used in plastics contribute to climate change through fossil-fuel intensive production, greenhouse gas emissions during manufacture and disposal, release of black carbon and methane from open burning and degradation, disruption of ecosystem



carbon sinks, and long-term dependence on petrochemical infrastructure.

The Carbon-Intensive Lifestyle

Plastic products do have many valuable uses in our daily lives, but the current rate of production and consumption levels can end up in posing serious threats to human health and the planet as a whole. Reports from the United Nations reveal that about 98 per cent of single-use plastic produced are made from petrochemicals that in turn creates carbon emissions that are responsible for global warming. As per the 2022 statistics by the Organisation for Economic Co-operation and Development (OECD), greenhouse gas (GHG) emissions from fossil-based plastics are projected to triple by 2060 with half of all plastic waste still being landfilled and less than a fifth being recycled. The impact arising from this very plastic production and usage can be such that it can cause human carcinogenic toxicity to acidification, eutrophication, and land-use change. Overall, plastics lifecycle emissions are projected to increase from 1.8 Gt CO_2e in 2019 to 4.3 Gt CO_2e in 2060, growing from 3.7 per cent to 4.5 per cent of global emissions. This carbon-intensive lifestyle must be tackled by preventing the leakage of plastics into the environment that is essential not only for protecting marine bodies, biodiversity and human life but also for tackling the global temperature rise which can support climate justice worldwide.

Bioplastics often known as a "sustainable substitute" to virgin plastics are taking the front seat. It can help trim down the carbon emissions only to a certain extent. The carbon math cannot be solved without a reduction in total plastic production. The end-of-life reality of bioplastics hits different as they require specific conditions like high temperature of industrial composting facilities to decompose. In case they end up in standard landfills or water bodies like virgin plastics, they do persist for extended periods deteriorating soil health as the ambient temperatures rises. Expert opinion from European Bioplastics suggests that the greatest climate benefits are achieved when bioplastics are manufactured with renewable energy, used and processed efficiently in industrial facilities without energy intensive processes or used for renewable energy recovery at the end of their lifecycle. Be it virgin plastics or bioplastic a full lifecycle approach must be taken into consideration which is the only solution to tackle the escalating plastic menace.



A Simple Solution That Matters

Bioplastics can be part of the solution, but they are not a complete answer to the plastic crisis. In fact, many experts, including experts from the United Nations Environment Programme (UNEP) warn that bioplastics can create new environmental problems if they are treated as a "silver bullet." The real solution lies in: reducing unnecessary plastic use, reuse systems, circular economy models, better collection and recycling, safer materials, and responsible innovation.

Sustainable waste management can be achieved through effective source segregation. Segregation is the first mile of circularity. Source segregation enables cities to treat their waste scientifically, thereby reduce dumping in landfills and thus preventing pollution of land, water bodies, and air. The success of these models lies in the segregation of waste at the source and appropriate engagement with the citizens.

A few of the cities/districts in India have demonstrated how citizen action can effectively and efficiently solve this crisis. The Alappuzha district in the state of Kerala has embarked on the 'Clean Home Clean City' project focussed on source segregation. The Alappuzha Municipal Council (AMC) has distinguished itself by its success in source-level segregation coupled with decentralized waste management. This has helped the city in protecting its water bodies from clogging up with plastic waste for its sustainable waste management practices; Alappuzha received recognition from the UNEP in 2017.

Indore in the state of Madhya Pradesh through its source segregation, stakeholder participation and proper governance paved the way for achieving efficient plastic waste management. The city has earned the 5-star garbage-free city tag and is being ranked the cleanest city of India in *Swachh Survekshan* surveys since 2017.

The city of Panaji in Goa has adopted a zero-waste and zero-landfill model by implementing decentralized waste management system and treatment of waste at its place of origin. The municipal corporation of the city has adopted innovative technologies, continuous information, education and communication (IEC), treating waste at source, waste reduction owing to its space constraint and the large quantum of waste that was generated. Awareness campaigns have helped to promote source segregation of waste in the city.

Policy Solutions and Climate Actions

Moving forward, policy actions are mandatory and need of the hour in addition to the waste management solutions that are in place to tackle the current global climate crisis. Achieving complete plastics circularity will need continuous collaboration across various sectors and stakeholders, including policymakers. Policy actions can help resolve the deeply interconnected problem of plastic pollution on one hand and the climate-related problems on the other hand such as dumping of huge piles of plastic waste, better waste collection, recycling systems, and environmentally sound disposal methods, preventing plastics from entering oceans and waterways. The Global Plastics Treaty is a legally binding international agreement formulated by the United Nations to combat the rising crisis of plastic pollution. The treaty helps in mandating and building a full-life-cycle approach which regulates plastics from their very nascent stage of design



and raw material production down to their disposal and recycling.

Extended Producer Responsibility (EPR) is a means of tackling the plastic pollution and climate change issues by making the producers responsible for collecting, recycling, and managing the waste generated from their products and packaging. This kind of mandate will also help companies reduce unnecessary usage of plastics in their products, design and adopt recyclable or reusable packaging, and invest in better waste management and recycling systems. All these can have a positive effect by diminishing the carbon-intensive energy reliance. Minimal carbon footprint, circular economy, reduced financial burden of waste management, producer responsibility, accountability and innovation in sustainable packaging solutions can bring in a drastic change thereby tackling the global climate crises.

A Way Forward

Implementing a Pollution Prevention (P2P) approach can help address both plastic pollution and the climate crisis wherein focus is on preventing waste and emissions at the source rather than dealing with them once generated. Adopting this approach can be rewarding: restricting excessive plastic use, fostering eco-friendly material alternatives, boosting efficient use of resources and adopting cleaner production methods. Lowered greenhouse gas emissions, decreased environmental pollution, circular economy principles can enable a gradual shift towards sustainable practices thereby conserving the energy resources and alleviating long-term environmental impacts.

In a nutshell, addressing mismanaged plastic waste requires a transition from fragmented waste management approaches to an integrated climate-responsive circular economy framework. Reducing plastic leakage, eliminating open burning, strengthening circular systems, improving producer responsibility, and integrating plastic emissions into climate policy are critical steps towards mitigating both environmental and climate risks. This requires integrating plastic waste into: Climate action plans, Carbon accounting, ESG frameworks, and Sustainability reporting. ■

Anagha Krishnan and Girija K Bharat, Mu Gamma Consultants, Gurugram.

Beyond Outrage: Rethinking Great Nicobar

A Call for Consistent Focus

The article by **Gajanan Khergamker** examines the debate around the Great Nicobar development project, suggesting that much of the public reaction has been short-lived and surface-level. While acknowledging legitimate concerns about environmental impact and tribal rights, it stresses the need for consistent, long-term attention rather than episodic outrage. The piece highlights the importance of balancing development with ecological protection and social responsibility, arguing that meaningful progress depends on careful oversight, scientific evaluation and transparent decision-making rather than momentary public attention.

A famous politician's visit to Great Nicobar in April 2026 was framed as a moral intervention against ecological destruction and tribal displacement. Standing amid the dense tropical landscape of Campbell Bay, he described the proposed infrastructure project on the island as among the gravest assaults on India's natural and indigenous heritage. The political timing of the visit, however, carried its own unmistakable significance. The outrage that followed travelled through the predictable circuitry of digital activism with extraordinary speed. Social media accounts that had displayed little prior engagement with the geography, ecology or strategic significance of the Andaman and Nicobar archipelago suddenly discovered a deeply performative environmental conscience.

The Great Nicobar Island Development Project is neither a small undertaking nor an uncomplicated one. Spread across more than 166 square kilometres, it involves the construction of a transhipment port, an international airport, a township and associated power infrastructure. The scale of forest diversion involved has triggered concern among environmentalists, scientists, and tribal rights advocates. Those concerns deserve rigorous attention because projects of this scale alter ecological systems permanently and reshape demographic realities for generations.



The National Green Tribunal's refusal in February 2026 to halt the project altered the tenor of the debate significantly. The Tribunal declined to interfere with the environmental clearance granted earlier and acknowledged the strategic rationale advanced by the government, while simultaneously insisting upon strict adherence to environmental safeguards and regulatory conditions. That judicial position complicated attempts to portray the matter as an unchallenged environmental catastrophe proceeding outside institutional scrutiny. This is precisely where the discussion begins separating genuine constitutional concern from political theatre.

Former Environment Minister Jairam Ramesh's interventions on the issue, including his earlier objections regarding ecological impact and tribal vulnerability, fall squarely within democratic accountability. Parliamentary scrutiny,



environmental litigation and public questioning of executive decisions are indispensable features of a constitutional democracy. Questions relating to forest diversion, tribal consent and biodiversity protection require sustained examination through legal, scientific, and administrative processes.

What deserves equal scrutiny, however, is the extraordinary selectivity with which global outrage manifests itself whenever India attempts large-scale infrastructure expansion. Britain's HS2 rail project faced widespread criticism for damage caused to ancient woodland ecosystems considered ecologically irreplaceable. Conservation groups repeatedly argued that centuries-old habitats could not simply be relocated or recreated through compensatory plantation exercises. The ecological consequences were serious, acknowledged and extensively documented. International outrage, however, remained relatively restrained. The same moral absolutism now visible in discussions surrounding Great Nicobar was largely absent when comparable environmental trade-offs accompanied infrastructure expansion in the developed world.

That contrast is revealing because it exposes the political geography of contemporary environmental discourse. The world's most powerful economies routinely recalibrate environmental standards whenever strategic or commercial priorities demand acceleration.

In the United States, environmental review mechanisms have repeatedly been diluted or streamlined in the name of infrastructure growth, energy expansion and administrative efficiency. Governments justify these measures as reforms necessary for national development. The language employed in such contexts is pragmatic, technocratic, and strategic. Developing nations attempting similar infrastructure ambitions are often subjected to an entirely different vocabulary rooted in moral alarmism.

Singapore presents an even sharper comparison. Frequently cited as the benchmark for maritime efficiency and transhipment excellence, Singapore achieved its strategic transformation through extensive land reclamation and aggressive coastal expansion. Ecological consequences involving mangroves, marine ecosystems and coral habitats were acknowledged as developmental costs accompanying national ambition. The global discourse surrounding Singapore celebrated vision, efficiency and strategic foresight. India's proposal to establish a transhipment hub near one of the world's most critical maritime corridors has generated a dramatically different reaction despite operating within a comparable strategic logic.

The inconsistency is impossible to ignore. Countries that constructed prosperity through relentless industrial expansion, territorial modification and strategic infrastructure growth now often adopt an elevated moral posture when developing nations pursue comparable ambitions. The environmental consequences of Western expansion are treated as historical complexity. Similar processes in India are frequently framed as evidence of democratic or civilizational failure.

Great Nicobar has therefore become a site onto which larger anxieties are being projected. This does not diminish the seriousness of the ecological concerns involved. The island's biodiversity is extraordinarily sensitive.

Questions relating to the Shompen community, categorized among India's Particularly Vulnerable Tribal Groups, carry immense constitutional and ethical significance. Consent mechanisms, rehabilitation frameworks and the long-term implications of demographic change require transparent and

independent oversight. The Leatherback turtle nesting habitat around Galathea Bay also requires conservation mechanisms insulated from bureaucratic conflicts of interest.

Those concerns demand continuity rather than episodic outrage linked to political visibility cycles. The problem with digitally amplified environmental activism is that it often privileges emotional spectacle over institutional persistence. Viral indignation generates visibility for a few days before moving towards the next politically useful controversy.

Ecological protection, by contrast, requires years of sustained litigation, scientific monitoring, policy enforcement and bureaucratic accountability. The people producing dramatic reels about Great Nicobar today may not remain invested when the harder questions surrounding implementation, compliance and tribal rights begin emerging in courtrooms and regulatory hearings.

The island deserves more seriousness than that. India possesses a legitimate strategic interest in strengthening its maritime infrastructure in the Indian Ocean region, particularly near the Malacca Strait through which a substantial portion of global trade passes. Geostrategic realities cannot simply be wished away through rhetorical environmentalism. Simultaneously, strategic necessity cannot become an excuse for administrative opacity or ecological negligence. Democracies are tested precisely in their ability to negotiate these tensions honestly rather than rhetorically.

The challenge before India is therefore two-fold. It must resist external moral patronization rooted in geopolitical double standards while also ensuring that developmental ambition does not erode constitutional safeguards, ecological protections and tribal rights through bureaucratic expediency. That balance cannot emerge through social media spectacle.

The conversation surrounding Great Nicobar requires scientific precision, constitutional clarity and sustained institutional vigilance. Environmental safeguards attached to the project must be enforced rigorously. Tribal rights cannot become ceremonial references inserted into policy documents without meaningful adjudication. Independent ecological oversight must remain continuous rather than symbolic. These are substantive democratic obligations and they extend far beyond the lifespan of any viral outrage campaign.

The performative ecosystem surrounding the issue will eventually migrate elsewhere because spectacle thrives on movement. Great Nicobar, however, will remain long after the hashtags disappear. The consequences of what is built there, how it is built and whose interests shape the process will continue defining the island's future for decades. That future deserves a more intellectually honest conversation than the one presently dominating digital discourse.

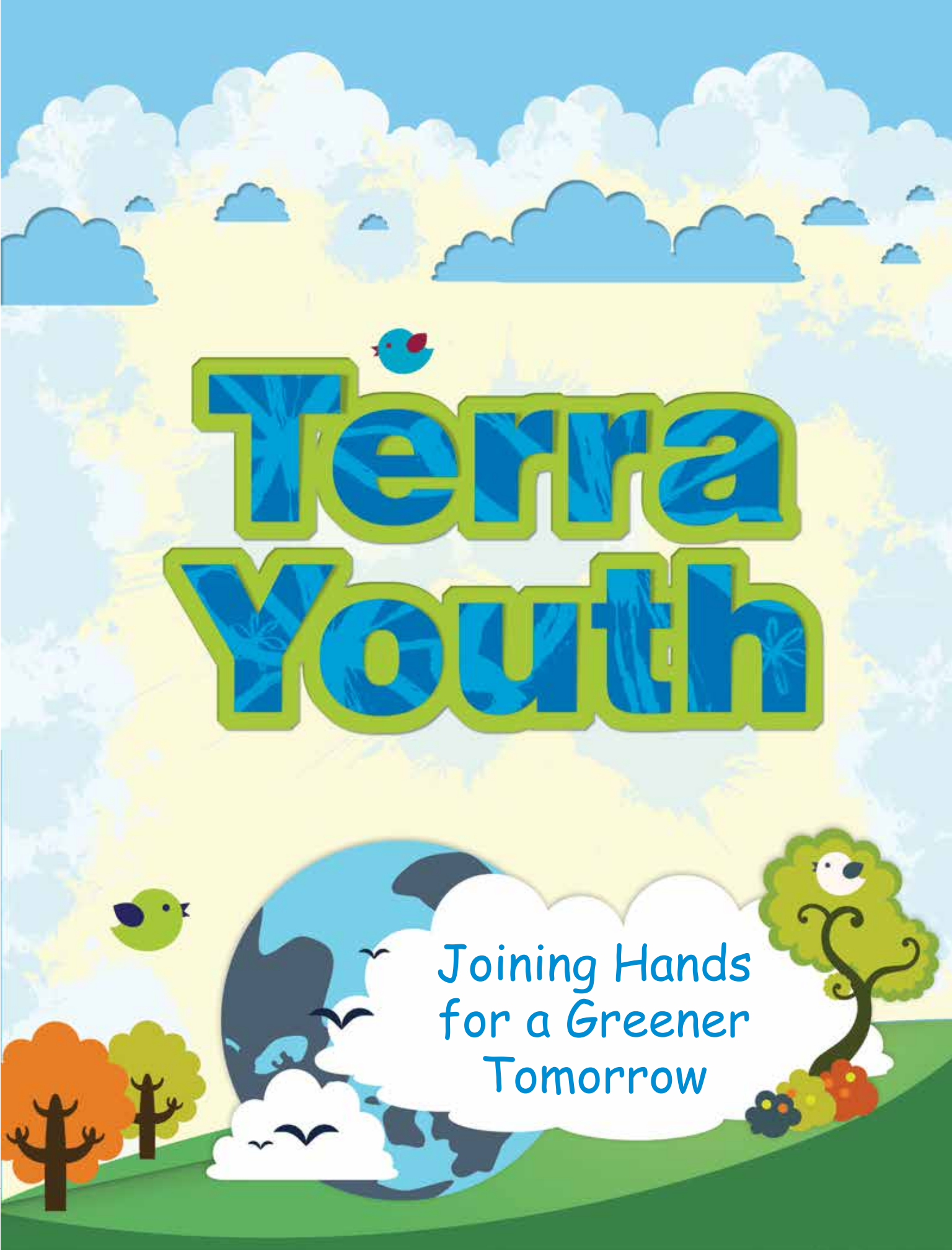
The outrage surrounding Great Nicobar was never solely about ecology. The island became the latest arena for a familiar international reflex that grows deeply uncomfortable whenever India signals strategic ambition on a scale historically associated with developed powers. Ecology provided the vocabulary and geopolitics supplied the emotional charge. The resulting discourse transformed a complex constitutional and developmental issue into a simplified morality play crafted for political consumption.

Great Nicobar deserves scrutiny grounded in consistency rather than selective indignation. It deserves legal accountability applied without ideological convenience. It deserves environmental vigilance that does not fluctuate according to electoral timing or geopolitical preference. Most importantly, it deserves a conversation capable of recognizing that infrastructure, sovereignty, ecology and indigenous rights are not slogans competing for visibility but realities that must coexist within the difficult architecture of a modern democratic state.

Disclaimer: The views expressed in this article are solely those of the author and do not necessarily reflect the views of TERI. ■



Gajanan Khergamker is Editor, Solicitor, and Documentary Filmmaker heading think tank DraftCraft International. He is the Founder Editor of The Draft. He writes across borders on Law, Diplomacy, Public Policy, and International Affairs.


Terra Youth
Joining Hands for a Greener Tomorrow

Their Share of the Environment

Environmental awareness grows when ecology connects to daily lives, livelihoods

In this reflective and deeply grounded essay, **Rajshekhar Pant** examines the widening gap between academic environmental discourse and the lived realities of ordinary people in the Himalayan hill regions. Moving beyond the rhetoric of climate change and global ecological debates, the essay explores how issues such as reckless hill-cutting, drying water sources, invasive species, excessive pesticide use, and unregulated tourism continue to reshape fragile mountain ecosystems. Through vivid local examples from Bhimtal, the piece argues that meaningful environmental awareness can emerge only when ecological concerns are connected to everyday lives and local livelihoods.

June 5 comes and goes every year.

A few articles appear in newspapers and magazines, panel discussions are held, and environmental concerns briefly find a place in the headlines. Then comes another day, another date—June 6—and an entirely new set of concerns. Before long, newspapers and television channels are once again stripped of the heavy rhetoric loaded with statistics and imposing terms such as 'ozone depletion,' 'carbon footprints,' and 'global warming'. The urgency fades almost as quickly as it arrives.

One often feels that the unnecessary ritualism surrounding such a sensitive issue, along with an excessive dependence on complex scientific terminology and intimidating data, has made the subject of the environment far more distant from ordinary people than it ought to be.



Shoreline of lakes in the remote hills is being encroached upon

Within academic discussions on the environment, one often encounters the familiar slogan: *Think Globally, Act Locally*. The "globally" part of this phrase largely belongs to the academic world. It concerns those who engage with environmental issues as scholars, researchers, or commentators. Many among them are remarkably well informed about the latest ecological developments across the world.

The "act locally" part, however, belongs to ordinary people.

Yet the common citizen's understanding of environmental concerns is shaped largely by the articles, speeches, seminars, and media discussions produced by this academic class. Ironically, these discussions frequently revolve around the Amazon rainforest, whales hunted in distant oceans, oil spills in the Atlantic, endangered bird species in South America, or cyclones in the Arabian Sea triggered by rising temperatures. In this

vast academic discourse, the priority of connecting people with their immediate environmental realities often gets lost.

Let me illustrate this through the example of my own small hill town, Bhimtal, situated in the Middle Himalayas. Here, mountains are being cut in an utterly unscientific manner to make way for expanding concrete structures. Lakes and ponds continue to fill with debris. Hillsides are excavated indiscriminately in the obsession with building roads everywhere. Invasive plants such as Mexican Devil continue to spread unchecked. The use of chemicals in farming and horticulture has increased sharply. Crop damage caused by birds and wild animals is rising steadily. Landslides have become more frequent. Water sources are drying up. Minerals are being extracted recklessly, and tourism is expanding without any meaningful regulation.

These are all serious environmental concerns, yet most continue to remain on the margins of public consciousness.

Public awareness regarding such issues is still largely absent.

At the same time, environmental concerns often lose out to the pressures of immediate development priorities. And if public discourse remains focused primarily on subjects such as America's indifference towards climate change, deforestation in tribal regions, or ecological crises in faraway places, how can one realistically expect a poorly educated hill farmer or a daily-wage labourer to become environmentally conscious?

This is not to suggest that global or national environmental issues should not be discussed locally. Such discussions are extremely important. My concern is something else entirely: how do we connect environmental awareness with the daily realities of local people—the farmer living in a nearby village, the roadside vendor, the boatman, the mule owner transporting sand and stones, or the labourer cutting through a mountainside for a new construction project?



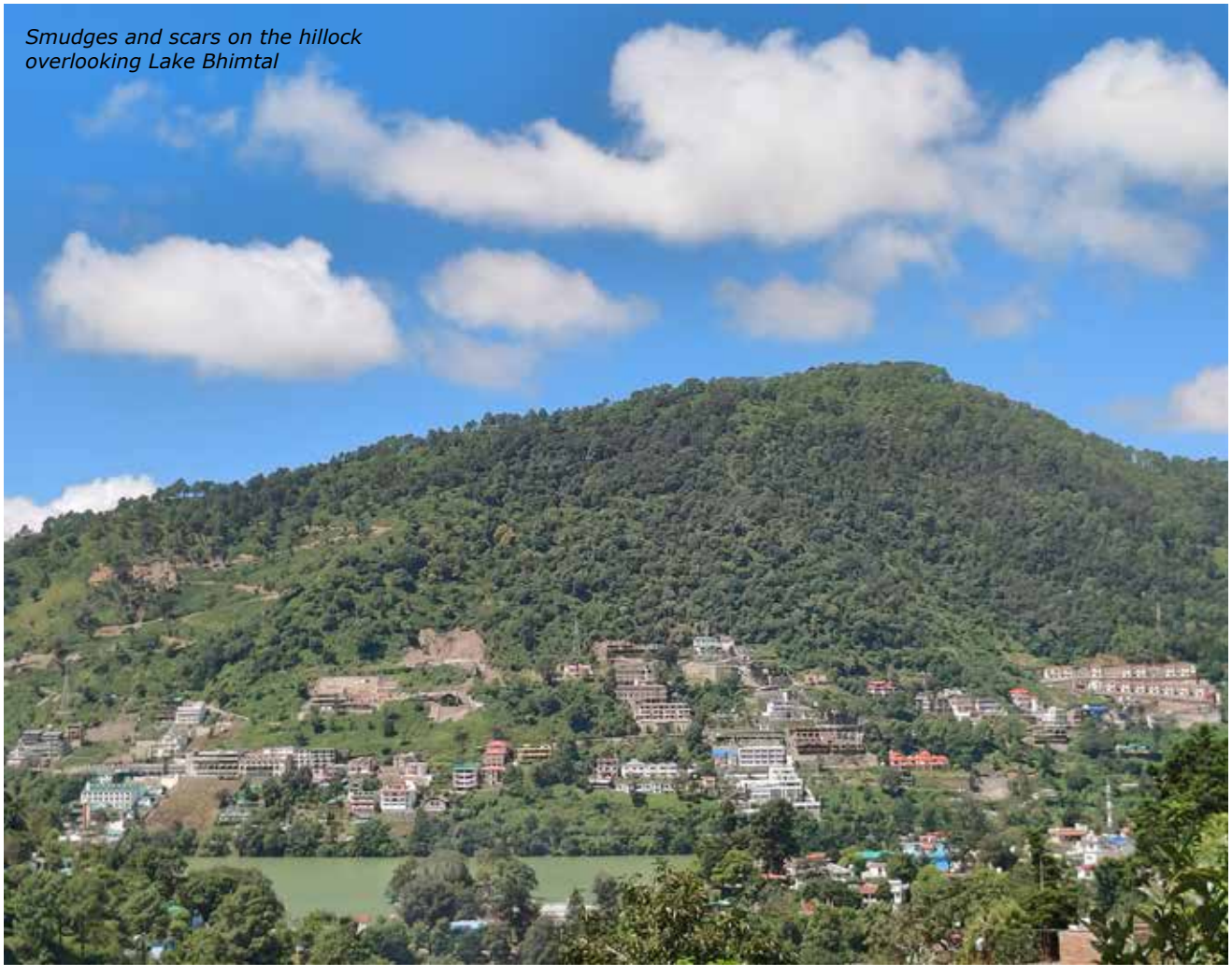
Photo by John Vimal Velpula on Unsplash

A farmer in my town who uses excessive pesticides and fungicides on crops such as cabbage, peas, and tomatoes is often completely unaware of the long-term harm these chemicals can cause. He may not realize that he himself is partly responsible for the increasing damage to crops caused by birds and changing ecological patterns.

Similarly, when a labourer cuts into a steep hillside to create an access road for a villa being built by a new settler at some scenic vantage point, or when he excavates unstable slopes in the name of "site development," he rarely realizes that he may actually be laying the groundwork for a future landslide that could threaten the very village below.

These are only a few examples. If one honestly observes environmental realities at the local level, the list can become quite extensive. Perhaps this is why, in many hill regions, environmental awareness among ordinary people remains limited largely to planting trees, avoiding the killing of animals, and understanding that cutting trees is illegal. The extent to which human actions themselves contribute to climate extremes, changing behavioural patterns among wild animals, flash floods, cloudbursts, declining soil fertility, and the drying up of water sources is something that still remains insufficiently understood.

I suspect this condition is not unique to my town alone. Yet this does not mean that change at the grassroots level is impossible. I would like to cite another example from Bhimtal itself. Until a few years ago, there was virtually no understanding here regarding the proper disposal of polythene bags, wrappers, kitchen waste, and household garbage. The shoreline of the lake remained littered with waste. Most families simply dumped garbage into nearby drains or along roadsides. A cleanliness-conscious family living near my home would regularly burn accumulated neighbourhood waste in a drain every Sunday morning.



Smudges and scars on the hillock overlooking Lake Bhimtal

A few years ago, however, the young and visionary Executive Officer of the local civic body, Mr Vijay Bisht, initiated an earnest campaign that combined door-to-door garbage collection with sustained public awareness efforts. Today, children and young people carrying waste bins wait for the garbage vehicle to arrive. People are slowly beginning to understand the importance of waste segregation and composting biodegradable garbage. As a result, my small hill town has begun to look noticeably cleaner and more beautiful than before.

The irony is difficult to miss. The mountains that once gave birth to the Chipko Movement and taught the world a unique lesson in environmental stewardship are today witnessing a growing indifference towards environmental concerns among ordinary people. If environmental discourse fails to connect with villages, farms, water sources, mountain slopes, and local livelihoods, it will remain confined to seminars, speeches, and newspaper columns. Environmental protection is undoubtedly a global challenge, stretching from the Amazon rainforest to the Himalayan peaks, but meaningful action must begin much closer to home—with an understanding of the soil beneath our feet, the water we depend upon, the forests around us, and the fragile ecological balance that sustains our daily lives.

Perhaps this is the true meaning of *"Think Globally, Act Locally."* The future of our environment will be determined not only by international agreements and scientific conferences, but also by the choices made by farmers, labourers, shopkeepers, boatmen, and ordinary citizens within their own communities. Unless they become active participants in the environmental conversation, genuine and lasting change will remain elusive. ■

Rajshekhar Pant is an amateur filmmaker, photographer, and writer who has written over a thousand write-ups, reports, etc., published in the leading newspapers and magazines of the country.

Responsible E-Waste Management and Environmental Sustainability

Surya Roshni Partners with Local Communities in Punjab

Surya Roshni Limited reinforced its commitment to environmental sustainability by conducting a comprehensive e-waste collection and awareness initiative across key residential communities in Punjab and Chandigarh. The initiative was carried out in partnership with authorized recycling agencies and local residential welfare associations to encourage the safe disposal and responsible recycling of electronic waste.

The awareness and collection drive was organized across Ansal's Woodbury Apartments in Zirakpur, Pushpac Society Complex and Nirvana Society in Chandigarh, and TDI-1 in Mohali. Residents were encouraged to responsibly dispose of end-of-life electrical and electronic products, including lighting products, electrical appliances, and other household electronic waste, ensuring that these materials are processed through authorized recycling channels.

As electronic consumption continues to rise across India, the challenge of managing discarded electrical and electronic equipment has become increasingly significant. Improper disposal of e-waste can lead to environmental contamination and loss of valuable recoverable resources. Through this initiative, Surya Roshni sought to create greater awareness among consumers regarding the importance of responsible disposal practices and the role every individual can play in building a more sustainable future.

The company has established a robust pan-India collection network that facilitates the safe and secure collection and transportation of e-waste from consumers to authorized recycling facilities. As a responsible producer and brand owner, Surya Roshni fully complies with the Extended Producer Responsibility (EPR) obligations under the E-Waste (Management) Rules, 2022, Battery Waste Management Rules, and Plastic Waste Management Rules, 2016. The company works closely with government-approved and registered recyclers to ensure environmentally sound recycling and disposal of collected waste.

Speaking on the initiative, Vasumitra Pandey, CEO – Lighting & Consumer Durables, Surya Roshni Limited said, "Environmental responsibility is a shared commitment that requires active participation from businesses, communities, and consumers alike. Through our e-waste collection and awareness initiatives, we aim to encourage responsible disposal practices while ensuring that discarded products are recycled through authorized channels. Sustainability remains an integral part of our business philosophy, and we will continue to support initiatives that contribute to resource conservation and environmental protection."



Beyond consumer-facing initiatives, Surya Roshni has implemented clearly defined Standard Operating Procedures (SOPs) across its manufacturing operations to manage and mitigate e-waste generation. The company also supports advanced resource recovery processes that enable the treatment, recovery, and reuse of exhausted components, helping conserve valuable resources while minimizing environmental impact.

The e-waste management initiative forms part of Surya Roshni's broader sustainability agenda focused on environmental stewardship, regulatory compliance, circular economy principles, and responsible manufacturing. By fostering awareness and facilitating safe recycling practices, the company continues to contribute towards creating a cleaner, safer, and greener future for generations to come.

With over 50 years of industry leadership, an annual turnover exceeding ₹7,500 crore, and exports to 50+ countries, Surya has emerged as India's largest ERW pipe exporter and a leading name in lighting and electrical solutions. The company remains committed to sustainable manufacturing, long-term partnerships, and creating enduring value for customers, communities, and stakeholders. ■

For more information, visit www.surya.co.in.

World Environment Day 2026

A Renewed Call for Climate Action

Observed annually on June 5, World Environment Day (WED) has evolved into the world's largest global platform for environmental awareness and action.

Established by the United Nations General Assembly in 1972 following the landmark Stockholm Conference on the Human Environment, the World Environment Day was first celebrated in 1973 and has since grown into a powerful annual reminder of humanity's responsibility towards the planet. Today, it brings together governments, businesses, communities, and individuals across more than 150 countries, making it one of the most far-reaching campaigns for environmental protection.[1]

In 2026, the global observance was hosted by Baku, Azerbaijan, and focused squarely on climate action. The theme—*"Inspired by Nature. For Climate. For Our Future."*—highlights the central role of nature-based solutions in addressing climate change while securing a sustainable future. Reinforced by the campaign call *#NowForClimate*, this year's message is unambiguous: the time for incremental change has passed; urgent, collective action is needed to tackle the climate crisis.[2]

A Planet under Pressure

World Environment Day 2026 unfolds against a backdrop of escalating environmental challenges. Scientific warnings are no longer distant projections—they are visible realities. Rising global temperatures, prolonged



heatwaves, melting glaciers, and extreme weather events are impacting ecosystems and human livelihoods across continents. Climate change is increasingly intertwined with other crises such as biodiversity loss, land degradation, and pollution, amplifying risks for both natural and human systems.[3]

This convergence of environmental challenges underscores the need for integrated solutions. It is no longer enough to address issues in isolation; the climate crisis demands a systems approach—one that recognizes the interdependence of ecological, economic, and social systems. World Environment Day serves as a platform to communicate this urgency and mobilize collective action at all levels.

Nature as Solution, Not Just Victim

At the heart of the 2026 theme lies a crucial insight: nature is not merely a casualty of climate change—it is also one of the most effective solutions. Ecosystems such as forests, wetlands, oceans, and grasslands have immense capacity to absorb carbon, regulate climate, and support biodiversity. Protecting and restoring these systems can significantly contribute to mitigation and adaptation efforts.[4] Nature-based solutions offer multiple co-benefits. Beyond carbon sequestration, they enhance water security, reduce disaster risks, and sustain livelihoods, particularly in vulnerable communities. By emphasizing these solutions, World Environment Day 2026 reinforces the need to align environmental protection with development priorities.

However, this requires a paradigm shift in how societies view nature—not as a resource to be exploited, but as a life-support system that must be protected and regenerated. The theme's emphasis on being "inspired by nature" reflects this shift, encouraging innovation that draws from ecological principles and sustainable practices.

1 Details available at <https://www.un.org/en/observances/environment-day>

2 Details available at <https://www.moneycontrol.com/science/world-environment-day-2026-date-theme-host-significance-history-and-why-it-matters-more-this-time-article-13940816.html>

3 Details available at <https://www.unep.org/news-and-stories/press-release/planet-swelters-world-environment-day-2026-focuses-urgent-climate>

4 Details available at <https://www.news18.com/lifestyle/events/world-environment-day-2026-theme-history-significance-climate-action-ws-e-10129219.html>

From Global Awareness to Local Action

Over the decades, World Environment Day has played a significant role in shaping environmental discourse and policy. Each year's theme focuses attention on a specific issue—ranging from plastic pollution to biodiversity conservation—creating momentum for action. The 2026 focus on climate action aligns with global priorities under the Paris Agreement and the Sustainable Development Goals.

What distinguishes World Environment Day is its ability to translate global concerns into local action. Across cities and villages, activities such as tree plantation drives, waste management campaigns, environmental education programmes, and policy dialogues mark the occasion. These initiatives may vary in scale, but collectively they contribute to a larger movement aimed at transforming behaviour and attitudes.

Individuals also play a critical role in this process. The campaign encourages people to adopt sustainable lifestyles—reducing waste, conserving energy, choosing eco-friendly products, and advocating for environmental responsibility. While systemic change is essential, individual actions act as catalysts, reinforcing broader policy and institutional shifts.

The Role of Governments and Industry

The scale of environmental challenges demands strong leadership from governments and active participation from industry. World Environment Day provides an opportunity for policymakers to announce new initiatives, strengthen regulatory frameworks, and commit to ambitious climate targets. It also creates a platform for international cooperation, which is essential for addressing transboundary issues like climate change.

Industry, too, plays a pivotal role. Transitioning to low-carbon technologies, adopting circular economy practices, and investing in sustainable innovation are no longer optional—they are imperative. The 2026 campaign underscores the importance of aligning business strategies with environmental goals, ensuring that economic growth does not come at the cost of ecological stability.



Moreover, financial systems must support this transition by directing investments towards sustainable projects. Climate finance, green bonds, and responsible investment practices are key enablers of this shift. World Environment Day highlights these dimensions, calling for a coordinated approach across sectors.

A Call to Act—Now

Perhaps the most compelling message of World Environment Day 2026 is the urgency of action. The planet is already sending clear signals—rising seas, intensifying storms, and shrinking natural habitats. Delaying action will only increase the costs—economic, social, and environmental—of addressing these challenges in the future.[5]

Yet, there is also a sense of possibility. Around the world, solutions are emerging: renewable energy is expanding, cities are becoming more sustainable, and restoration projects are revitalizing degraded ecosystems. These examples demonstrate that change is not only necessary but achievable.

World Environment Day, therefore, is both a warning and an opportunity. It reminds us that while the challenges are immense, the tools and knowledge needed to address them are already within reach. What is required is the collective will to act—decisively and without delay.

Towards a Sustainable Future

As the world marks World Environment Day 2026, the message resonates across borders: safeguarding the environment is not a choice but a necessity. The health of the planet underpins economic development, social well-being, and human survival.

The way forward lies in integrating climate action with sustainable development, fostering innovation, and strengthening global cooperation. By embracing nature-based solutions, promoting responsible consumption, and ensuring inclusive participation, it is possible to build a future that is both resilient and equitable.

Ultimately, World Environment Day is a reminder that every action counts. Whether at the level of policy, business, or individual behaviour, each effort contributes to a larger collective goal—protecting the Earth for present and future generations. As the 2026 theme aptly conveys, the path to a sustainable future begins with inspiration from nature, but it must be driven by decisive human action. ■

5 Details available at <https://www.worldenvironmentday.global/2026/about/theme-and-host>



Beneath Our Feet Lies a Fungal Superhighway Stretching 68 Quadrillion Miles

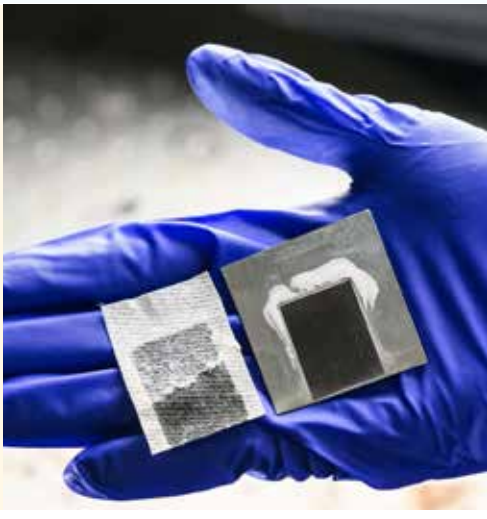
Beneath the ground, vast networks of fungi quietly support plant life and play an important role in regulating the planet's climate by helping move carbon into soils. Now, researchers have created the first global maps showing where these underground fungal networks are found and how much of them exist worldwide. The study, published in *Science*, focuses on arbuscular mycorrhizal fungi, a group of fungi that form partnerships with most plants on Earth. Alongside the research, scientists released an interactive visualization that allows users to explore the remarkable scale of this hidden underground infrastructure. The maps are expected to help researchers and policymakers identify areas where these fungal networks are thriving and where they may be under threat.

Source: https://www.sciencedaily.com/

New Solar Desalination Breakthrough Makes Fresh Water without Toxic Brine

According to the United Nations, 2.2 billion people still do not have access to safely managed drinking water. To help meet growing demand, many regions, from California to parts of the Middle East, rely on desalination plants that convert seawater into fresh water. Traditional desalination methods such as reverse osmosis and thermal distillation can be expensive and energy intensive. They often require chemical treatments before and after processing the water and generate large volumes of concentrated saltwater known as brine. When discharged back into the ocean, brine can damage marine ecosystems by increasing salinity and reducing oxygen levels. In Professor Chunlei Guo's lab at the University of Rorchester, researchers developed a solar desalination device featuring laser-etched superwicking black metal, a technology that produces fresh water from seawater while capturing salts and minerals instead of generating harmful brine waste.

Source: https://www.sciencedaily.com/



To know more... Read



ISBN: 9788179936375

KNOW ALL ABOUT

TREES (THE GREEN GEM)

Swapna Dutta

Do you know where the fruits you eat come from?

Do you know where the oxygen you breathe comes from?

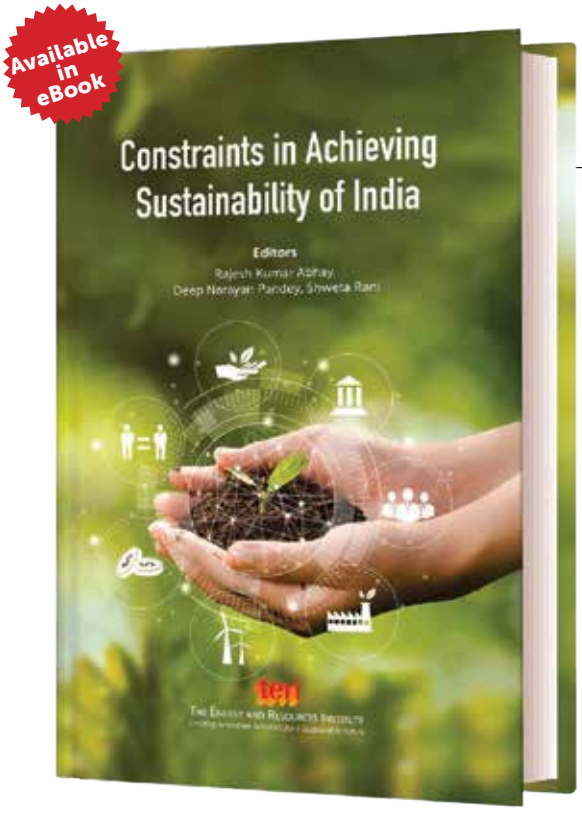
Do you know what keeps the soil from being washed away during rains?

Do you know where your favourite bird lives?

Tree is a very important part of our world. The tree give us food, it provides us clean air, it shelters animals, and saves us from the harsh environment. In this book we will learn about different types of trees, its life cycle, its functions, different parts of a tree, and what can we do to save the most important natural resource.

Available at: amazon.in flipkart amazon kindle Google play teri bookstore

Study of the challenges to sustainable development via scientific means



Major topics covered

- Sustainable Development: concept, components and history
- Environment, Culture, and Sustainable Development
- Sway of Indian Cinema in Diffusing Environmental Sentience
- Poverty Lines and Poor in India
- Sanitation Workers and Associated Problems for the Sustainability of Religious Events
- Assessment of Basic Infrastructure Development and Associated Issues in India

ISBN: 9789394657120 • Price: ₹550.00

Purpose of the book is to develop, contribute, and disseminate scientific knowledge pertaining to the issues related to sustainable development. The chapters are developed so that the contents can facilitate comprehension of the major constraints in achieving sustainability including but not limited to environmental, social, economic, and governance-related issues from local, regional, to national level. Resource management, climate change, agriculture, population, education, women, poverty, infrastructure, crime, corruption, governance, are the other relevant topics that have been both identified and suitably discussed. *Constraints in Achieving Sustainability of India* can be utilized as a guiding tool for realizing sustainability in development, especially, in the Indian context.

The Energy and Resources Institute
Attn: TERI Press
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi – 110 003/India

Tel. 2468 2100 or 4150 4900
Fax: 2468 2144 or 2468 2145
India +91 • Delhi (0)11
Email: teripress@teri.res.in
Web: http://bookstore.teri.res.in

To purchase the book, visit our online bookstore at http://bookstore.teri.res.in or send us your demand draft or cheque in favour of TERI, payable at New Delhi (outstation cheques are not accepted).

Exploring Atalaya Castle's Timeless Charm

A Journey through History, Nature, and Coastal Heritage

In this first-person account, **Dr Marianne Furtado de Nazareth** describes her visit to Atalaya Castle in Huntington Beach State Park, South Carolina, during a family trip. Drawn by her interest in history and sustainability, she reflects on the castle's striking terracotta architecture and its unique blend of Spanish and Moorish styles. Exploring the expansive structure, she highlights its thoughtful design, central courtyard lined with Sabal Palmetto palms, and features adapted to the region's climate. She also recounts the legacy of Archer and Anna Huntington, whose vision combined art, ecology, and social responsibility. The visit is enriched by the park's natural beauty, wildlife, and historical significance, making it both an educational and immersive experience.

The US has a number of State Parks, which I enjoy visiting with family, on my annual visits there. The Rocky Mountain National Park in Colorado, Yosemite National Park in California and the Badlands in South Colorado are some of the many parks I have visited. Most of these Parks in the US of late focus on sustainable living and sustainable practices, which is the focus of my writing as a Science and Environment journalist. Lucky the US is such a huge country, so every one of these parks are sprawling over enormous acreage. State parks are protected areas managed at a sub-national level to preserve natural beauty, historic sites, or provide recreational opportunities. These areas, often smaller than national parks, offer hiking, camping, and fishing to visitors at a nominal and affordable price.

"Since we are going to Myrtle Beach, let's go see Atalaya Castle, which is in the Huntington State Park," said my son Andrew, who enjoys visiting historical places like me. "It's a historic hidden gem in Murrells Inlet, South Carolina."



It was such a pleasant surprise to visit the "Castle" which is completely built with terracotta red brick which is unusual for the US. Most houses are built with wood, so seeing exposed terracotta brick walls of this "Çastle' was very unusual, especially since it was built in the 1930s. There was a small entry fee, which we were glad, as there were five of us!

Reading up the Information on the Castle at the entrance gate, we learnt that Atalaya Castle, which is located in Murrells Inlet, in South Carolina, was constructed between 1931 and 1933 by philanthropist Archer Huntington and his wife, sculptor Anna Hyatt Huntington, as a winter residence. Designed by Archer himself the Castle is a unique blend of Spanish and Moorish architectural styles. Imagine the size of the building as it features thirty rooms arranged around a central courtyard, with a 40-foot water tower at its heart.

Atalaya means "watchtower" in Spanish, as in the real Atalaya Castle



in Spain. The house is dominated by a square tower, which used to house a 3,000 gallon water tank. This tower rises commandingly up to 40 feet above a covered walkway, which bisects the inner courtyard of the Castle. What interested me as a tree lover was the central courtyard is edged with beautiful, mature Sabal Palmetto palms, which is the South Carolina State tree. One palm was loaded with ripe dates which had fallen all over below it. Of course, we could not resist picking and eating after checking if they were edible on Google! The palms and the brick building naturally gave out a very tropical vibe.

The Huntingtons as a couple were the brains behind this amazingly sustainable Castle. Archer Huntington, was a noted scholar of Spanish culture and art, and designed the residence in the Moorish Revival and Mediterranean Revival architecture styles from Spanish Andalusian coast models.

Atalaya was built near the Atlantic Ocean in northeastern South Carolina, within present day Huntington Beach State Park. The location was chosen as a milder winter retreat for the health of Anna Huntington, who suffered from tuberculosis from the mid-twenties to the mid-thirties.

The Castle was built by local labourers during the Great Depression to support the regional economy. The estate also included animal enclosures and art studios, and later became part of Huntington Beach State Park, preserving its rich history and cultural significance. Many locals worked on the house and gardens, and the Huntingtons were known as good employers. Situated on the ocean within an estate, which







originally spanned over 9,000 acres, part of the land was dedicated to creating Brookgreen Gardens, the first public sculpture garden showcasing Anna's work.

The 30 actual rooms in which they lived were around three sides of the perimeter, while Anna's studio, with its 25 foot skylight, opened into a small, enclosed courtyard where she worked on her outstanding sculptures. But across the building are hand-wrought iron grills which were designed by Anna which immediately catch the eye, as they cover the exterior of every window. This area gets hit by hurricanes so the shutters and grills were actually fixed for protection against hurricane winds.

Besides enjoying the wonderful sea breeze, this is a bird watchers' paradise and surf fishers can experience great catches. We were also told that alligators live in Huntington Park's fresh water ponds, giving visitors a unique experience to see them in their native habitat. Called the Lowcountry, the Park preserves native plant species and showcases historically significant flora.

History has it that during World War II the Huntingtons vacated Atalaya and allowed the Army Air Corps use for 6 years – 1942 to 1946. After Anna Huntington died her studio equipment was shifted to a new studio in their property called Brookgreen gardens. Later the entire residence and grounds were donated to become the Huntington Beach State Park. ■



The Sabal palmetto, commonly known as the cabbage palmetto or palmetto palm, is the official state tree of South Carolina, which is nicknamed "The Palmetto State". It is a highly resilient, salt-tolerant palm native to the coastal regions of the southeastern United States. It was nominated as the state tree in 1939, and it appears on the state flag, and state sea. In 1776, patriots at Sullivan's Island built a fort using palmetto logs. The spongy, fibrous wood absorbed the impact of British cannonballs, causing them to bounce off, allowing the troops to win the battle.

American alligators: There are substantial populations of American alligators in South Carolina, particularly in the coastal plain and low-country regions. They inhabit swamps, rivers, lakes, and marshes, with high concentrations in areas like Huntington Beach State Park. While active year-round, they are most active during warm weather and mating season (May). They can grow quite large, with individuals over 13 feet long documented in the state. Keep pets and children away from water edges, as alligators can move quickly. Do not feed them, as it is illegal and makes them dangerous.

Dr Marianne Furtado de Nazareth is freelance Science and Environment Journalist. She is former Assistant Editor, The Deccan Herald.

Mitrakida

Rethinking Pest Control through Nature's Own Balance

Mitrakida, founded by entomologist **Dr Rahul Marathe** in 2016, promotes a paradigm shift in pest control by treating insects as ecological allies rather than adversaries. Rooted in Integrated Pest Management, the organization uses biological solutions such as predator insects, parasitoids, and microbes to regulate populations without chemicals. Its tailored interventions support farmers, gardeners, and institutions while preserving biodiversity. Mitrakida has successfully reduced bird strikes at airports by decomposing waste that attracts scavengers, developed bio-toilets for sub-zero regions like Leh, and revived mango orchards in the Konkan by restoring pollinators. Alongside practical innovations, it also fosters ecological awareness through education, advocating respect for insects as vital contributors to a balanced and sustainable environment. Read this article by **Dr Rina Mukherji**.

It was when working as a Researcher for a Life Sciences organization that entomologist Dr Rahul Marathe developed a profound understanding of the insects. "I realized that insects account for approximately 70 per cent of all known animal species," Dr Marathe explains. "In a balanced ecosystem, every organism has a natural check—a predator or a parasite. Biologically speaking, no insect is a 'pest' by nature; that is a human-centric label we apply to organisms that compete with us for resources like food or wood.

"To manage insect populations effectively, it is important to know and understand their life cycles. They also perform an important role in nature. For instance, even though the caterpillars (the larval stage of Lepidoptera) consume plant matter, they are the necessary



Mitrakida founder Dr Rahul Marathe speaking at a workshop

precursors to adult butterflies and moths, which serve as vital pollinators.

When we use broad-spectrum chemical pesticides to 'save' greenery, we inadvertently kill these larvae, thereby depleting the population of future pollinators. Thus, spraying chemicals can have an undesirable adverse effect," Dr Marathe explains to me. The solution, Dr Marathe suggests, is not eradication, but Integrated Pest Management (IPM), maintaining insect populations below a certain level to preserve biodiversity while protecting yields. "Every insect has a predator. Green Lacewings are generalist predators effective against soft-bodied insects like aphids and mealybugs. *Trichogramma* wasps (Tricho-wasps) are egg parasitoids specifically used to control lepidopteran caterpillars. Scavengers such as Black Soldier Fly larvae act as decomposers, recycling nutrients by breaking down organic waste and debris".

Convinced that a new beginning needed to be made in insect control,



Dr Marathe founded Mitrakida in 2016 in Pune. Mitrakida focuses on biological control, using natural enemies to manage "pest" populations without the use of toxic chemicals.

"We view insects as biological tools," says Dr Marathe. "We calculate the precise predator-prey ratio required to suppress a population and utilize models like Entomopathogenic Nematodes (EPN)—microscopic worms that lethally infect soil-dwelling larvae."

Solutions are customized by the organization for farmers, private garden



Mitrakida team and Dr Rahul Marathe with farmers in a village

owners, and government organizations, as per their individual needs. It is never a "one size fits all" solution, ever.

Tackling Bird Hits at Airports

Of late, Mitrakida is successfully tackling the issue of bird hits at airports in many parts of India. A major aviation safety problem, bird hits are an ecological by-product of garbage accumulation in the vicinity of airports due to slums and illegal settlements. Garbage dumps attract scavengers such as black kites and crows. By using beneficial insects and microbes to rapidly decompose organic waste, Mitrakida removes the primary food source for these birds, causing them to forage elsewhere. This method has been implemented at several major airports, including Mumbai, New Delhi, and Kochi, markedly bringing down bird hits.

Developing Bio-toilets for Sub-Zero Temperatures

The challenge of human waste management in sub-zero environments like Siachen and Leh has been tackled. Standard bio-toilets rely on bacteria that become sluggish at low temperatures. Mitrakida developed a specialized (cold-loving) microbial and insect culture capable of breaking down waste at altitudes of 9,000 to 15,000 feet, where temperatures often remain well below freezing. These insect inspired toilets continue to successfully operate at Leh.

Augmenting Mango Production

Over the last seven years, Dr Marathe and his team at Mitrakida are extending a helping hand to more than a hundred mango orchards in the mango-producing belt of Devgadh, Ratnagiri, Sindhudurg and Chiplun by bringing back pollinators into orchards. Certain practices like the removal of undergrowth or 'weeds' removes the insect pollinators too. In many orchards, the situation has turned so bad that manual beating of the inflorescence had to be done for pollinating them for the fruit. In the Konkan region, Mitrakida is working to reverse the "ecological doom" caused by the overuse of chemical pesticides by using customized biosolutions against the major pests on mangoes.



Mitrakida team investigating into pests in an orchard



From a situation when horticulturists were on the verge of abandoning mango orchards, organically produced mangoes from these farms are now commanding a huge premium.

Educating for the Future

Dr Marathe's work has earned him the 'Times Man of the Year (2018)' and other accolades. However, rather than rest on his laurels, Dr Marathe continues to work on developing new insect cultures to tackle the problems faced by farmers and agriculturists, despite being strapped for funds. To sensitize the younger generation to respect the natural world, his organization Mitrakida Foundation for Insect Research and Conservation conducts workshops and awareness sessions in schools.

At every such workshop, children learn to respect and acknowledge the insect world, and the ecological balance that sustains all living beings. They learn to recognize insects, and the multiple ways that they benefit us all. "Our youngsters are the best guarantee if we want a better future for all mankind," Dr Marathe believes. ■

Dr Rina Mukherji is a prolific writer who regularly contributes articles in TerraGreen.

Ecological Ayurveda

Reimagining the Circular Economy

What began for him as a search for health gradually evolved into a different way of seeing the world—not through theory or ideology, but through a quiet shift in what he began to notice. This essay is simply an attempt to describe that shift—and where it might lead, as **Ram Ramprasad** reflects.

A Personal Turning Point

In 2005, my doctor recommended surgery. The logic was straightforward, and I wasn't opposed to it—but I remember sitting with a quiet unease, a feeling that the conversation had somehow skipped over me. The body was the problem. Fix the body. Move on.

That feeling led me towards Ayurveda. Not because I had become a believer in anything, but because I was looking for a different way to understand what was happening.

What I Observed in Kerala

What I found surprised me. The practitioners I met weren't particularly interested in my diagnosis. They were more interested in patterns—how heat moved through the body, where things seemed stuck, what appeared excessive and what seemed depleted.

In this framing, disease wasn't something you simply "had." It was something that had developed over time, through accumulated imbalance. Which also meant it might, in some cases, be shifted.

Two things stayed with me after several visits. The first was how differently each patient was treated. Even when symptoms looked similar, prescriptions varied significantly—there was no single standard protocol. Treatment was built around the individual. The second was the caution around herbs. Practitioners mostly preferred sourcing from the hospital's own farm rather than relying on outside suppliers. Quality and origin clearly mattered.

These may sound like small details, but they pointed to something larger—a medical tradition that paid close attention to relationships: between the patient and their environment, between a plant and the soil it came from, between balance and its absence.



Five Elements, One Framework

Ayurveda begins with five elements—earth, water, fire, air, and space—not as poetic metaphor, but as a practical vocabulary for how living systems behave. From these arise three organizing tendencies: Vata (air and space), which drives movement and change; Pitta (fire and water), which drives transformation and metabolism; and Kapha (earth and water), which provides stability and cohesion.

The point is not to memorize these categories but to recognize what they imply: health is not fixed—it is continuously adjusting. When one tendency dominates for too long, imbalance follows in predictable ways.

At the core of this system sits a deceptively simple principle: *like increases like, and opposites restore balance.*

Add heat to a system already running hot, and it intensifies. Introduce something cooling, and the system gradually returns towards equilibrium. You see this clearly in

the body—if someone already carries excess heat, adding more through diet or environment does not nourish; it aggravates. The response is not random. It follows a pattern.

The Same Patterns, Everywhere

Standing in a Kerala garden one morning, watching a practitioner tend medicinal plants with the same careful attention she brought to patients, it struck me: she was reading the same signals in both. Too much sun, too little water, the wrong soil—imbalance in a plant looks different from imbalance in a body, but the corrective logic is identical. Restore what is deficient. Reduce what is excessive. Watch how the system responds. I found it hard, after that, not to see the same pattern at a much larger scale.

We are adding heat—through emissions, through the clearing of forests, through the spread of heat-absorbing surfaces—to a planet that is already warm. Temperatures rise. Cycles destabilize. The system escalates rather than self-corrects. Water appears where it shouldn't and disappears where it should. Soil loses its vitality. Waste accumulates in forms that cannot reintegrate.

We tend to treat these as separate crises. But are they? Or are they different expressions of a single imbalance—the same way inflammation, acidity, and restlessness in the body are not three separate problems, but one system running too hot?

The Ayurvedic practitioner does not treat each symptom in isolation. She reads them as a single signal and responds with counterbalancing forces. The question this tradition poses to us, applied to the earth, is whether we are capable of the same reading.

Restoration, in both cases, is not only about reducing harm. It is about actively introducing what is missing: cooling where there is excess heat, regeneration where there is depletion, renewal where there is stagnation. In ecological terms—afforestation, restoring disrupted water flows, rebuilding soil systems, redesigning built environments to work with natural cycles rather than against them.



This is not simply a metaphor. It is a way of reading systems that may be as useful at planetary scale as it has been at the scale of the human body.

The Circular Economy's Blind Spot

The circular economy represents important progress. Designing out waste, closing material loops, reusing resources—these are necessary shifts, and they are gaining real traction globally.

But there is a limitation worth naming. A system can be materially circular and still remain ecologically imbalanced. Water may be treated and reused while rivers lose their natural flow. Materials may be recycled efficiently while soil continues to degrade. Energy systems may be optimized while stress is quietly transferred elsewhere.

In such cases, circularity becomes mechanical rather than regenerative. Efficiency without balance is not true circularity—it is simply a slower form of extraction.

A Broader Definition of Circularity

From this perspective, circularity needs a second condition: A circular economy is one in which material cycles remain closed while elemental balance is continuously restored. Without that second condition, circular systems risk sustaining imbalance rather than resolving it. The questions become:

- Is land being regenerated or merely used more efficiently?
- Are natural water flows maintained, or corrected only after disruption?
- Is atmospheric balance treated as a shared system, or an afterthought?
- Do built environments reduce ecological stress, or quietly amplify it?

These are not separate domains. They interact continuously—and ignoring that interaction does not eliminate imbalance. It simply shifts it elsewhere.

India's Specific Opportunity

What surprised me, returning to these questions, was that India already possesses the vocabulary—scattered across traditions that have never quite been read together.

One Problem, Three Angles

What makes India's position distinctive is that it already possesses a set of knowledge traditions that address balance—not as a single unified theory, but as a family of disciplines that approach the same problem from different angles.

Ayurveda addresses balance within the human body—understanding how elemental tendencies interact, where imbalance originates, and how to restore equilibrium through diet, herbs, and practice. Vastu Shastra approaches the same question through space—how the arrangement of elements within a built environment, its orientation, airflow, and relationship to natural forces, shapes the well-being of those who inhabit it. Vriksha Ayurveda extends this to plant and ecological systems—treating soil, water, season, and surrounding life not as backdrop but as active participants in a living system that can be read and tended.

What these traditions share is an assumption so basic it is easy to miss: nothing exists in isolation, and balance is not a static endpoint but an ongoing relationship between parts. Seen together, they form not a collection of separate disciplines but interlocking lenses on a single worldview—one in which the body, the home, the garden, the watershed, and the atmosphere are all expressions of the same underlying dynamic.

The opportunity for India is to recognize this not as heritage to be preserved, but as a living analytical framework—one that modern science, engineering, and governance could draw from, provided the translation is done carefully and without reduction.

The Missing Bridge

What remains largely absent is exactly that: a bridge. Scientists, engineers, economists, and policymakers operate with powerful tools for measurement and scale. Traditional systems offer deep observational insight into balance and interconnection. What is needed is translation—so that each can inform the other without distortion.

Reframing Governance through Elements

When governance is structured around foundational elements—water, soil, air, energy, space—the interdependencies between systems become easier to see and manage. India has already taken a step in this direction with the Ministry of Jal Shakti. Extending this logic across other elemental domains could allow governance to function less in silos and more as a coordinated system of relationships.



From Atmanirbhar Bharat to Bhumi Nirbharata

India's vision of Atmanirbhar Bharat emphasizes self-reliance and economic resilience. But resilience built on depleted soil, disrupted water, and degraded air is resilience on borrowed time. *Bhumi Nirbharata*—self-reliance rooted in the health of the earth itself—means that a village's food security rests on living soil, that a city's resilience draws from functioning watersheds, that economic ambition is built on systems that renew rather than deplete. It is not a replacement for economic ambition. It is the ecological foundation without which that ambition cannot endure.

A Final Thought

Most systems do not collapse suddenly. They drift. A river gradually loses volume. Soil fertility declines across seasons. Air quality deteriorates until thresholds are crossed and the damage becomes visible.

What Ayurveda offered me was not only a method of understanding health, but a way of noticing—of recognizing the early signals of imbalance before they become breakdown. The body gives warnings long before it gives symptoms. A practitioner learns to read them. So does the earth. And the signals are already there.

The knowledge to read them—and to respond with counterbalancing intelligence rather than isolated fixes—exists. It has existed for a long time, distributed across traditions that were always pointing at the same thing from different directions. ■

This article was first published in Sustainability Next.

Ram Ramprasad is a sustainability writer and author. A graduate of Yale University in economics, he has published widely on platforms including Sustainability Next and TerraGreen, focusing on practical pathways for sustainable development.



SUBSCRIBE

TerraGreen

INDIA'S LEADING MONTHLY ENVIRONMENTAL MAGAZINE

http://terragreen.teriin.org

TerraGreen promotes the concept of sustainable development. Launched in June 2004, this magazine from TERI is an effort to bring forth information and knowledge in the fields of energy, environment, and sustainable development. The magazine is in keeping with our mission to expand the base of environmentally conscious readers and popularize sustainability issues at the local level. TerraGreen aims to provide the readers with the necessary inputs to enable them to be a part of the process of change. The magazine stays away from all jargon, so that the educated, informed, yet lay readers are updated on all that happens around them everyday.

Tick one	Term (yrs)	No. of issues	Cover price		You pay		You save	
			₹	US$	₹	US$	₹	US$
	1	12	840	122	800	116	40	6
	2	24	1680	234	1510	211	170	21
	3	36	2520	302	2270	272	250	30

*Name of the Customer (IN BLOCK LETTERS).....

Designation..... Company / Organization.....

City..... State.....PIN.....Country.....

Email.....

PAYMENT PROCEDURE

Enclosed a Cheque/Draft number.....drawn in favour of 'TERI' payable at New Delhi for

₹/.....for 1/2/3/ year subscription of TerraGreen.

To SUBSCRIBE or make online payment, visit: http://bookstore.teri.res.in/TerraGreen

For subscription related queries,
contact: +91 11 2468 2100 / 7110 2100
Email: teripress@teri.res.in

THE ENERGY AND RESOURCES INSTITUTE
Darbari Seth Block, IHC Complex, Lodhi Road, New Delhi – 110 003
Tel. 2468 2100 or 7110 2100, Fax 2468 2144 or 2468 2145, India +91 • Delhi (0) 11
http://terragreen.teriin.org

Green events

FORTHCOMING MONTHS

Global Conclave on Plastics Recycling and Sustainability (GCPRS)
July 2–5, 2026
New Delhi, India
https://10times.com/

Global Solar Expo (Delhi Edition)
July 9–10, 2026
New Delhi, India
https://globalsolarexpo.com/delhi-expo/

Global Sustainability Summit (GSS) 2026
July 23–24, 2026
New Delhi, India
https://gss2026.iisdindia.in/

Eco Sustain Expo
July 30–August 1, 2026
Hyderabad, India
https://10times.com/

EnRISE 2026 – International Conference on Environmental Research and Innovation for Sustainable Engineering
August 7–8, 2026
Indore, India
https://enrise.iiti.ac.in/?utm_source=chatgpt.com

TerraGreen
EARTH MATTERS

FEEDBACK FORM

PLEASE TICK YOUR CHOICE.

1. **Which section(s) did you find the most interesting?**
   ☐ TERI Analysis ☐ Environmental Research ☐ Feature
   ☐ In Conversation (Interview) ☐ Cover Story ☐ Special Report
   ☐ Green Challenges ☐ Terra Youth ☐ Review

2. **In your opinion, which section(s) need(s) improvement?**
   ☐ TERI Analysis ☐ Environmental Research ☐ Feature
   ☐ In Conversation (interview) ☐ Cover Story ☐ Special Report
   ☐ Green Challenges ☐ Terra Youth ☐ Review

3. **What do you think about the look and feel of *TerraGreen*?**
   ☐ Brilliant ☐ Design is not a priority, content is
   ☐ Average ☐ Needs improvement

4. **In your opinion, what aspect(s) of *TerraGreen* need(s) improvement?**
   ☐ Choice of stories ☐ Handling of issues ☐ Language
   ☐ Design ☐ Presentation

5. **Please rate *TerraGreen* on a scale of 1–5 (5 being the best).**
   ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

6. **What issues would you like *TerraGreen* to cover?**
   .....
   .....

7. **Which other environmental magazine(s) do you read?**
   ..... ☐ None

8. **Any further suggestions?**
   .....
   .....

YOUR DETAILS

Name: .....

Profession:.....

Tel.: .....

E-mail: .....

The most innovative suggestion will get a surprise gift.

The Energy and Resources Institute
Attn: TERI Press
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi – 110 003/India

Tel. 2468 2100 or 7110 2100
Fax: 2468 2144 or 2468 2145
India +91 • Delhi (0)11
Email: teripress@teri.res.in
Submit online: http://bookstore.teri.res.in/terragreen

June 2026

ADVERTISE IN...

TERRAGREEN

Circulation information

Industries, Ministries, PSUs, Corporates, Multi and Bilateral Agencies, Universities, Educational Institutions, and Research professionals.
Readership of 40,000

General information

- Monthly
- All colour
- Matte paper
- Number of pages: 56



Technical specifications

Finished size:	20.5 cm × 26.5 cm
Non-bleed ad size:	17.5 cm × 23.5 cm
Half page ad size:	17.5 cm × 11.75 cm
Bleed size (3 mm bleed on all sides):	21 cm × 27.5 cm
Artwork preference:	Print ready, minimum 300 dpi (tiff, eps, pdf, or cdr) files with all fonts with high quality print proofs and progressives for colour reference.

Advertisement tariffs (₹)

Position	Card rate for single issue(INR)	quarter contract (3 issues) (INR)	bi-annual contract (6 issues) (INR)	annual contract (12 issues) (INR)
Advertorial (per page)	100,000	255,000	480,000	900,000
Back Cover	100,000	255,000	480,000	900,000
Inside Back Cover	75,000	191,250	360,000	675,000
Inside Front cover	75,000	191,250	360,000	675,000
Inside Full Page	50,000	127,500	240,000	450,000
Inside Half page	30,000	76500	144,000	270,000

GST & taxes additional as applicable

Subscription

One year ₹840 / $122 • Two years ₹1680 / $234 • Three years ₹2520 / $302

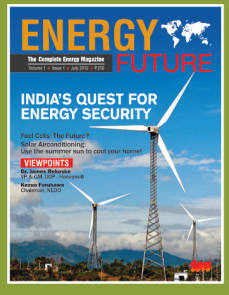
ENERGY FUTURE

Circulation information

Industries, Ministries, PSUs, Corporates, Multi and Bilateral Agencies, Universities, Educational Institutions, and Research professionals.
Readership of 25,000.

General information

- Quarterly
- All colour
- Matte paper
- Number of pages: 96



Technical specifications

Finished size:	20.5 cm × 26.5 cm
Non-bleed ad size:	17.5 cm × 23.5 cm
Half page ad size:	17.5 cm × 11.75 cm
Bleed size (3 mm bleed on all sides):	21 cm × 27.5 cm
Artwork preference:	Print ready, minimum 300 dpi (tiff, eps, pdf, or cdr) files with all fonts with high quality print proofs and progressives for colour reference.

Advertisement tariffs (₹)*

Ad location	Back cover	Inside back cover	Inside front cover	Inside full page	Inside half page	Inside quarter page	One-sixth page
Single issue	60,000	50,000	50,000	40,000	20,000	12,000	7,000
Two issues	114,000	95,000	95,000	76,000	38,000	22,800	13,300
Three issues	171,000	142,500	142,500	114,000	57,000	34,200	19,950
Four issues	228,000	190,000	190,000	151,000	76,000	45,600	26,600

Subscription

One year ₹800 / $80 • Two years ₹1600 / $160 • Three years ₹2400 / $240

Contact details

Sanjeev Sharma
Email: sanjeev.sharma@teri.res.in
<Extn 2443>

Bank details for NEFT:

The Energy and Resources Institute
Bank: State Bank of India
A/c Number: 62002345487
IFSC Code: SBIN0020511
Website:http://bookstore.teri.res.in/TerraGreen

The Energy and Resources Institute
Darbari Seth Block, IHC Complex
Lodhi Road, New Delhi – 110 003
Tel: 011 2468 2100 / 7110 2100
Fax: 011 2468 2144 / 2468 2145
Website:http://bookstore.teri.res.in

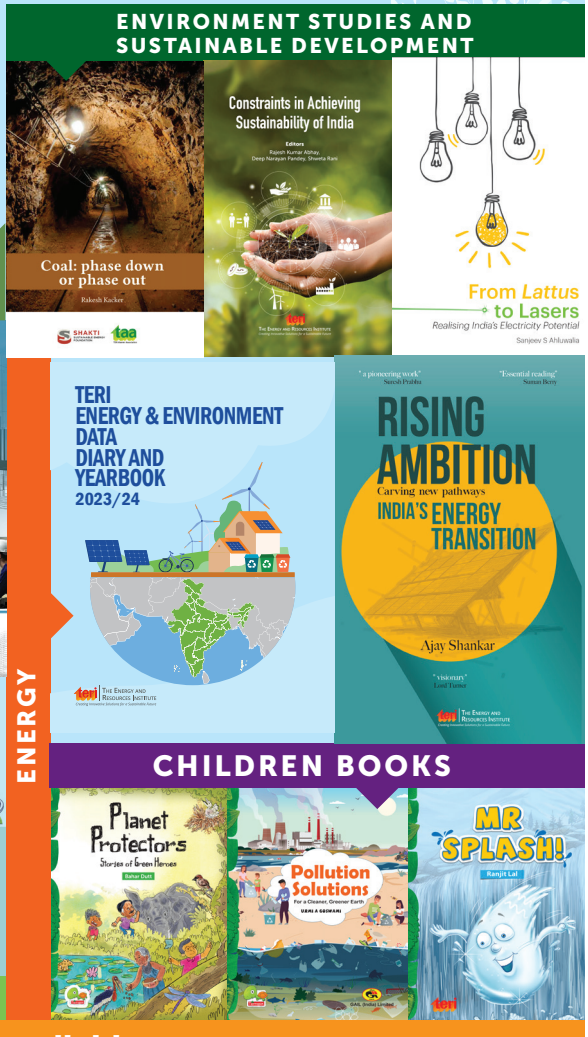
No. of Pages 56 without Cover

Postal Regn. No. DL(S)-17/3328/2020-22
RNI No. DELENG/2008/24157
ISSN No. 0974-5688

OPEN YOURSELF TO A WHOLE NEW WORLD OF ENVIRONMENT INTELLIGENCE!

PRESERVE • CONSERVE
INSPIRE • LEARN

ORDER YOUR COPY TODAY



TERI publications also available at

amazon.in flipkart.com GET IT ON Google play LEARNERLIBRARY mintbook Experience Reading
amazonkindle ShopClues.com infibeam.com paytm kopykitab Same textbooks, klick away

For more information, log on to http://bookstore.teri.res.in