TerraGreen

EARTH MATTERS

₹70

Subscriber's copy VOLUME 18 | Issue 9 | December 2025

COP30 in Belém

The 1.5°C Limit, Climate Diplomacy, and Prospects of Global Finance

SPECIAL HIGHLIGHTS

Delhi-NCR's Air Pollution Crisis

COP30: Hits and Misses

IN CONVERSATION

Mr Sunil Rajan,
CEO, WOG Technologies

TERRA YOUTH

Winter Wonderland's Impact on the Planet

teri

teri PERIODICALS

Bundle Offer Rs.8,990/-

TERI Information Digest on Energy and Environment*

TIDEE aims to keep policy-makers, scientists, and technologists abreast of the latest developments in the fields o f energy, local and global environment, and sustainable development. More than 600 periodicals, several hundred other documents, indexing services and other electronic resources, such as CD-ROMs, World Wide Web, discussion groups, and mailing list, are scanned.

Editor: Dr. P K Bhattacharya, TERI, New Delhi
Frequency: Quarterly (4 issues per year—March, June, September, and December)
Print ISSN: 0972-6721 • **Online ISSN:** 0975-7589
Subscription rate: **Print with free Online** – ₹2500/$203 • **Online** – ₹1300/$176

World Digital Libraries: An International Journal

WDL is an international peer-reviewed biannual journal. It publishes quality research papers that present original theoretical approaches. It also publishes experimental case studies related to digital library developments and maintenance, and disseminates digital information focusing on research and integration of knowledge at the interface of resources and development.

Editor: Dr. P K Bhattacharya, TERI, New Delhi
Frequency: Bi-annual (2 issues per year—June and December) • **Print ISSN:** 0974-567-X • **Online ISSN:** 0975-7597
Subscription rate: **Print with free Online** – ₹1900/$191 • **Online** – ₹900/$165

Journal of Resources, Energy, and Development*

JREaD focuses on research and integration of knowledge at the interface between resources and development. It provides a forum for comprehensive investigation, analysis, and review of issues in the fields of energy, environment, and natural resource management that confront decision-makers, planners, consultants, politicians, and researchers. It deals with theoretical and methodological subjects and explores sustainability issues and transitions and facilitates dialogue between the scientific community and the society at large.

Editor: Souvik Bhattacharjya, TERI, New Delhi
Frequency: Bi-annual (2 issues per year—March and September) • **Print ISSN:** 0975-7554 • **Online ISSN:** 0975-7562
Subscription rate: **Print with free Online** – ₹2300/$232 • **Online** – ₹1200/$198

TerraGreen

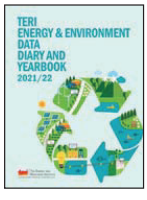
TerraGreen is India's most respected monthly magazine dedicated to informing and enlightening its readers on issues of environment, energy, and sustainable development. Launched in 2004, *TerraGreen* has made an indelible impression on the minds of readers, both in India and across the world. Today, it enjoys a readership of over 40,000 and a subscriber base of close to 10,000.

Frequency: Monthly (12 issues per year) **Print ISSN:** 0974-5688
Subscription rate: **Online only** – ₹840/$122
(Free access to online archives of over 12 years)

Energy Future

Energy Future draws from a deep well of expertise at TERI, India's leading research institute on energy and green growth. Knowledge of energy security and development is a critical requirement in the modern global economy, and Energy Future aims to educate and inform you about the wide world of energy; its history, its future, how the energy industry works, how it has affected the world, and how it continues to affect you and me.

Frequency: Quarterly (4 Issues per year) **Print ISSN:** 2278-7186
Subscription rate: **Print with free Online** – ₹800/$80
(Free access to online archives of over 12 years)



TERI Energy & Environment Data Diary and Yearbook

A TERI Publication

TERI Energy & Environment Data Diary and Yearbook, or *TEDDY*, is an annual publication brought out by TERI since 1986. *TEDDY* is often used as a reference in other peer-reviewed books and journals for energy and environment-related data. It gives an annual overview of the developments in the energy supplying and consuming sectors as well as the environment sector. It also provides a review of the government policies that have implications for these sectors of the Indian economy.

402 pages • Hardback • 220mm × 280mm • ₹1995/$129 (PDF only)

* For subscriptions outside India, please contact: IOS Press Tel. +31 20 6883355 Nieuwe Hemweg 6B, 1013BG, The Netherlands
E-mail: order@iospress.nl,

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

Bank details for NEFT:
The Energy and Resources Institute
Bank: State Bank of India
A/c Number: 62002345487
IFSC Code: SBIN0020511

EDITORIAL

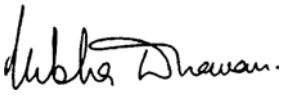
> It is evident from the last few COPs that moving forward countries must convert promises and pledges into real progress.

COP30 in Belém delivered mixed but significant outcomes as countries agreed on several key issues and took the resolve to take decisive actions to strengthen global climate mitigation response. They committed to mobilizing $1.3 trillion annually by 2035 to scale up climate finance, while also pledging to double adaptation finance by 2025 and triple it by 2035 to enable in building resilience across vulnerable nations. To accelerate progress, delegates launched the Global Implementation Accelerator and the Belém Mission to 1.5°C, aimed at driving ambition and coordinated action. Additionally, Parties committed to promoting information integrity and countering climate disinformation to support science-based policymaking.

The cover story of this edition of *TerraGreen* examines the outcomes of COP30 in Belém, highlighting the sharp divide between ambition and delivery, particularly on climate finance and mitigation. The article throws light on disagreements over the New Collective Quantified Goal (NCQG), adaptation finance, and the Mitigation Work Programme (MWP) which eventually resulted in deep North–South divide. While COP30 advanced work on the Global Goal on adaptation, just transition, and ocean-climate action, it failed to secure consensus on critical finance and fossil-fuel phase-out issues.

The deal finalized at COP30 commits more funding to help countries adapt to climate change, but it lacks explicit plans to transition away from fossil fuels such as oil, coal, and gas — the main drivers of global warming. This commitment, along with other outcomes from the Summit, is significant, yet still falls short of what science shows is necessary. While previous COPs have largely centred on mitigation, this year's conference placed unprecedented emphasis on "adaptation" and a "just transition." It is evident from the last few COPs that moving forward countries must convert promises and pledges into real progress. The window to keep 1.5°C within reach is rapidly closing, and decisive action is more urgent than ever.

We believe you will find each article in this issue thought-provoking and motivating, reinforcing our shared resolve to protect the planet's fragile equilibrium and advance towards a sustainable, carbon-neutral future.



Vibha Dhawan
Director-General, TERI

The November 2025 cover story on *Ageratina adenophora* is a timely and unsettling reminder of how quietly ecological crises can take root. The author's account of the Mexican Devil's spread across the Himalayas reveals not merely the menace of an invasive species, but the deeper vulnerabilities created by fragmented forest governance and reactive land management. Introduced as an unremarkable weed in the 19th century, *Ageratina* has exploited disturbed ecosystems, outcompeting native flora, degrading pastures, and undermining rural livelihoods. The article compellingly shows that this invasion is not an isolated botanical problem, but a symptom of neglect—where early warnings were ignored and coordinated control measures remained absent.

Addressing this crisis demands more than eradication drives; it calls for long-term ecological monitoring, community participation, and stronger institutional accountability in forest management. As climate change further destabilizes fragile mountain ecosystems, the story of the Mexican Devil should serve as a cautionary tale for India's environmental future.

Samrit Pandey
New Delhi

The November 2025 feature story on the 'Feel Good' movement offers a much-needed narrative of hope from Uttarakhand's hills. As the author shows, decades of shrinking farmland and mass migration have drained villages of people, purpose, and productivity. Yet the return of one individual to his native village in Pauri district has ignited a quiet grassroots revolution. By encouraging residents to come back, farm sustainably, and rebuild local economies, the 'Feel Good' movement challenges the assumption that opportunity lies only in cities. Its true achievement lies in restoring confidence—especially among youth—that life in the hills can be dignified, viable, and ecologically balanced. At a time when policy discussions often overlook community-led solutions, this story powerfully demonstrates that resilient futures are rooted in local initiative, shared stewardship, and a renewed connection to land and livelihoods.

Mohan Aswal
Dehradun, Uttarakhand

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

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
TERI, CA Site No. 2, 4th Main, 2nd Stage
Domlur, Bangalore–560 071
Email: terisrc@teri.res.in

North-Eastern Regional Centre
Chachal Hengrabari, Express Highway
Guwahati- 781 036
Tel: 0361-2334790, Fax: 0361-2334869
Email: terine@teri.res.in

Western Regional Centre
House No. 233/GH-2, Vasudha Housing Colony,
Alto-St Cruz, Tiswadi, Goa-403 202
Tel: 0832-2459306, 2459328
Email: teriwrc@teri.res.in

Contents

VOLUME 18 • ISSUE 9 • DECEMBER 2025

4 NEWS

12 FEATURE

Delhi-NCR's Air Pollution Crisis

18 IN CONVERSATION

Mr Sunil Rajan,
CEO, WOG Technologies

22 COVER STORY

COP30: Hits and Misses

30 SPECIAL REPORT

COP 30: Hits and Misses

34 GREEN CHALLENGES

The World's Climate Talks Shift from Goals to Action

37 TERRA YOUTH

46 WILDLIFE

First Photographic Record of Pallas's Cat Captured

50 PIONEER

56 GREEN EVENTS

12 FEATURE

30 SPECIAL REPORT

22 COVER STORY

10 ENVIRONMENTAL RESEARCH

37 TERRA YOUTH

Delhi's RML Hospital Launches 'Pollution Clinic' to Treat Smog-Linked Ailments

As Delhi continues to battle toxic air and rising pollution-linked ailments, Dr Ram Manohar Lohia (RML) Hospital has launched a dedicated Pollution Clinic to provide specialized treatment for patients suffering from smog-related illnesses. The clinic, a first-of-its-kind in a Central government hospital, aims to tackle the growing public health emergency triggered by the city's worsening air quality. The clinic, which began operations two years ago, brings together specialists from multiple departments—respiratory medicine, ENT, dermatology, ophthalmology, and psychiatry—to address the wide-ranging health effects of air pollution. It is currently operational on Mondays from 2 pm to 4 pm.

Source: https://thepatriot.in/

Lessons from Beijing in Clearing Delhi's Air Pollution

As the government looks to tackle the stubborn smog choking the national capital region (NCR), flagging vehicular pollution and calling for a shift to electric vehicles (EVs), China's action plan for curbing air pollution in its capital city offers some actionable cues. Beijing's transformation—from one of the world's most polluted cities to among the ones with the cleanest air—was built on a strong policy framework accompanied by a blueprint fostering cooperation across sectors, including private and state-owned enterprises, offering a replicable pathway. Its success could serve as a model for other cities worldwide.

Source: https://indianexpress.com/

Bengaluru Second in Rooftop Solar Installations

Bengaluru Urban was ranked second compared to other Indian metropolis in the installation of rooftop solar panels and the number of households benefiting from it, according to a report from the Ministry of New and Renewable Energy (MNRE), Govt. of India. But the state government officials say that Karnataka lags behind the target set by the central government for the installation of solar rooftop panels under the Pradhan Mantri-Surya Ghar Muft Bijli Yojana scheme. The Ministry in its response to Bangalore South MP Tejavi Surya's question in Lok Sabha stated that there are 4,984 solar rooftop installations in Bengaluru Urban and 386 in Bengaluru Rural, making it a total of 5,370 installations in BESCOM limits. Bengaluru Urban lagged behind Mumbai covering 18,223 households under the scheme with 428 installations in Mumbai and Mumbai Suburban.

Source: https://www.newindianexpress.com/

Endangered Himalayan Plants to Be Conserved

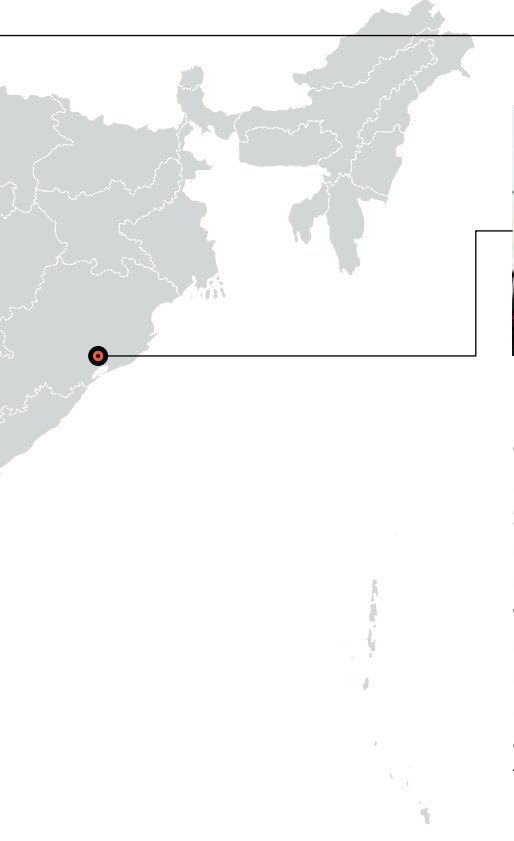
The GB Pant National Institute of Himalayan Environment has launched an initiative to cultivate endangered Himalayan medicinal plants in Darma and Vyas valleys of Pithoragarh, aiming to conserve the wild species, support border security, and boost rural incomes. The initiative, announced at a recent two-day workshop attended by scientists, farmers and Indo-Tibetan Border Police (ITBP) personnel, targets plants such as kuth, kutki, gandrayani and wild turmeric.
KS Kanwal, senior scientist at the institute, warned that several Himalayan medicinal plants are approaching extinction. "Taking these plants from the wild is no longer sustainable. The only lasting solution is to grow them scientifically on farms. It protects the species and strengthens the hands that tend them," he said.

Source: https://timesofindia.indiatimes.com/

HydroMingle 2025 Brings Together Innovators to Address India's Water Challenges

HydroMingle 2025, hosted at the India Habitat Centre by GuruJal in partnership with FluxGen Sustainable Technologies, AIM–NITI Aayog, AIC–IIT Delhi, Sonipat Innovation Foundation, Water Digest, TERI School of Advanced Studies, and several industry collaborators, brought together innovators, policymakers, and experts to explore India's water challenges and solutions.
The event was attended by Union Minister Shri Rao Inderjit Singh, Ministry of planning, who engaged with entrepreneurs and stakeholders working at the intersection of water systems, emerging technologies, and nature-based solutions.

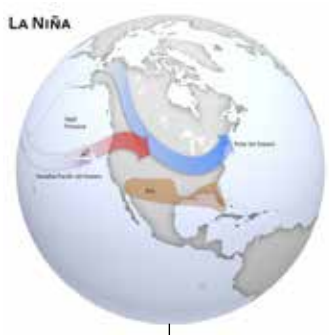
Source: https://timesofindia.indiatimes.com/



Inland Waterways Expansion with Major MoUs Signed at India Maritime Week 2025

Inland Waterways Authority of India (IWAI), the nodal agency under the Ministry of Ports, Shipping & Waterways (MoPSW) for development of waterways in the country, made major announcements for development and stepping up Uttar Pradesh's inland waterways network, signing key agreements at India Maritime Week 2025 (IMW). IWAI signed MoUs worth more than ₹6,000 crore for development and expansion of Inland Waterways network on river Ganga (NW 1). The MoUs aim at strengthening river cruise tourism, ship repair infrastructure, multimodal connectivity and clean-energy transportation along National Waterway-1 (Ganga). IWAI announced an investment boost of ₹1,350 crore to accelerate inland water transport and river cruise infrastructure in Uttar Pradesh, following the signing of MoUs during IMW 2025.

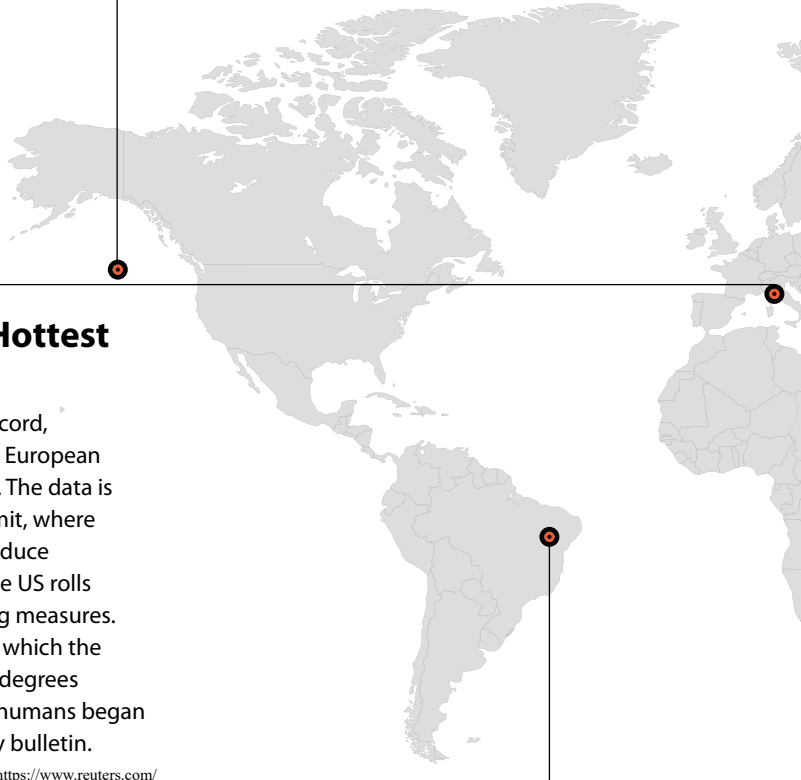
Source: https://www.pib.gov.in/



La Niña to Fade Early Next Year, Neutral Pacific Conditions Likely

La Niña is expected to linger for another month before likely giving way to neutral Pacific conditions between January and March 2026, carrying a 68 per cent probability, the US Climate Prediction Center said recently. La Niña is part of the El Niño-Southern Oscillation climatic cycle, which affects water temperatures in the central and eastern Pacific Ocean. La Niña results in cooler water temperatures, increasing the chance of floods and drought, which can impact crops. When ENSO is neutral, water temperatures stay around the average level, leading to more stable weather and potentially better crop yields.

Source: https://www.reuters.com/



2025 will Be World's Second or Third-Hottest Year on Record, EU Scientists Say

This year is set to be the world's second or third-warmest on record, potentially surpassed only by 2024'S record-breaking heat, the European Union's Copernicus Climate Change Service (C3S) said recently. The data is the latest from C3S following last month's COP30 climate summit, where governments failed to agree to substantial new measures to reduce greenhouse gas emissions, reflecting strained geopolitics as the US rolls back its efforts, and some countries seek to weaken CO_2-cutting measures. This year will also likely round out the first three-year period in which the average global temperature exceeded 1.5 degrees Celsius (2.7 degrees Fahrenheit) above the 1850–1900 pre-industrial period, when humans began burning fossil fuels on an industrial scale, C3S said in a monthly bulletin.

Source: https://www.reuters.com/

World is Losing $5 Billion Every Hour Due to Fossil Fuel Use, Food Production

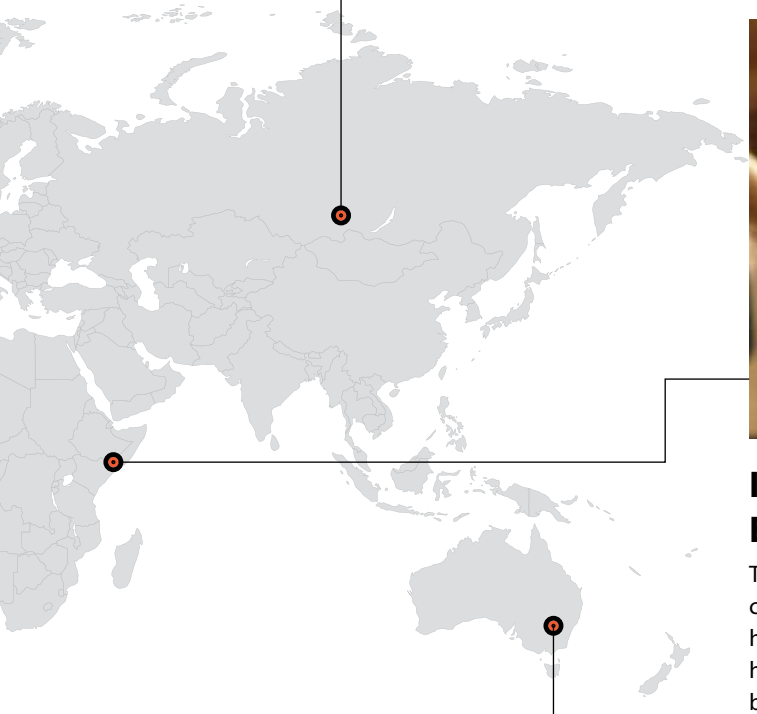
The United Nations (UN) has issued yet another warning in an attempt to prompt global action to battle factors that lead to climate change. This time, the warning came in the form of a hefty assessment for humanity, estimating that the world is losing around $5 billion every hour due to environmental damage caused by unsustainable food production and fossil-fuel use. The latest Global Environment Outlook (GEO), prepared by 200 researchers under the UN Environment Programme (UNEP), said that this level of harm is part of a broader breakdown that could make global collapse unavoidable unless governments act against climate change collectively and revamp the way economies function.

Source: https://www.indiatoday.in/

Microplastics Penetrating Human Brain, Accelerating Alzheimer's, Parkinson's

A new study has warned that microplastics could be fuelling neurodegenerative diseases like Alzheimer's and Parkinson's, adding an alarming layer to an already growing global health crisis. More than 57 million people worldwide currently live with dementia, and experts say cases are set to rise sharply. If microplastics are aggravating or accelerating these illnesses, they could reshape how we think about everyday environmental risks. According to Dua, adults around the world may be ingesting 250 grams of microplastics every year, enough to cover a dinner plate entirely. "We ingest microplastics from a wide range of sources, including contaminated seafood, salt, processed foods, tea bags, plastic chopping boards, drinks in plastic bottles and food grown in contaminated soil, as well as plastic fibres from carpets, dust and synthetic clothing," Dua added.

Source: https://www.indiatoday.in/



Iain Douglas-Hamilton, Pioneering Elephant Conservationist, Dies Aged 83

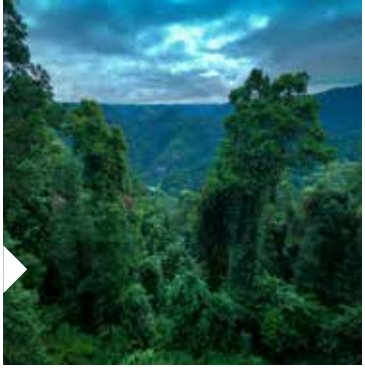
The Prince of Wales has paid tribute to pioneering elephant conservationist Iain Douglas-Hamilton, who died aged 83 at his home in Nairobi on December 8, 2025. Douglas-Hamilton spent his life studying and campaigning to protect African elephants, becoming a world-leading expert on their behaviour in the wild.

Source: https://www.bbc.com/

Australia's Rainforests are Releasing More Carbon than They Absorb, Warn Scientists

Australia's tropical rainforests have become the first in the world to release more carbon than they absorb, in a trend linked to climate change, a study has found. Rainforests are usually regarded as so-called "carbon sinks" as they absorb more emissions than they emit with new trees offsetting the carbon released by dead ones. But a study looking at data from Queensland forests found that extreme temperatures have caused more tree deaths than growths. The lead author of the study, which was published in science journal *Nature*, said the findings have significant implications for global emissions reduction targets which are partly based on how ecosystems—such as rainforests—can absorb carbon.

Source: https://www.bbc.com/



Reimagining Resilient Indian Cities

Building Flood-Ready Futures

India's cities face mounting climate risks, with floods, heatwaves, and unplanned growth causing significant human and economic losses. In this article, **Shabnam Bassi** says that resilience must be embedded in urban planning rather than added as a reactive measure. To ensure infrastructure is both resilient and equitable amid rapid urbanization and climate change, development must be user-centric and grounded in practical realities, encouraging behavioural shifts in consumption and daily practices. Only when resilient design, affordable housing, public health systems, finance, governance, and community participation advance together can India's cities be reimagined as sustainable, inclusive, and climate-ready.

India reported the loss of over 80,000 lives and nearly $180 billion due to 400 extreme weather events between 1993 and 2022, experiencing devastating floods and severe heatwaves in recent years. During this period, the country recorded high absolute fatalities and economic losses, as well as a large number of people affected in both absolute and relative terms. Unplanned urban expansion continues to hinder sustainable growth and impede long-term development. Incidents of urban flash flooding have become frequent, even during minor rainfall, resulting in infrastructure damage and disruption of daily life, underscoring the lack of resilience in Indian cities.

Need for Built-in Resilience

Mere optimization of resources does not ensure resilience to future climate- or disaster-related shocks. For a "return on resilience" framework for large urban projects, we must shift from viewing resilience as a reactive cost to embedding it as a strategic investment; meaning, we need to prepare in advance for anticipated risks and prevent them, rather than responding after disasters occur. This approach reflects what is known as "resilience built-in" rather than an "add-on". Rebuilding roads after floods or retrofitting buildings after extreme heat events is reactive; the essential shift is to make resilience a built-in, forward-looking strategy–integrated into how we design, plan, and finance cities from the start.

The biggest opportunity lies in merging grey and green infrastructure through multifunctional design, where one component serves multiple purposes. Designing stormwater-absorbing streets to manage runoff or mandating holistic green building standards enables cities to act like sponges—absorbing rather than discharging water. Integrating green corridors, bioswales or permeable surfaces can serve as flood buffer zones in large-scale projects. Roads and drainage corridors can be developed to integrate Sustainable Urban Drainage Strategies (SUDS) and urban green pathways (vegetated pergolas), such as bioswales to absorb stormwater and vegetated corridors to provide shaded pedestrian networks. Instead of treating

green spaces as aesthetic add-ons, embedding them into hard infrastructure projects can serve both ecological and social purposes.

Affordable housing too must be reimagined with built-in resilience. Modular, low-cost, and climate-sensitive designs, such as elevated housing in flood-prone areas, passive cooling in heat-prone regions, and shared green courtyards for water absorption, can make housing both affordable and climate resilient. The focus should not be on short-term returns on investment (ROI), but on long-term value creation through avoided losses, reduced health costs, improved well-being, and mitigation. Yet, even the most resilient housing and infrastructure cannot scale effectively without supportive financial systems, robust governance, and citizen participation.

Making Green Investment the Norm

India has progressive urban policies and building codes that, on paper, strongly advocate sustainability, resource efficiency, and climate resilience. However, these remain largely unfulfilled due to a persistent gap between intent and implementation. A significant silo in our urban ecosystem today lies between policy ambition and financial mechanisms. Sustainability often remains aspirational because the financial ecosystem fails to fully integrate resilience and green principles into mainstream lending or project evaluation. A green affordable housing project may meet all policy requirements and yet struggle to secure concessional finance or lower-interest loans.

To bridge this gap, the most transformative action is to institutionalize green finance as the norm rather than the exception. That means, embedding green building frameworks not only into policy but also into financing criteria, so that sustainability becomes a prerequisite for loans, grants, or incentives. Streamlining

funding through credible impact assessments will ensure transparent and accountable disbursal of green funds.

The Way Forward

Resilient infrastructure and finance systems require strong governance and integrated planning. It is crucial that top-down policy directives and bottom-up citizen partnership meet midway. One of the most critical non-physical needs for Indian cities today is a framework where robust policies, transparent data platforms, and participatory models work in harmony. In this context, multi-layered Geographic Information System (GIS) data analysis can be a powerful enabler. Capturing spatial and temporal dynamics through time-lapse GIS studies can help stakeholders visualize patterns of population growth, ecological change, and resource utilization, thereby facilitating informed, integrated, data-driven land-use planning and avoiding overlaps.

However, resilience must extend beyond infrastructure and planning; cities need to mainstream health resilience with climate planning. This involves integrating public health data into climate risk models, ensuring hospitals and primary healthcare centres are climate-proofed–with backup power, flood-safe design, and adequate ventilation—and developing early warning systems not only for floods but also for heatwaves, vector-borne diseases, and water contamination linked to extreme weather.

Equally critical is the role of communities. During disasters, communities are often first responders providing immediate support to affected populations. Their involvement is vital for preparedness and recovery, as they possess local knowledge of hazards, vulnerabilities, and existing capacities. Community-led preparedness ensures that strategies are contextually grounded, addressing real needs and fostering a sense of ownership where people view themselves as participants, not passive beneficiaries, of urban systems.

To make infrastructure truly resilient and equitable amid rapid urbanization and climate change, development must be user-centric and practical, encouraging behavioural shifts in consumption and everyday practices. Only when resilient design, affordable housing, public health infrastructure, finance, governance, and community participation move in concert can India's cities be reimagined as sustainable, inclusive, and climate-ready. ■

Ms Shabnam Bassi, Senior Fellow & Director, GRIHA Council, Sustainable Buildings division, TERI, New Delhi.

Everyday Microplastics could be Fuelling Heart Disease

A New Study Highlights

Microplastics—tiny particles now found in food, water, air, and even human tissues—may directly accelerate artery-clogging disease, and new research shows the danger may be far greater for males. In mice, environmentally realistic doses of microplastics dramatically worsened plaque build-up, altered key vascular cells, and activated harmful genes linked to inflammation and atherosclerosis, all without changes to weight or cholesterol.

A research team at the University of California, Riverside has found that routine exposure to microplastics—tiny pieces released from packaging, fabrics, and common consumer plastics—may speed up the formation of atherosclerosis, the artery-narrowing condition associated with heart attacks and strokes. The effect appeared only in male mice, offering new insight into how microplastics may influence cardiovascular health in people.

"Our findings fit into a broader pattern seen in cardiovascular research, where males and females often respond differently," said lead researcher Changcheng Zhou, a professor of biomedical sciences in the UCR School of Medicine. "Although the precise mechanism isn't yet known, factors like sex chromosomes and hormones, particularly the protective effects of oestrogen, may play a role."

Microplastics Found Throughout the Environment and the Body

Microplastics are found widely in the modern environment, including in food, drinking water, and the air. They have also been detected inside the human body. Recent clinical studies have identified microplastics in atherosclerotic plaques and associated higher concentrations with elevated cardiovascular risk, although it was not clear whether these particles directly cause arterial injury.

"It's nearly impossible to avoid microplastics completely," Zhou said. "Still, the best strategy is to reduce exposure by limiting plastic use in food and water containers, reducing single-use plastics, and avoiding highly-processed foods. There are currently no effective ways to remove microplastics from the body, so minimizing exposure and maintaining overall cardiovascular health—through diet, exercise, and managing risk factors—remains essential."

Study Design Using a Heart Disease Mouse Model

In their paper published in *Environment International*, Zhou and colleagues describe their use of LDLR-deficient

mice, a common model for examining atherosclerosis. Both male and female mice were placed on a low-fat, low-cholesterol diet similar to what a lean and healthy person might eat.

The team then administered microplastics daily (10 milligrams per kilogram of body weight) for nine weeks. This amount reflects levels that could realistically be encountered through contaminated food and water.

Microplastics Intensify Plaque Formation in Male Mice

The results showed a sharp increase in atherosclerosis, but only in males. Male mice exposed to microplastics developed 63 per cent more plaque in the aortic root, the segment of the aorta connected to the heart, and 624 per cent more plaque in the brachiocephalic artery, a major vessel branching from the aorta in the upper chest. Female mice exposed to the same conditions did not show significant plaque progression.

The researchers confirmed that microplastics did not cause weight gain or increased cholesterol in either sex. The mice stayed lean, and their lipid profiles remained unchanged, indicating that traditional risk factors such as obesity or high cholesterol did not explain the heightened arterial damage.

Disruption of Artery-Lining Cells

The study also showed that microplastics interfered with the function and makeup of cells lining the arteries. Using single-cell RNA sequencing, which identifies gene activity in individual cells, the researchers observed that microplastics altered several cell types involved in atherosclerosis. Endothelial cells—the cells that form the inner lining of blood vessels and help regulate inflammation and circulation—were affected the most.

"We found endothelial cells were the most affected by microplastic exposure," Zhou said. "Since endothelial cells are the first to encounter circulating microplastics, their dysfunction can initiate inflammation and plaque formation."

Microplastics Enter Arterial Plaques and Alter Gene Activity

Fluorescent microplastics used in the study were found inside plaques and concentrated within the endothelial layer, consistent with reports from human samples that have revealed microplastics in arterial lesions.

Another key observation was that microplastics activated harmful gene pathways in endothelial cells from both mice and humans. This included genes associated with pro-atherogenic (plaque-promoting) activity, suggesting that microplastics trigger similar biological responses across species.

"Our study provides some of the strongest evidence so far that microplastics may directly contribute to cardiovascular disease, not just correlate with it," Zhou said. "The surprising sex-specific effect—harming males but not females—could help researchers uncover protective factors or mechanisms that differ between men and women."

Future Research on Sex Differences and Microplastic Types

Zhou and his team emphasize that more work is needed to determine why males appear more susceptible. The group plans to investigate whether humans show similar patterns.

"We would like to investigate how different types or sizes of microplastics affect vascular cells," Zhou said. "We will also look into the molecular mechanisms behind endothelial dysfunction and explore how microplastics affect male and female arteries differently. As microplastic pollution continues to rise worldwide, understanding its impacts on human health— including heart disease—is becoming more urgent than ever."

Zhou conducted the study with collaborators from UCR, Boston Children's Hospital and Harvard Medical School in Massachusetts, and the University of New Mexico Health Sciences. The work received partial support from the National Institutes of Health. ■

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

Delhi-NCR's Air Pollution Crisis

Some Short-term to Long-term Solutions

Delhi-NCR faces a severe annual air pollution crisis driven by a combination of local emissions, regional pollution transport, and winter weather that traps pollutants close to the ground. $PM_{2.5}$ levels routinely reach hazardous ranges, causing major health impacts, economic losses, and pressure on hospitals. While short-term actions under GRAP help manage acute spikes, they cannot resolve the region's chronically high baseline pollution. Effective solutions require coordinated airshed-level governance, cleaner transport and fuels, strict dust and waste controls, support for sustainable farming practices, and stronger public engagement. Long-term, structural reforms—backed by accountability and transparency—are essential to reduce pollution and safeguard public health.

Every year after Diwali and during early winter season, the skies over Delhi-NCR turn an uneasy, orange-brown. Streets and monuments fade into haze; schools warn children to stay indoors and hospitals report surges in respiratory cases. In November–December 2025, the pattern returned with familiar severity — high $PM_{2.5}$ and PM_{10} concentrations, repeated activations of the Graded Response Action Plan (GRAP), and emergency measures such as intensified dust control, road repairs and stricter industrial monitoring. Policymakers and city managers have responded with a flurry of short-term interventions, but the core of the crisis persists: a complex mix of local emissions, regional sources and weather that traps pollution close to the surface.

What's in the Smoke: the science of the smog

Most of the immediate harm comes from fine particulate matter—$PM_{2.5}$—particles small enough to penetrate deep into lungs and enter the bloodstream. These particles are produced by vehicle exhaust, diesel generators, industry, construction dust, biomass and waste burning, and episodic sources such as fireworks. During winter, cooler temperatures, weak winds and temperature inversions prevent dispersion, concentrating pollutants near the ground. Recent measurements show Delhi's winter $PM_{2.5}$ routinely in the "very poor" to "hazardous" range—many times higher than WHO guidelines—leading to measurable rises in hospital admissions and long-term health burdens. A recent multi-year study quantifying respiratory deposition and health impacts in Delhi highlights how dangerous sustained exposure to fine particles has become.

The Usual Suspect

For years, stubble or crop-residue burning in Punjab and Haryana has been spotlighted as a main driver of Delhi's winter smog. The smoke from farm fires does contribute, especially on days when winds carry plumes into the capital. But multiple analyses and recent government briefings have stressed that stubble burning is only one part of a broader emissions picture. Local sources—traffic (especially diesel vehicles and older petrol models), construction activity, industrial emissions and in-city waste burning—are substantial and often the dominant contributors during many pollution spikes. This means that even when farm fires are reduced, Delhi can still face severe air quality episodes if

local emissions and meteorological conditions align unfavourably.

Why Short-Term Fixes are Necessary but Not Sufficient

The GRAP provides a graded set of emergency measures—from stopping construction and closing schools to restricting old vehicles—which are valuable for immediate risk reduction. Recent revisions to the GRAP and Winter Action plans have tightened triggers and broadened the set of enforcement actions, reflecting the urgent nature of the problem. Rapid repairs of potholes, more aggressive dust suppression on construction sites, temporary curbs on the oldest vehicle cohorts, and increased monitoring of industries can blunt the worst days. Yet these interventions are inherently reactive: they reduce acute exposure but do not structurally cut the year-round emissions that keep Delhi's baseline pollution high.

The Human Cost

The health impacts are profound and not limited to seasonal coughs. Sustained exposure to high $PM_{2.5}$ increases risks of asthma, chronic obstructive pulmonary disease (COPD), cardiovascular disease, low birth weight, and premature deaths. Hospitals see spikes in emergency

visits during pollution peaks; clinics report worsening of chronic conditions. Beyond direct health effects, there are economic losses from missed workdays, reduced productivity and higher public health spending. Long-term, exposure contributes to a measurable burden of disease across the population — a cost that grows with each polluted winter.

Why an Airshed Approach Matters

Delhi does not sit in a vacuum. Pollutants travel across administrative borders, which is why the Commission for Air Quality Management (CAQM) and interstate coordination are critical. Recent policy moves have sought to treat the National Capital Region as an integrated airshed — aligning action plans across neighbouring states and setting shared targets for road repairs, dust control, industry compliance and transport improvements. This regional framing is necessary: patchwork measures inside Delhi alone cannot fix pollutants that originate or accumulate regionally. But better coordination must be matched by accountability and funding to be effective.

Practical Solutions — Short, Medium, and Long Term

Below are evidence-based steps that, combined, can convert emergency relief into lasting improvement. They are ordered roughly from the most immediate to the most structural.

Short-term (weeks to a season)

Proactive GRAP enforcement with transparency: Activate the appropriate GRAP stage early and stick to it — close monitoring, clear timelines and public dashboards showing emissions and compliance foster trust and behaviour change. The revised GRAP is a useful tool;

rigorous, transparent enforcement makes it credible.

Targeted traffic management: Temporarily tighten emissions standards for heavy diesel vehicles, enforce anti-idling rules, and deploy odd-even or congestion pricing only where they demonstrably reduce emissions and not merely shift traffic. Boost last-mile public transport (electric buses, feeder services) on high-pollution days.

Construction and dust control blitz: Enforce mandatory wheel-washing, site fencing, regular water spraying and immediate penalties for violations. Repairing major road potholes reduces re-suspended dust — a low-hanging fruit for acute improvement.

Medium-term (months to 3 years)

Accelerate electrification of public and freight transport: Prioritize electric buses, incentivize electric three-wheelers and two-wheelers, and create charging infrastructure corridors. Fiscal incentives plus stricter emission norms for commercial diesel fleets will shift the fleet mix faster.

Cleaner fuels and retrofit programmes: Enforce tighter fuel quality standards and implement diesel particulate filter (DPF) retrofits for in-service heavy vehicles. Phase out older, polluting vehicles with buy-back and replacement subsidies targeted at low-income vehicle owners and small businesses.

Urban waste reforms: Ban open burning of waste with strict local enforcement, and invest in decentralized composting, formalized waste collection and material recovery facilities so organic residues don't end up aflame.

Support alternatives for farmers: Continue scaling access to machinery (happy seeders, straw shredders) and market incentives for residue management services, while expanding biomass-to-energy or composting programmes to make residue useful rather than waste. Evidence shows episodes of reduced farm fires when alternatives and subsidies are available — but policy must be sustained and locally appropriate.

Long-term (3–10 years)

Airshed governance with shared targets and finance: Move beyond ad hoc coordination to a legally backed airshed authority with budget, data-sharing, pollution budgets and binding emission reduction targets across states. Regional industrial norms, transport planning and agricultural strategies should be set against an airshed emission ceiling.

Reimagine cities for low emissions: Invest in high-capacity public transport (metro extensions, BRT), complete-streets redesign that reduces private-vehicle dependence, and zoning that reduces heavy-truck movement through residential corridors. Urban greening can help — but must be paired with emissions reductions to have measurable air quality benefits.

Industrial transition: Tighten stack-emission norms, require continuous online monitoring with public disclosure, and provide transition finance for small and medium enterprises to adopt cleaner technology.

Health system preparedness and behavioural change: Build primary care capacity for pollution-related illnesses, maintain public early-warning systems, and run continuous public campaigns about exposure reduction (masks on bad days, school policies, indoor air purification for vulnerable institutions).

Accountability, Data and Public Participation

Data transparency drives action. Public dashboards that show station-level AQI, major emissions sources and enforcement actions create pressure for compliance. Citizen science (low-cost sensors) can fill spatial gaps, but must be calibrated and integrated into official systems. Finally, community involvement—from school programmes to resident welfare associations—multiplies the effect of policy by changing behaviour: less outdoor burning, reduced private car trips, and greater support for regulation.

Closing: the choice is political, technical, and social

Delhi-NCR's air crisis is not a single-cause problem with a single cure. It is a seasonal expression of chronic urban and regional development choices — transport systems built on private vehicles, loosely enforced industrial pollution rules, waste streams that are allowed to burn, and agricultural practices shaped by crop economics. Short-term emergency measures save lives in the immediate term; medium and long-term structural reforms cut the baseline that makes those emergencies inevitable.

If the region treats the airshed as a shared commons, invests consistently in cleaner transport and fuels, supports farmers with practical alternatives, and enforces rules transparently, the skyline can clear and the health burden fall. The tools exist; what remains is the will to use them systematically and the civic commitment to demand better air as a basic public good. ■

The article has been compiled by TerraGreen's editorial team.

Driving India's Water Transformation

WOG's Vision for Reuse, Decentralization, and Circularity

WOG Technologies is a world leader in providing delegated management of water, wastewater services and renewable energy generation for industrial and municipal client. It designs the technological solutions and builds the facilities required for these services. Here, we are in an exclusive email conversation with **Mr Sunil Rajan,** CEO, WOG Technologies.

Please let us know about WOG's large-scale wastewater reuse projects reshaping industrial and municipal water management.

WOG's large-scale wastewater treatment and reuse projects have become critical benchmarks in regions experiencing severe water scarcity across India, Southeast Asia, and the Middle East. As freshwater sources shrink and regulatory frameworks tighten, industries and municipalities are rapidly shifting from a "treat-and-discharge" mindset to a "treat-reuse-recover" approach, and WOG has been at the forefront of this transition.

Across more than 1,200+ MLD of cumulative treatment capacity, WOG's advanced membrane bioreactor (MBR), MBBR, desalination, and ZLD systems are enabling cities and industries to reuse 60–90 per cent of their treated water. This has reduced freshwater dependence by 800+ million litres annually and helped industries meet stringent compliance norms while maintaining uninterrupted operations.

In highly water-stressed belts, such as Rajasthan, Tamil Nadu, Greater Jakarta, and parts of the Gulf, WOG's decentralized and industrial cluster solutions have transformed how water is managed. Industries that once relied on borewells or tanker water now operate using fully recycled process water. Phuket Project of WOG is one such example. Municipal bodies are now repurposing treated sewage water for landscaping, cooling towers, agriculture, and industrial supply networks.

What is reshaping the sector is not just technology but the new governance model WOG enables: design–build–operate (DBO) structures, performance-linked KPIs, digital monitoring, and real-time compliance reporting. Together, these create a reliable ecosystem where water reuse becomes economically viable, environmentally beneficial, and operationally sustainable.

Can you explain WOG's initiatives to embed renewable energy and green hydrogen across its water infrastructure operations?

WOG has long believed that the future of water infrastructure lies at the intersection of water, energy, and carbon. Our next-generation wastewater treatment plants integrate renewable energy, biogas recovery, and green hydrogen pathways to deliver systems that are not only resource-efficient but also climate-positive.

Through advanced anaerobic digestion (AD) and hybrid bio-reactor technologies, WOG recovers biogas from high-strength industrial effluents, generating clean energy that offsets 30–70 per cent of a plant's total operating energy demand. In several chemical, textile, and food-processing installations, this energy is reused for boiler operations and thermal loads, creating direct cost savings and emissions reductions.

In parallel, WOG is developing pilot-scale "water-to-hydrogen" modules, where treated wastewater is used as a feedstock for green hydrogen production. This not only reduces freshwater demand for electrolysers but also creates a circular loop where wastewater becomes a fuel precursor. Early pilots in India and Southeast Asia indicate that integrating electrolysis with tertiary-treated effluent could reduce water input costs by 70 per cent.

Solar PV integration is another major focus. Newer WOG plants are being designed as "net-zero energy" water assets, combining solar rooftops, biogas-to-power, and energy-efficient MBR systems. As renewable energy adoption becomes mandatory under ESG frameworks, WOG's hybrid water-energy systems are turning treatment facilities into energy producers rather than energy consumers, paving the way for climate-aligned water reuse ecosystems.

Please explain WOG's decentralized and modular models aimed at strengthening the resilience of urban water systems in India.

India's cities are experiencing a watershed moment, exponential wastewater generation, aging sewer networks, and limited treatment capacities. WOG's decentralized and modular systems offer a transformative pathway to urban resilience by shifting from large, central sewage treatment plants (STPs) to scalable, localized, and rapidly deployable treatment units.

WOG's decentralized MBR/MBBR modules, containerized treatment plants, and hybrid STP clusters can be installed in 4–6 months, compared to the 24–36 months required for conventional STPs. This agility has proven critical in growing cities such as Gurugram, Pune, Bengaluru, and tier-2 urban clusters, where land, time, and connectivity are major constraints.

Our "plug-and-play" systems operate with 70 per cent lower footprint, require minimal civil construction, and can be integrated directly into residential complexes, commercial districts, institutional campuses, industrial townships, and peri-urban zones. As a result, cities can treat wastewater at the source and reuse it locally for cooling, horticulture, construction, and flushing.

A key best practice is the digital supervision architecture built into WOG's plants; IoT sensors, SCADA, real-time quality dashboards, and AI-driven predictive maintenance alerts. This ensures compliance, reduces manpower dependency, and improves uptime, addressing the operational challenges that plague municipal STPs.

For India's rapidly urbanizing landscape, decentralized and modular systems offer a resilient roadmap: treat locally, reuse locally, and reduce the burden on centralized infrastructure. WOG is now working with state governments to scale such models under AMRUT 2.0, Smart Cities Mission, and industrial corridor programmes.

What about circular economy and resource recovery from wastewater?

Circular economy is no longer a theoretical concept; it is now an operational reality in WOG-led industrial ecosystems. By transforming wastewater and industrial effluents into usable water, biogas, nutrients, and thermal energy, WOG is enabling industries to achieve true resource circularity while dramatically lowering their environmental footprint.

Through ZLD systems, multi-effect evaporation (MEE), mechanical vapour recompression (MVR), and advanced membrane processes, WOG recovers up to 97 per cent clean water from complex effluents in textiles, chemicals, pharma, and heavy manufacturing. This reduces freshwater intake, eliminates discharge, and supports regulatory compliance.

Equally critical is the transformation of organic waste streams into renewable energy. WOG's anaerobic hybrid reactors recover methane-rich biogas that can fuel boilers, generate electricity, or be upgraded into biomethane. Effluents from food, beverage, distillery, and agro-processing industries can generate 200–1000 m^3/day of biogas, significantly offsetting fossil fuel use.

WOG is also advancing nutrient recovery systems, where sludge is converted to soil conditioners or fertilizer precursors through solar drying, composting, and controlled stabilization.

These circular systems strengthen India's resource recovery ecosystem by:

- Reducing industrial dependence on borewells
- Cutting CO_2 emissions
- Improving ESG performance
- Extending the life of water sources
- Creating new economic value from waste

As India moves towards a net-zero pathway, WOG's circular economy models become indispensable frameworks for sustainable industrial transformation.

What are the emerging opportunities in India's water and environmental infrastructure?

India's water-wastewater sector is on the cusp of unprecedented expansion, driven by urbanization, industrialization, climate stress, ESG compliance, and investor interest in green infrastructure. Over the next decade, the biggest opportunities will emerge in industrial water reuse, ZLD, decentralized urban systems, desalination, wastewater-to-energy, and

digital water management.

Industrial water reuse is set to become mandatory across sectors such as textiles, pharma, food processing, refineries, and chemicals. Demand for ZLD and high-recovery systems is expected to grow at 15–18 per cent CAGR, creating opportunities for advanced systems such as MBR-MVR hybrids and low-energy desalination.

Cities will increasingly adopt cluster-based STPs, modular STPs, and tertiary treatment plants for reuse in cooling towers, horticulture, and construction. AMRUT 2.0, Smart Cities Mission, and industrial corridor programmes collectively represent a multi-billion-dollar opportunity.

India's coastline is driving investments in desalination, especially in Gujarat, Maharashtra, Tamil Nadu, and Andhra Pradesh. The most exciting opportunities emerge in digital water; AI, IoT sensors, predictive analytics, digital twins, and remote O&M. These will define the next generation of operation-performance models.

WOG is positioning itself by expanding R&D, scaling its technology centre, deploying digital automation across assets, and partnering with global membrane and green energy companies. With its integrated water–energy–sustainability capabilities, WOG is poised to lead India's industrial and urban transformation over the next decade.

Please share your thoughts on AI, IoT, and membranes enabling smarter and more efficient water management.

Technology is transforming water management, and WOG is pioneering this shift by embedding AI, IoT, automation, and next-gen membranes into every stage of water and wastewater operations. WOG's plants are now equipped with smart IoT sensors that continuously track COD, BOD, TSS, turbidity, MLSS, pH, ammonia, and nutrient load, enabling real-time compliance and early detection of process deviations. AI-driven predictive maintenance algorithms forecast equipment failures before they occur, improving plant uptime and reducing operational costs by 20–70 per cent.

Our digital twins replicate the biological and hydraulic behaviour of treatment plants, allowing operators to simulate scenarios, optimize energy consumption, and adjust loads dynamically. At scale, this transforms water infrastructure into intelligent, self-learning systems rather than manual-driven operations.

On the treatment side, WOG's advanced membrane systems (ultra-low fouling MBRs, ceramic membranes, and high-recovery RO) significantly improve water quality and reduce lifecycle costs. By integrating automation with high-efficiency membranes, WOG achieves 70–97 per cent water recovery, even for complex effluent streams.

For municipalities, we are planning to establish remote command centres to provide centralized dashboards, analyzing data from multiple STPs in different cities. For industries, digital systems reduce manpower dependency and strengthen ESG reporting. Together, these innovations are enabling a new paradigm of smart, resilient, data-driven water ecosystems; critical for India's next phase of urban and industrial growth. ■


JUSTICE
FIRE
WISDOM
JUST TRANS

COP30 in Belém

The 1.5°C Limit, Climate Diplomacy, and Prospects of Global Finance

In this article, **Dr Anil Pratap Singh** analyses the outcomes of COP30 in Belém, highlighting the sharp divide between ambition and delivery, particularly on climate finance and mitigation. He explains how disagreements over the New Collective Quantified Goal, adaptation finance, and the Mitigation Work Programme exposed deep North–South tensions. While COP30 advanced work on the Global Goal on Adaptation, just transition, and ocean-climate action, it failed to secure consensus on critical finance and fossil-fuel phase-out issues. The author concludes that a transformative, legally grounded climate-finance paradigm is urgently needed.

The 30th Conference of the Parties (COP30) to the United Nations Framework Convention on Climate Change (UNFCCC) was held from November 10 to 21, 2025, in Belém do Pará, Brazil, an Amazonian city selected to emphasize the profound interconnection between climate action and the preservation of natural ecosystems. Occurring ten years after the Paris Agreement, COP30 stood as a moment of 'truth' and 'implementation'. However, the final outcomes reveal gaps in ambition, especially regarding the essential elements of climate finance and mitigation. The Belém negotiations did not yield a proper consensus, but dissolved into the reluctant acceptance of a governing standstill. Significant shortcomings marked COP30's delivery of the required financial and structural mandates; the political will for aggressive mitigation remains paralyzed by the unresolved historical commitment of equity. Now, the COP31 is scheduled to be held in Türkiye (Turkey) in 2026.

In his welcome remarks, COP30 President, André Corrêa do Lago highlighted the central theme, stating that they had successfully introduced the Indigenous Brazilian word, 'mutirão' to global discourse. "It is through the mutirão itself that we will be able to implement the decisions of this COP and of the previous ones," he said.

Why the 'Mutirão' Spirit Challenged: The Battle over Climate Finance

Brazil's chief climate negotiator André Corrêa do Lago, sought to stimulate the spirit of international cooperation through the final package of decisions, aptly named the "global mutirão." Originating from the Indigenous Tupi-Guarani language, 'mutirão' signifies collective efforts towards a common community goal. This text was designed to synthesize complex and contentious issues, namely finance, trade, the imperative of limiting warming to 1.5°C and ensuring data transparency that challenged consensus throughout the two weeks of intense, and at times disruptive, deliberations. The magnitude of the adopted decisions, with over 150 pages of formal text across various subsidiary bodies, shows to the technical depth of the talks, even as the high-level political breakthroughs remained enormously opposed.

Despite this collaborative framing, the Summit featured deep divisions. The primary conflict at COP30 was climate finance, and the negotiations were marked by the procedural delay of politically sensitive issues into closed-door Presidency Consultations. This strategic trick, while avoiding the argumentative

agenda adoption deadlocks of previous years, merely relocated the conflicts, setting the stage for ministerial-level politics. Fundamentally, this process highlighted a governance crisis where implementation is conditional upon the prior satisfaction of means of implementation. But, the global south observed effectively exercised a veto on ambition until the core mandates of the Convention, i.e., finance and equity, were tangibly addressed.

The New Collective Quantified Goal and the Article 9.1 Arithmetic

The discussions surrounding the New Collective Quantified Goal (NCQG)—the new finance goal intended to succeed the largely unmet 100 billion annual target became a microcosm of the diplomatic mistrust along the North–South divide. This debate was less about the amount of money and more about the legal and historical responsibility for its provision. Developing country syndicates, i.e., G77, China, Like-Minded Developing Countries (LMDCs) including India, African Group were resolute in their demand for a specific, mandated work programme under Article 9.1 of the Paris Agreement. This proposed framework was intended to establish a clear legal obligation for developed countries to bear the primary burden of the new goal, thereby fastening the NCQG firmly within the CBDR-RC principle (Common but Differentiated Responsibilities and Respective Capabilities). The political demand centred on a new, verifiable target well exceeding the $100 billion floor, with the Brazilian Presidency itself proposing the ambition of a $1.3 trillion annual flow from a variety of public and private sources. This aspirational figure stresses the scale of financial mobilization deemed necessary by the host nation. The core of this demand was accountability and predictability, moving away from voluntary pledges towards enforceable commitments. On the other side, the developed country bloc, i.e., European Union (EU), Umbrella Group, Canada, Australia determinedly resisted any language that implied a legal obligation or new quantitative burden-sharing modalities.

The NCQG, intended as a guiding light of renewed financial commitment, remains politically contested at its very foundation, confirming that the post-Global Stocktake (GST) conversation has shifted from how to raise finance to who is legally obligated to provide it, and under what political conditions. Thus, the failure to conclude the NCQG framework represents the single greatest systemic failure of COP30.

The Imperative of Adaptation Finance

The urgency of adaptation, amplified by the increasing frequency and severity of global climate disasters, led to COP30 being intentionally designated as the 'COP of Adaptation.' However, the final decisions revealed a persistent imbalance: despite the thematic prioritization, the conference often favoured the development of technical frameworks over the provision of commensurate and adequate financial backing required for genuine global resilience. This outcome underscored a continued disconnect between the recognized need for adaptation and the political will to fund it. CEO and Chairperson of the Global Environment Facility (GEF) Carlos Manuel Rodríguez contended that countries are investing much more in climate-damaging activities than they are spending on preventing and adapting to climate change.

The Global Goal on Adaptation

The key focus centred on the Global Goal on Adaptation (GGA), an essential pillar of the Paris Agreement designed to enhance adaptive capacity, strengthen

resilience, and reduce vulnerability. Negotiators successfully agreed upon a reduced set of indicators to measure national progress under the GGA, being a technical achievement for the framework that provides the architecture for measurement. But, at COP30, there was political fight over measuring adaptation and weakening cooperation.

Political Fight over Measuring Adaptation: The political will to provide the requisite financial support for these indicators remained frankly inadequate. The primary technical and political stalemate centred on the indicators themselves. The African Group and other developing countries strongly opposed immediate adoption, arguing that the draft list contained "insensitive" indicators that attempted to track and measure domestic policies and budgetary allocations. Their opposition went beyond technical concerns; it was a fundamental defense of national policy space and a rejection of what they perceived as an attempt to shift the burden of accountability.

Trust Breaks Down: The African Group stated that the indicators tracked domestic policies and thus 'growing disunity' by shifting the burden of accountability from developed country finance provision to developing country domestic policy alignment. The GGA indicators, therefore, transformed from a neutral tool for tracking global progress into a symbol of perceived neocolonial financial surveillance.

The Financial Shortfall and the Five-Year Delay

Remarkably, the "global mutirão" decision includes a provision that 'calls on' developed nations to triple adaptation finance by 2035. This commitment fell significantly short of the pressing demands and expectations as voiced by the most vulnerable nations.

The Least Developed Countries (LDCs), Alliance of Small Island States (AOSIS), and the African Group had advocated for a more ambitious target: a tripling of adaptation finance, ideally to $120 billion by 2030. The final agreed date of 2035 represents a five-year delay, drawing substantial criticism from the Global South and highlighting the unwillingness of major economic blocs to countenance the immediate financial burden. Furthermore, the financial shortfall is a matter of intense urgency, rendering the adaptation goal largely aspirational without firm fiscal commitments. As per the UN Environment Programme (UNEP), developed nations provided only $26 billion in adaptation finance in 2023 which was a marginal decrease from the prior year, while the estimated annual adaptational finance need for developing nations is approximately $310 billion out to 2035. This gap, which the agreed-upon 2035 target fails to bridge immediately, places an unsustainable burden on developing countries that are disproportionately vulnerable to climate shocks. The reluctance of major economic blocs to features the LDCs' proposal which argued that such a target might prematurely renegotiate the NCQG that stresses the ongoing tension between developed and developing blocs regarding their respective financial responsibilities. Moreover, the Loss and Damage Fund saw positive, targeted technical work at COP30. The text for operationalizing the fund, including the deletion of limiting qualifiers on which developing countries could access it, was successfully cleaned up and forwarded to the Presidency. President of Brazil, Luiz Inácio Lula da Silva asserted that the $1.3 trillion needed to address the climate crisis is less than the over $2.7 trillion in annual military spending.

Mitigation, Trade, and the Fossil Fuel Stand-off

Mitigation negotiations were profoundly overshadowed by the political fallout of the GST. Belém was tasked

with integrating this outcome into the operational arm of the UNFCCC, yet the final decision texts revealed a critical gap in collective ambition. Countries arrived in Belém cognisant of reports that indicated, even with over 100 new Nationally Determined Contributions (NDCs) submitted, the world remains catastrophically off track, heading towards a warming scenario of 2.3°C to 2.5°C by 2100.

The discussions around the Mitigation Work Programme (MWP) were highly contentious during COP30. However, Brazil's President Luiz Inácio Lula da Silva had initially championed a vision for formal roadmaps to phase away from fossil fuels and reverse deforestation. However, the final "global mutirão" text evidently lacked any formal new roadmaps. This omission drew immediate and sustained condemnation from a coalition of 82 nations advocating for robust and specific pathways for a global energy transition. The MWP discussions revealed a fundamental cleavage regarding its scope and duration. Developed Parties advocated for incorporating the outcomes and key messages from the GST energy package, effectively seeking to embed language on a just and equitable transition away from fossil fuels, and a tripling of renewable energy capacity.

The resulting MWP decision text remained heavily bracketed, reflecting a failure to transition the high-level language of the GST from a conceptual agreement to a prescriptive mandate. The underlying structural condition remains that the Global North cannot impose new mitigation targets on the Global South until the foundational requirements of equity and finance are met. To address the immediate mitigation vacuum, the final text included the launch of the "Belém Mission" to increase collective actions to reduce emissions, serving as the politically acceptable compromise following the failure to mandate firm fossil fuel phase-out pathways. Jim Skea, Chair of the Intergovernmental Panel on Climate Change (IPCC), cautioned that implementation of all NDCs would still lead to 2.3–2.5°C warming by the end of the century.

Optimistic Decisions and Ocean Breakthroughs

Despite certain disappointments especially in resolving the finance and mitigation, the conference delivered productively on several key outcomes in social equity, adaptation support, and sectoral commitments as well as amplified strong wave of civil society engagements.
This year's Earth Summit was well marked by a resilient spirit of protest, from indigenous-led demonstrations inside the venue during the first week to thousands marching in the streets to make their voices heard. While the final agreement fell short of explicitly naming fossil fuels as the leading driver of climate change, the negotiations produced several key decisions, including:

- A promise to triple adaptation funding to protect communities against climate impacts.
- The launch of an agreement for a Just Transition Work Programme (JTWP) mechanism.
- Strengthened recognition of the rights of Indigenous people in the final texts.

Moreover, under ocean agenda and blue economy realm there witnessed significant upshots for the ocean. This year marks the launch of the Oceans Breakthroughs Dashboard, the first global tool for tracking ocean-climate action and outlining a pathway to cut up to 35 per cent of global emissions by 2030. The key milestones include:

- Brazil's commitment to sustainably manage all of its waters by 2030.
- The decision by 17 countries to join the Blue NDC Challenge and integrate ocean-based climate action into their national plans.
- Advances in supporting a regenerative blue economy and safeguarding key marine ecosystems.

Governance and Procedural Issues

Beyond the thematic issues, COP30 also emphasized UNFCCC governance in its process and transparency. A positive outcome was the agreement on a new global mechanism to support a 'just transition' worldwide, vital for ensuring the global shift to a low-carbon economy

is managed in a manner that creates decent work and leaves no community behind. The critical consensus that emerged was defensive: the JTWP must be non-sectoral and be contingent on developed countries achieving net-negative emissions to free up carbon budget space for developing nations.

Moreover, the negotiations on Article 6 mechanisms, i.e., the rules governing international carbon markets were hindered in highly technical but politically charged disputes. A key point of failure was the disposition of the remaining $26.8 million in the Clean Development Mechanism (CDM) Trust Fund. Furthermore, technical work on Article 6.2 and 6.4 struggled, and discussions were effectively halted on the final day, underscoring the political fragility of these market mechanisms. The rapid gavelling of key texts led to formal objections from countries such as Panama, supported by the EU and Colombia.

The Collapse of the "Mutirão" Strategy and the Prospects for Global Governance

The highly anticipated climax of the conference, the adoption of the "Global Mutirão decision" never materialized in the manner intended. The second week was characterized by intense, round-the-clock Ministerial consultations aimed at reconciling the bracketed texts handed up from the technical track.

The Brazilian Presidency's strategy of bundling all contentious issues like Finance, GGA, MWP, JTWP, NDCs, etc., into a single, high-level political package was designed to force trade-offs and political compromise. However, this strategy failed when the final draft of the 'Mutirão decision' contained an explicit reference to a fossil fuel exit roadmap. This inclusion triggered a significant counterattack from the LMDCs, the Arab Group, and the Russian Federation, who called for a 'reset' of the entire process. This move indicated that the political gap was too wide for a single document to bridge. The final daily reports showed delegates waiting for new guidance and the fate of the key issues left entirely unresolved as the formal closing approached. The collapse of the Mutirão strategy confirmed that the political will for a grand bargain on climate action is currently non-existent. Hence, the Belém Climate Change Conference of COP30 did not end with a decisive "Mutirão," but with an exhausted realization of a governance deadlock.

The New Climate Economy: A Call for Paradigm Shift

The post-COP30 reality necessitates a fundamental reassessment of the 'New Climate Economy' paradigm. This paradigm can no longer be based solely on voluntary private investment or market signals; it must be secured in the self-governing and legal obligations of developed nations. Further, the failure of the developed world to accept the Article 9.1 mandate confirms that the reliance on private capital to fill the NCQG gap is a political evasion of sovereign responsibility. The estimated annual needs of $310 billion for adaptation and $1.3 trillion for the total climate flows cannot be met without a massive addition of public, grant-based finance and a legally binding framework for MDB and private sector mobilization that does not impose new provisions on the Global South. And, the developed nations are expected to deliver a credible, quantified, and obligated finance package that addresses adaptation and avoids the coercive measures of unilateral trade policy.

The pathway to a climate-resilient future demands that the aspirational language of the *mutirão* be translated, without delay, into tangible action and trillion-dollar commitments. UNFCCC Executive Secretary Simon Stiell underscored that Parties need to move faster in strengthening resilience and reducing emissions to return to 1.5°C after any temporary overshoot and start moving towards the USD 1.3 trillion goal in mobilized climate finance.

UN Secretary-General António Guterres said that every fraction of a degree means more hunger, displacement, and loss, especially for those least responsible. He treated this as moral failure and deadly negligence. On final outcome he said 'I cannot pretend that COP30 has delivered everything that is needed. The gap between where we are and what science demands remains dangerously wide'. ■

Dr Anil Pratap Singh, General Secretary & Founder Director, Global Science Academy (GSA), Basti, Uttar Pradesh.

WORLD SUSTAINABLE DEVELOPMENT SUMMIT 2026

परिवर्तन I TRANSFORMATIONS: VISION, VOICES, AND VALUES FOR SUSTAINABLE DEVELOPMENT

February 25-27, 2026
Taj Palace, New Delhi, India

World Sustainable Development Summit: Towards the Silver Jubilee Edition

The World Sustainable Development Summit (WSDS) is the annual flagship multistakeholder convening organized by The Energy and Resources Institute (TERI). Instituted in 2001, the Summit's mission is making 'sustainable development' a globally shared goal. As the only independently convened international summit on sustainable development and the environment based in the Global South, WSDS strives to provide long-term solutions for the benefit of global communities by assembling world leaders on a single platform.

The 2026 edition of WSDS will mark the **Silver Jubilee** of the Summit. This 25th edition of the milestone event will be held from **25–27 February 2026** at the **Taj Palace, New Delhi**, under the umbrella theme: **परिवर्तन | Transformations : Vision, Voices, and Values for Sustainable Development**.

"WSDS has catalyzed partnerships and collective action to address one of the most urgent challenges of our times."

Shri Narendra Modi
Hon'ble Prime Minister of India
(Message for WSDS 2024)

Summit Series: 2001-2025

59	149	13	3730	2158	41889
Heads of State	Ministers	Nobel Laureates	Speakers	Business Leaders	Delegates

For Partnerships and information, please contact:
WSDS Secretariat
The Energy and Resources Institute (TERI)
Tel. +91 11 24682100 (Extn: 2424) I Email: **wsds@teri.res.in** I **http://wsds.teriin.org**

To Engage, Scan QR Code

#WSDS2026 I #ACT4EARTH I #WSDSSILVERJUBILEE

teriin

COP 30

Hits and Misses

In this article, **Arvind Kumar** analyses the outcomes of COP30, highlighting both progress and persistent gaps in global climate action. He notes advances such as updated NDCs, new adaptation indicators, increased finance targets, the Belém Action Mechanism for just transition, and the launch of the Tropical Forest Forever Facility. However, he stresses that climate finance remains fragmented, adaptation underfunded, and a global fossil fuel phase-out roadmap was not agreed upon. The author concludes that despite meaningful steps, COP30 falls short of what is needed to keep 1.5°C within reach.

With rising global temperatures and frequent extreme weather events, climate change remains a key challenge to address. Global greenhouse gas emissions are still increasing, while fast and deep emission reductions are needed to keep the goals of the Paris Agreement within reach. This is particularly true as the World Meteorological Organization (WMO 2025) found that 2024 was likely the first year on record that had a global mean temperature of more than 1.5 degrees Celsius (°C) above pre-industrial levels.

Against this backdrop, the 30th Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) took place in Belém, Brazil, from November 10–21, 2025. However, negotiations were extended by a day due to deep divisions among parties on critical issues like climate finance and the phasing out of fossil fuels. COP30, as it is called, was hosted in Belém, a city on the edge of the Amazon rainforest, a crucial regulator of climate and home to many Indigenous peoples who are hit hard by climate change and are part of the solution. COP30 was convened under the shadow of both urgency and deepening scepticism.

As highlighted by the UNFCCC, staying under 1.5°C demands a seismic change: emissions must plummet 43 per cent by 2030 and 60 per cent by 2035 from 2019

levels, and hit net-zero CO2 by 2050—an urgent race against a heating planet that tolerates no delay, compromise, or half-measures.

Nationally Determined Contributions (NDCs) 3.0

All signatory states were to submit their climate targets for 2035 this year for collective assessment. Global warming has already exceeded the 1.5°C threshold, leading to increasingly severe environmental and societal consequences. Developing countries are heavily impacted by these changes. Reducing emissions is therefore critical, not only for climate stability but also for economic security, equity, and community well-being. By the end of COP30, 119 countries representing 74 per cent of global emissions had submitted new national commitments in NDCs. These commitments still fall short of the emissions reductions required by 2035 to hold global temperature rise to 1.5°C. The sixteenth edition of the *Emissions Gap Report* finds that global warming projections over this century, based on full implementation of NDCs, are now 2.3–2.5°C, while those based on current policies are 2.8°C. Even with additional submissions expected from major economies, the efforts in this new round of NDCs will not be enough to keep global temperatures from rising more than 1.5°C above pre-industrial times, the threshold world governments set at a landmark 2015 climate agreement in Paris.

Agreement on Indicators for the Global Goal on Adaptation

Adaptation refers to actions that help reduce vulnerability to climate impacts, such as building sea walls to keep out rising tides, or early warning systems to reduce lives lost to cyclones. Adaptation has seen slow progress. A key task for negotiators was finalizing how the Paris

Agreement's Global Goal on Adaptation (GGA) will be put into action, including establishing indicators to track progress. The GGA seeks to increase countries' adaptive capacity, strengthen their resilience, and reduce their vulnerability to climate change through an adequate response to the damage that is already occurring.

COP30 finally agreed a set of 59 adaptation indicators for the GGA across seven sectors, such as water, agriculture and health, and the adaptation policy planning process, including on finance, capacity building and technology transfer. The list also takes into account cross-cutting considerations such as gender and human rights. These will help evaluate improvements in areas such as water security, food systems, infrastructure resilience, the reach of early warning systems and access to adaptation finance. These indicators will be used to measure needs and outcomes in climate adaptation and resilience, potentially facilitating investments in these areas. However, there has been some controversy about how indicators were finalized and modified from an initial list provided by experts. Crucially, some of the final indicators still need to be developed before they can be measured. Negotiations were difficult, and many governments stressed that the indicators will need further refinement, leaving significant work for coming COPs. Still, having a first version in place gives countries a common framework to assess whether adaptation efforts are on track.

Climate Finance

Financing adaptation is a biggest challenge. By 2035, developing countries will need somewhere between $310 billion and $365 billion per year for adaptation projects, according to estimates by the UN Environmental Programme. Climate finance is sound economics, not just charity. The free market simply does not deliver the goods at the scale required when returns are uncertain financially, though not socially. Studies show that every $1 invested in adaptation can generate more than $10 in long-term benefits. For developed countries, supporting adaptation and resilience abroad helps stabilize supply chains, reduce disaster risks, and prevent future crises that will spill over borders.

A new target to triple adaptation finance to $120 billion by 2035. This will be counted under an overarching $300 billion goal for climate finance by 2035. The latest target replaces a $40 billion target set four years ago at the COP26 summit in Glasgow in 2021. Nevertheless, the fact that climate negotiators came to agreement signals

intention to support climate adaptation investments over the next decade. Tools like green/blue bonds and debt-for-nature swaps are attempting to improve adaptation funding with financial engineering. But the lack of cash flow has been accentuated by recent cuts in aid budgets of the rich nations.

Climate finance is delivered through a fragmented architecture, spread across dozens of channels, including bilateral donor programmes, multilateral development banks (MDBs), and multilateral climate funds such as the Green Climate Fund (GCF). Each institution has its own rules, priorities, and procedures. For many countries, especially those with limited administrative capacity, this means accessing climate finance is slow, unpredictable, and burdensome.

Most climate finance continues to flow through traditional development finance institutions (DFIs) rather than through the mechanisms created under the UNFCCC. Thirty-nine per cent of the international climate finance to developing countries was delivered through multilateral DFIs, including multilateral development banks (MDBs) followed by cross border private finance accounting for 22 per cent; and around 18 per cent from bilateral DFIs. Only 1.5 per cent was channelled through multilateral climate funds and other specialized institutions created under the UNFCCC during 2018–2023. This distribution highlights a key challenge: most climate finance continues to flow through traditional DFIs rather than through the mechanisms created under the UNFCCC. Adaptation remains underfunded relative to mitigation, making up around 28 per cent of climate finance provided and mobilized by developed countries to developing countries in 2022, and only around 3.4 per cent of global climate finance in 2023 (UNCTAD). Loss and damage finance have faced even greater neglect. The creation of the Fund for Responding to Loss and Damage (FRLD) at COP27 and its operationalization at COP28 were important milestones, but commitments remain a fraction of estimated need at only $788.8 million and disbursement systems are still being established.

Mechanism to Guide "Just Transition"

One of the Summit's most consequential outcomes was the creation of a just transition mechanism in line with the Sustainable Development Goals (SDGs). Just transition refers to the idea that climate action should not leave anyone behind, particularly communities and workers whose livelihoods depend on fossil fuels or carbon-intensive sectors. It also means giving developing countries the support they need to grow their economies in cleaner, more resilient ways. The new Belém Action Mechanism (BAM) will serve as a platform to coordinate assistance, share best practices, mobilize resources and track progress. Its establishment means that fairness in the global shift towards sustainable economies is no longer only a political slogan but now has a formal

home within the UN climate system. Parties requested the 64th Sessions of the UNFCC Subsidiary Bodies, scheduled for June 2026, to recommend a draft decision in order to operationalize the mechanism at next year's COP31.

Launch of Tropical Forest Forever Facility

The Tropical Forest Forever Facility (TFFF) is an innovative international forest conservation initiative. It operates as an investment fund, not a donation mechanism. The TFFF will reward those who keep their forests standing and those who invest in the fund. A genuine win-win approach to tackling climate change, the TFFF has secured $6.7 billion in pledges from Brazil, Indonesia, France, Germany and Norway, against a target of $25 billion. Leading by example, Brazil has announced a $1 billion investment in the TFFF. The fund will invest its principal for profit, and use the returns to reward countries for protecting their forests.

Absence of Fossil Fuel Transition Roadmap

More than 80 countries sought a roadmap to wean the world of fossil fuels, but the initiative failed to make it into the final agreement after resistance from key parties, including major oil and gas producers and some emerging economies.

Instead, the main text agreed on the launch of a "global implementation accelerator", and the "Belém Mission to 1.5". This will essentially create a coalition of the willing — the roadmap will be voluntary and will sit outside of the COP process. These initiatives are aimed at "enabling ambition and implementation" of countries' climate plans and at keeping the 1.5°C temperature limit of the Paris Agreement in reach. This refers to the more ambitious goal of the Paris accord — to hold the global rise in temperature to below 2°C above pre-industrial levels, and preferably to 1.5°C.

Trade on the COP Agenda

For the first time, trade talks made it on to the official COP agenda — with the EU's Carbon Border Adjustment Mechanism (CBAM) attracting strong criticism from some of the EU's main trading partners. The final COP text "reaffirms that measures taken to combat climate change, including unilateral ones, should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade" and a new Integrated Forum on Climate Change and Trade (IFCCT) will be set up as a dialogue platform, which could be an opportunity to align CBAMs and coordinate the design of compliance carbon markets.

Conclusions

COP process is far from perfect, and achieving consensus amid competing interests is inherently a big challenge. Nevertheless, it serves as a platform for all nations irrespective of their income and development levels specifically those least developed countries that often contribute the least emissions but suffer the most from climate change.

Despite years of negotiations, pledges, and summits, greenhouse gas emissions have risen by a third since that first meeting; fossil fuel consumption continues to rise; and global temperatures are on track to breach 1.5°C thresholds scientists say will inflict irreversible damage to the planet. Global greenhouse gas emissions have increased by 34 per cent since 1995. While this is a slower rate than the 64 per cent rise in the three previous decades, it still represents a trajectory incompatible with climate stability, according to scientists.

COP30 made progress on climate finance, adaptation, just transition and forest protection. The deal finalized at the COP30 conference pledges more money to help countries adapt to climate change, but lacks explicit plans to transition away from the fossil fuels such as oil, coal and gas that heat the planet.

These achievements matter. But they still fall short of what science tells us is required. Previous COPs have been characterized by their focus on climate mitigation. In contrast, this year's COP has focused for the first time on climate adaptation and a "just transition". As the world looks to COP31, the task ahead is clear. Countries must turn their promises and pledges into achievements. The window for keeping 1.5 degrees within reach is rapidly closing, and the need for decisive action has never been more urgent. ■

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

The World's Climate Talks Shift from Goals to Action

At COP30

In this article, **Dr Shamim Haque Mondal** says that COP30 marked a shift from climate promises to the urgent need for implementation. He highlights that despite rising temperatures, worsening disasters, and repeated failures to meet the Paris Agreement's 1.5°C goal, global action remains slow and uneven. While COP30 brought hope through renewed commitments to renewable energy and climate justice, major gaps persist in climate finance, fossil-fuel phase-out, and technology transfer. The author stresses that without real cooperation and timely action, the world risks moving towards an increasingly uncertain and hazardous future.

Recently, the 30th Conference of the Parties (COP30) to the United Nations Framework Convention on Climate Change (UNFCCC) concluded in Belém on November 22. It was originally scheduled to end on November 21, but a major fire on the final day forced negotiations to be extended by an additional day. Representatives from 195 countries, including politicians, climate scientists, rights activists, journalists, and indigenous leaders, attended the Conference. As the world's leaders, scientists, environmental activists, and representatives of the affected people gathered under the forested sky of Belém, at every step of their presence, the weight of the crisis on the one hand and the desire for liberation on the other were flowing. This global climate justice conference is important not only for its location but also for its focus on the Paris Agreement's implementation, past failures, and future responsibility.

The fact that the world is getting hotter is no longer a theory but a stark reality. Scorching heatwaves, relentless floods, unusual droughts, rising sea levels and disappearing species—all signal that the pain of progress has crossed the limits of sustainability. What were once warnings for the distant future have now become part of our daily news. COP30 has placed this alarming reality before the world, pushing nations towards a renewed and more enlightened commitment.

The Conference focused on carbon mitigation, the renewable energy revolution, compensating affected countries, protecting natural ecosystems, conserving forest resources, and enhancing adaptation. But it is not just the list of agendas but also the deep concerns expressed by world leaders and scientists that make it clear to us that the time for words is running out. What is needed now is effective implementation, swift action, and genuine cooperation between states.

The Paris Conference (2015) promised that the Earth's average temperature would not rise by more than 1.5°C in the 21st century, or else disasters will happen. But the member states have not kept their promises. Environmental

scientists have warned about this many times, yet nothing has changed since affluent countries aren't working together well enough. Many people have termed COP30 the "COP of implementation" for this reason. The organization of labour became less strict as more obligations were made. Developed countries often didn't give the money they promised, were late with it all the time, or cut it short for their own profit. Countries that are most affected, have the lowest CO_2 emissions, and are suffering the most have continually gone back empty-handed to demand justice.

Three years ago, when Brazil assumed the role of host, people held high expectations for them. Brazil, the host country for this year's summit, has stressed that no new pledges should be made. At COP28, governments promised to stop using fossil fuels, but they haven't done so yet.

The most important aspect of this Conference is to acknowledge that failure. After two weeks of negotiations, the representatives failed to come up with an acceptable and workable solution. Although no practical programme and timeline has been set to gradually reduce the use of 'Just Transition' or fossil fuel or fossil-based energy, i.e., coal, natural gas, and mineral oil, to zero, it is hoped that the end of the fossil fuel era has come to the mainstream of the discussion this time.

Another big question raised at COP30 is how timely and transparently the developed world is delivering on its promised $100 billion annual climate finance. The reality is that complexities, conditions, and political dilemmas are still major impediments to the flow of this funding. A large portion of the fund consists of debt, which creates financial liabilities for newly affected countries. But is this a fair charge? Their crime is minimum; their punishment is maximum.

Some world leaders believe that we need new technology-based carbon removal methods to protect the environment of the future, while others say that technology alone will not provide a solution unless people's behaviour and economic system change. We should also prioritize natural solutions such as forest protection, river rejuvenation, and enhancing sea tolerance. At COP30, the Amazon is a symbol, not only because it is the world's largest carbon sink, but also because it reminds us that the balance of the planet is in the hands of nature, not human development.

However, there was a glimmer of hope. Several countries have pledged to limit global warming to 1.5°C. Many countries have also collectively announced plans to triple the production of renewable energy. Some countries have even published specific timelines to reduce fossil fuel dependency, which is undoubtedly progress compared to the past. In particular, Third World countries have stated that they are ready for a new energy transition; the policies adopted to promote renewable energy and clean energy in their economies are also in line with modern global changes. But this transformation is not possible alone—without technology transfer, low-interest financing, and international cooperation, developing countries will never have a fair energy revolution.

The question is, will these promises be fulfilled? Or will it be a dream written on paper?

A review of environmental conferences in the last few decades shows that no matter how stimulating the decisions are, the most significant challenge in the way of implementation is the entanglement of politics, economics, and interests. From COP15 to COP21 and later COP26 and COP28, the global consensus has never been fully implemented. Promises to hold the developed world accountable have been partially fulfilled, and promises to provide technological opportunities to the developing world have largely fallen short.

Another important discussion at COP30 was the financing framework available to affected countries. What is needed is not high-interest loans but grant-based assistance, because the suffering is not the responsibility of the affected countries. Although the 'Loss and Damage Fund' stands on this reality, the transparency of the amount, source, and distribution of the fund is still questionable. Small island states and coastal countries are particularly concerned because the fund is linked to their existence.

On the other hand, while optimism about renewable energy has increased, technology transfer and investment are still limited. Future energy designs are being developed with solar, wind, and green hydrogen at the forefront, but implementation of these designs for the developing world is possible only when there is a fair financial framework and appropriate support.

The world is now faced with two challenges: development and sustainability. People desire development, technological advancement, and comfort in their lives, yet they cannot sustain this development beyond the boundaries of nature. Today, the poorest people bear the responsibility for the damage that the developed world's consumption system has done to the environment. This disparity has been reflected in the fundamentals of COP30 in a new way.

Where Will the World Go Next?

Experts say that if the promises are implemented, the use of renewable energy will be revolutionary by 2030. Technology-based carbon removal, eco-friendly agriculture, circular economy, and pollution-free urbanization can show the world a new path. But if the promise gets stuck in the political gridlock, the world will go into an uncertain dark future, where today's disaster will be tomorrow's routine.

Environmentalists warn that if sea level rises continue at the current pace, many coastal cities in Asia will be submerged by 2050. Food security will be threatened, water scarcity will intensify, thousands of species of animals will be lost, and there will be a fundamental change in the pattern of human life. Climate change is no longer a distant disaster; it is the greatest existential threat to human civilization.

This is why the discussion of COP30 has placed a greater emphasis on fairness, also known as climate justice. To save the world, justice is needed first, while the country that is responsible must bear its responsibility as strongly as possible. The more affected countries there are, the more their rights must be ensured. Protecting the earth means protecting not only nature but also the existence of human civilization.

The declaration adopted on the last day of the conference—although not fully meeting expectations—gave new confidence to the world. 'Enhanced Ambition,' 'Fossil Phase-out Dialogue,' 'Global Renewable Mission,' and 'Loss and Damage Architecture'—all these new structures tell us that the world is at least starting to move in the right direction. The road is long and rocky, but the light of hope has not faded.

Right now, every decision, policy, and piece of technology must move from intention to action. Time is running out, but the window of opportunity is still open. COP30 has given us a moment to push that door wider. It is now up to us—individuals, governments, and the global community—to keep it open or risk losing our way in the darkness of uncertainty. ■

Dr Shamim Haque Mondal, Physics Division, State Forensic Science Laboratory, Kolkata, West Bengal, India.

Terra Youth

Joining Hands
for a Greener
Tomorrow

Future of EV Charging Infrastructure in India

Challenges and the Road Ahead

India's electric vehicle (EV) transition is gathering momentum, with charging infrastructure emerging as a cornerstone in the nation's clean mobility ambitions. Much like how 2G mobile networks rapidly expanded across the country, EV charging stations are expected to pan out across states in a similarly widespread network. However, this transformation will demand significant capital expenditure to establish a seamless, intelligent, and accessible charging backbone.

> "India's EV charging infrastructure is not just growing in numbers—it's evolving in intelligence and accessibility. With projects like NHEV, we're reimagining highways as future-ready, clean mobility corridors that power both vehicles and economic growth."
>
> — Abhijeet Sinha, Program Director, National Highway for EV (NHEV)

Current Landscape and Corridor-Level Progress

As of early 2025, India has crossed a major milestone with over 26,000 public charging stations installed across the country—reflecting a dramatic increase in coverage compared to previous years. This growth is attributed to sustained efforts by both government bodies and private players, who are jointly driving investments into EV-friendly infrastructure. Regional distribution patterns reveal that states such as Karnataka, Maharashtra, and Uttar Pradesh have emerged as front-runners, with Karnataka alone is accounting for nearly 5,765 charging points.

At the corridor level, the National Highway for EV (NHEV) initiative has made noteworthy strides by prototyping key pilot stretches. The Delhi–Agra, Delhi–Jaipur, and Chennai–Trichy e-highways, spanning over 830 km collectively, have been established with technical trials and are to be upgraded with high-speed charging facilities. These corridors also integrate renewable energy sources and are enabled with AI-powered load management systems, creating a blueprint for the future of long-range, green highway travel in India.

Policy Push and Financing Models

Policy momentum has been central to this progress. The Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) Phase II scheme has led to significant fund allocations for setting up nationwide charging infrastructure. Just government financing, however, won't suffice—a Public-Private Partnership (PPP) model is essential to scale deployment sustainably. The newly launched PM E-DRIVE scheme aims to install 72,000 chargers with a cost of INR 2000 crore between October 2024 and March 2026, accelerating deployment across states that have conducted pilots under NHEV.

States have also set their own aggressive targets. For instance, Delhi is aiming for 18,000 charging stations by 2025, with plans to establish a charger every three kilometres in high-density urban areas. This decentralized approach

underscores the broader ambition of mainstreaming EV access across all vehicle segments and geographies. NHEV is at the forefront of this shift, funding upcoming stations through its innovative AHEM model.

A pivotal financial innovation in this context has been the rollout of the Annuity Hybrid E-Mobility (AHEM) model under NHEV. AHEM is a Hybrid Annuity Model (HAM)-based financing structure that mitigates the capital expenditure crisis associated with setting up EV infrastructure. In this model, the private player is not burdened with 100 per cent upfront investment. Instead, a portion (typically 40%) is reimbursed during construction, and the remaining investment is recovered as fixed annuity payments over a pre-defined concession period. This structure converts unpredictable revenue streams into assured OPEX-based returns, reducing investor risk and enabling sustainable infrastructure development.

AHEM revolutionizes electric mobility adoption by mirroring the Government e-Marketplace (GeM) model for the transportation sector. Just as GeM transformed public procurement, AHEM eliminates large upfront capital requirements—creating unprecedented Ease of Doing Business for Charging Point Operators (CPOs), fleet owners, and startups. This innovative framework serves as a unified mobility marketplace, equally applicable to both EVs and charging infrastructure, while actively promoting domestic manufacturing and rapid deployment across India's EV ecosystem.

Challenges on the Path to Scale for CPOs and Fleet Operators

You require a lot of components for the successful operation of an NHEV 3G Energy Station—land, power, safety compliance, user footfall, and incentives. These logistics are critical bottlenecks that still hinder rapid scaling for many CPOs and fleet owners.

NHEV's 3rd Generation stations function more like co-working spaces for electric mobility. The only thing a participant needs to bring in is a charger and the supporting mobility ecosystem. With such modular setups piloted by NHEV and supported by startups, station rollout can be drastically accelerated even in challenging terrains or low-traffic areas.

The Road Ahead

Looking forward, NHEV plans to install approximately 1.32 million chargers by 2030, with 22 per cent of this capacity earmarked for highways. In its initial stages, NHEV successfully ran 500 km pilot and established 5,000 km Proof of Concepts (PoCs). The mission now is to scale this ecosystem to 20,000 km across the country in the coming years.

As part of the Viksit Bharat National Master Plan for Decarbonization of Surface Transport, all current 3G energy stations are to be upgraded to 5G energy super stations from 2040 to 2047, introducing faster charging, battery swapping, renewable energy integration, and AI-based station management and discarding the thermal grid.

The accelerated rollout of EV infrastructure is also expected to reduce India's logistics spent from the current 14 per cent of GDP to around 9 per cent. Efficient and greener last-mile and freight logistics powered by clean mobility will be instrumental in making Indian goods more globally competitive.

In addition, the PM GatiShakti National Master Plan (PMGS-NMP) plays a critical role in enabling multi-modal connectivity, ensuring that EV infrastructure is integrated seamlessly with road, rail, port, and air connectivity to facilitate better logistics efficiency and asset utilization.

> "Public-private partnerships will play a pivotal role in accelerating India's infrastructure growth, including the development of EV charging networks. Each infrastructure ministry will now create a dedicated project pipeline under the PPP mode to ensure timely and efficient execution."
>
> — Nirmala Sitharaman, Union Finance Minister, Budget 2025–26

India's pursuit of a sustainable transport future hinges on the robust deployment of EV charging infrastructure. While challenges remain in cost, regulation, and technology, the convergence of government initiatives, private sector dynamism, and financial innovation—especially through models like AHEM—is laying the foundation for a greener, more energy-resilient nation. As EV adoption accelerates, it is the strength and intelligence of this charging backbone that will determine the true scale of India's electric mobility revolution. ■

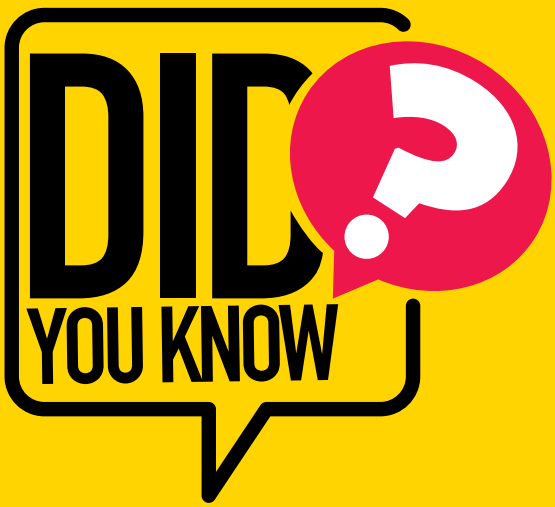
Article contributed by Mr Abhijeet Sinha, Project Director –NHEV.

Bizarre Facts

1. A snail can sleep for three years.
2. A crocodile cannot stick its tongue out.
3. It is physically impossible for pigs to look up into the sky.
4. Sloths can hold their breath longer than dolphins.
5. Trees can communicate through fungal networks.
6. Your stomach lining renews every 3–4 days.
7. Sharks existed before trees.
8. Ninety-five per cent of the universe is invisible. It is dark matter and dark energy.
9. Your body has enough iron to make a small nail.
10. Jellyfish survived all mass extinctions.

Did You Know?

- It is impossible to lick your elbow.
- People say "Bless you" when you sneeze because when you sneeze, your heart stops for a millisecond.
- "Rhythm" is the longest English word without a vowel.
- Limes sink but lemons float.
- 7,641 islands make up the Philippines.
- Africa is present in sections in all four hemispheres.
- The bumblebee bat is the world's tiniest mammal.
- Like fingerprints, everyone's tongue print is different.
- Wearing headphones for just an hour will increase the bacteria in your ear by 700 times.
- Crocodiles can go months without eating.



Source: Internet

IWMI Launches SoLAR Phase II

The Swiss Agency for Development and Cooperation (SDC) and the International Water Management Institute (IWMI), together with partners from India, Bangladesh, Kenya, Ethiopia, and global development organizations, convened more than 50 stakeholders on November 28, 2025 in New Delhi for the Inception Meeting of SoLAR Phase II (Solar Energy for Agricultural Resilience).

During Phase I in India, SoLAR generated strong evidence on the technical, social, and environmental performance of both grid-connected and off-grid solar irrigation pumps (SIPs). Studies under the Gujarat SKY scheme confirmed that grid-connected SIPs did not lead to increased groundwater extraction under the current incentive structure, while delivering significant climate benefits—offsetting nearly 12.3 tCO_2 per farmer per year, more than twice the reductions achieved by off-grid systems. More than 2,000 farmers were trained on technical and financial aspects of grid-connected SIPs, resulting in a 23 per cent increase in net energy evacuation and an additional INR 14,000 in income for SKY farmers.

In Madhya Pradesh, women-led solar service enterprises piloted with self-help groups improved irrigation access, crop productivity, and household incomes, demonstrating strong potential for gender-inclusive models. Off-grid SIP pilots showed clear livelihood benefits, including a shift to higher-value crops along with a substantial reduction in diesel use. Building on the success of SoLAR Phase I (2019–2024), the expanded Phase II will strengthen the enabling environment for the scaling of socially inclusive and climate-resilient solar energy for agriculture (SESA). The project will drive evidence-based policy design, innovative financing models, capacity strengthening, and the development of living labs to accelerate adoption of solar agricultural technologies.

The event brought together senior government representatives, development partners, financial institutions, private sector leaders, researchers, field practitioners, and farmers' organizations. The workshop also featured the launch of the SolaReady Dashboard, a knowledge and decision-support platform enabling governments and practitioners to plan and implement solar irrigation interventions more effectively. SolaReady is a spatial decision-support platform that maps the potential of solar irrigation to advance climate adaptation, mitigation, and groundwater sustainability goals.

The inception meeting marks the start of a multi-year effort to advance solar-powered agricultural resilience in India, Bangladesh, Kenya, and Ethiopia.

The International Water Management Institute (IWMI) is an international research-for-development organization that works with governments, civil society and the private sector to solve water problems in developing countries and scale up solutions. Through partnership, IWMI combines research on the sustainable use of water and land resources, knowledge services and products with capacity strengthening, dialogue and policy analysis to support implementation of water management solutions for agriculture, ecosystems, climate change and inclusive economic growth. Headquartered in Colombo, Sri Lanka, IWMI is a CGIAR Research Center with offices in 15 countries and a global network of scientists operating in more than 55 countries. ■

For more details, please contact: Tanmoy Bhaduri (Communications Specialist, IWMI), Email: t.bhaduri@cgiar.org

Winter Wonderland's Impact on the Planet

Artificial Ice Rinks and Their Environmental Cost

Artificial ice rinks, central to holiday festivities worldwide, carry a heavy environmental cost. Their construction and constant refrigeration consume massive electricity and often use hazardous chemicals such as ethylene glycol and high-impact refrigerant gases. Temporary seasonal rinks worsen energy use, while indoor facilities trap harmful emissions that affect skaters' health. Although some regions are adopting greener technologies and synthetic ice alternatives, much more progress is needed. This article by **Anaiya Giare** urges awareness and sustainable choices to ensure holiday joy doesn't come at the planet's expense.

As the holiday season approaches, cities across the world begin to shine with decorations, festive lights, traditional foods, warm beverages and a beloved ritual, ice rinks. These, set up across town squares, shopping malls, community centres and many other spots, are adored by children and adults alike. They draw thousands of visitors each year who seek the nostalgic charm of this activity. For most people, ice skating is synonymous to the holiday season, bringing together families, being an occasion to create everlasting memories and fill our social media with adorable pictures. However, behind the glittering ice lies a harsh truth. Recreating the perfect winter ambience in places where the snow never falls takes has an unimaginable environmental price.

For centuries, sports such as ice hockey, figure skating and speed skating could only be practised in outdoor settings, on naturally frozen lakes and ponds. The organization of such events was entirely dependent on the climate and limited to colder climates. Over time, these sports gained global popularity, and artificial rinks were the technological solution to a desire for indoor ice rinks. They allowed athletes to train year-round, enabling these winter traditions to flourish regardless of the climate and geographical location.

The creation and maintenance of these artificial ice rinks, however, are extremely consequential. Whether for seasonal pop-ups, or all-year permanent sports arenas, these ice rinks rely on large amounts of energy, hazardous chemicals and arduous engineering systems. Each glossy sheet of ice is supported with a thick, concrete slab that has embedded refrigeration pipes. These continuously circulate chilled liquids that ensure the water above remains a frozen solid surface by pulling the heat away from it. These refrigeration systems run continuously, day and night, regardless of if skaters are on it, to maintain the smooth ice. As a result of this tedious process, ice rinks are among the most energy intensive recreational facilities in the world.

This impact increases significantly during the festive season. For instance, temporary rinks appear in cities across the world each December, including London, New York, Dubai, and even Mumbai. These are operated for only a few weeks, yet the electricity used within

this short period is immense. A single medium-sized rink with an area of 3,900 m^2 can consume about 600,000 kWh of electricity per year. Larger facilities with heavy use can consume even 2,400 MWh per year for a single rink. The lower end of the range (about 600,000 kWh/year) can power 60 houses in the United States for an entire year. Furthermore, the increased consumption during the Christmas season can use 10s of thousands of kilowatt-hours in the short span of a few weeks.

To add to that, the chemicals involved such as ethylene glycol that are used as automotive antifreezes used to prevent the ice from melting also add a layer of concern. If water containing this ethylene glycol leaks from the rink, or is disposed incorrectly, it can contaminate water bodies and soil, which can poison animals and harm aquatic ecosystems. Even though saline solutions are safer alternatives, most ice rinks use chemical compounds since they are cheaper.

Indoor rinks, common in hotter regions or extreme climates, trap emissions from heating systems, equipment and resurfacing machines (used to smoothen the surface of the ice). These include nitrogen dioxide and carbon monoxide. This poses respiratory issues, headaches, dizziness and breathing difficulty for skaters, especially children. A study by the Environmental Defense Fund found that over 40 per cent of the world's ice rinks record nitrogen levels much higher than the safe recommended limit.

The carbon footprint of ice-related sports is also extremely high, caused by the use of refrigerant gases such as hydrofluorocarbons (HFCs), chlorofluorocarbons (CFCs), ammonia, and carbon dioxide. Even though policy mandates banning CFCs have come into place, many producers use leftover stocks of these CFCs, or HFCs, which are also greenhouse gases with risks much larger than carbon dioxide. Leaks from these refrigeration lines are extremely common in temporary seasonal rinks, since these are installed in a short span of time and release these gases into the atmosphere.

These "Winter Wonderlands" that most of us adore come at enormous environmental costs, ones that will take decades to repay. Nevertheless, awareness of these impacts has grown, and there are several organizations that attempt to implement sustainable alternatives. Since 2019, rinks across North America and Europe have adopted greener technologies, which have led to a 20 per cent reduction in emissions. This is far from the goal that should be achieved, but it is imperative we at least take small steps like these to get there.

One major solution is the shift to refrigerants like opteon, which offer efficient cooling technologies and far lower greenhouse emissions. Cities such as Vienna, Toronto and Copenhagen with strong Christmas market cultures have tried to adapt eco-friendly pop-up ice rinks made from synthetic ice panels that don't require refrigeration. Even though the skating experience is not the same as that with real ice, these are a compelling alternative that benefit the planet significantly.

Embracing the Christmas season, buying gifts for our loved ones, it is important we get one for the planet too, the gift of awareness. Ice rinks are a huge part of holiday atmosphere for people across the world, but it is important to recognize their environmental cost and make choices that advocate for greener alternatives and support sustainable practices. The joy of the holiday season should not be at the planet's expense. Innovation and awareness are imperative aspects that must be implemented to preserve the planet. ■

Anaiya Giare is a Grade 11 student at the Shri Ram School, Moulsari, Gurgaon. She has been a passionate environmental activist since she was in Grade 6.

Scientists Find Hidden Rainfall Pattern That Could Reshape Farming

A new study from the University of California San Diego identifies an unexpected influence on global crop stability: the original source of rainfall. Published in *Nature Sustainability,* the research follows atmospheric moisture back to the place where it first evaporated, whether from the ocean or from land surfaces such as soil, lakes and forests. Sunlight heats these surfaces, converting water to vapour that rises into the atmosphere and eventually returns as rain. Ocean-derived moisture can travel across continents within large weather systems including atmospheric rivers, monsoons, and tropical storms. Moisture that comes from land, often referred to as recycled rainfall, is created when water evaporates from nearby soils and vegetation, fuelling more localized storms. According to the study, the ratio of ocean to land moisture strongly shapes regional drought risk and agricultural productivity.

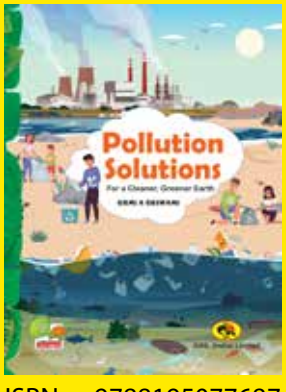
Source: https://www.sciencedaily.com/

Scientists Find Coastal Seas Acidifying Shockingly Fast

New research from the University of St. Andrews reports that some coastal regions are on track to become far more acidic than scientists once believed. As additional atmospheric CO2 enters the air, it dissolves into the ocean more quickly than anticipated, driving a rapid drop in pH that threatens coastal industries and livelihoods around the world. Because atmospheric CO2 and ocean pH (acidity) rise and fall together, any increase in CO2 above the ocean is soon reflected in the water below. This steady absorption of carbon makes seawater progressively more acidic over time. In a study published on November 13, 2025 in *Nature Communications,* the research team used the California Current as a case study.

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

To know more... Read



ISBN: 9788195077687

POLLUTION SOLUTIONS
FOR A CLEANER, GREENER EARTH

Urmi A Goswami

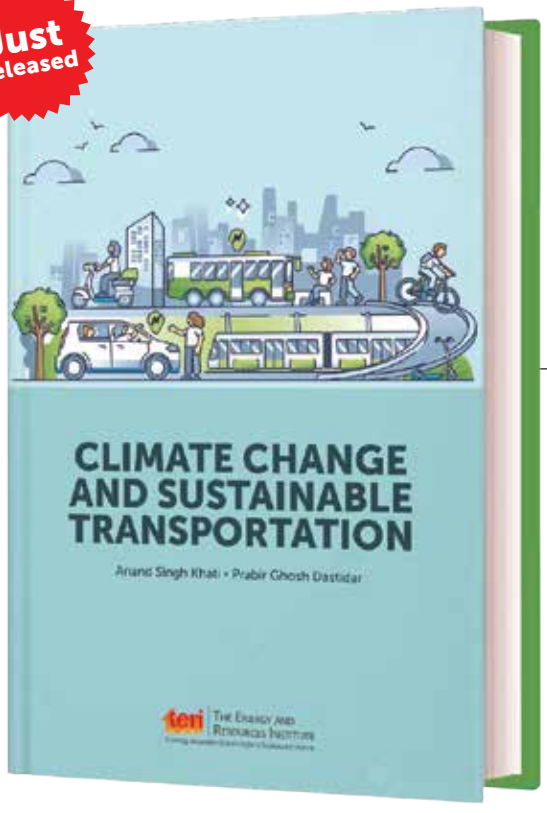
We are living in a fast changing world. Pollution of natural resources, such as air, water, and land is one of the biggest banes of our times. Under such precarious circumstances, it is needed that the young generation is not only made aware about the different kinds of pollution but also about the solutions. This is what this book *Pollution Solutions – For a Cleaner, Greener Earth* is all about.

Filled with eye-opening facts, informative illustrations, and multiple activities, this book is the perfect guide to help the young generation become environmental crusaders.

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

Discover the Impact of Climate Change on Sustainable Transport

Just Released



Major topics covered

- Broad overview of sustainable transport's relevance to the environment.
- Emphasis on integrating sustainability into policy and infrastructure development.
- Practical case studies from Delhi-NCR and across India.

ISBN: 9789386530110 • Price: ₹795.00

This book offers a comprehensive exploration of the climate system, the intricacies of climate change, and the vital role of transportation in this dynamic. Understand the origins of climate change and explore various migration options.

Key Features:

In-Depth Analysis: Chapters provide a broad overview of sustainable transport's significance in environmental and climate contexts.

Practical Insights: Case studies from Delhi-NCR and the wider Indian transport landscape enhance the text's relevance.

Target Audience: Valuable for researchers, policymakers, administrators, students, teachers, and the general public.

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).

First Photographic Record of Pallas's Cat Captured

During a Groundbreaking Survey in Arunachal Pradesh

A landmark wildlife survey conducted in Arunachal Pradesh has revealed a series of rare and significant discoveries, including the first-ever photographic evidence of the elusive Pallas's cat in the state. The survey also recorded the presence of five other wild cats—snow leopard, common leopard, clouded leopard, leopard cat, and marbled cat above 4200 metres, indicating the landscape's unique wild cat diversity.

WWF-India conducted the survey in 2024, with guidance from local communities and with support from the Forest Department, Government of Arunachal Pradesh, under its project 'Reviving Trans-Himalayan Rangelands – A Community-led Vision for People and Nature' that is funded by the UK Government through the Darwin Initiative. The WWF-India team was led by Rohan Pandit, Taku Sai, Nisam Luxom and Pemba Tsering Romo under the guidance of Rishi Kumar Sharma, Head for Science and Conservation, Himalayas Programme, WWF-India.

Between July and September 2024, WWF-India deployed 136 camera traps in 83 locations across 2,000 km^2 of rugged high-altitude rangelands in West Kameng and Tawang districts, making it one of the most extensive wildlife monitoring exercises. The survey involved meticulous planning and days of trekking through remote, high-altitude areas, where extreme weather, rugged and steep terrain, logistical hurdles and limited accessibility made the field work challenging. The camera traps were kept active for over eight months, often in extreme weather and remote, difficult-to-access terrain. The participation and partnership with local guides and community members enabled the team to overcome these challenges.

The survey documented the highest elevation records for several species – common leopard *(Panthera pardus)* at 4,600 metres above sea level (masl), the clouded leopard *(Neofelis nebulosa)* at 4,650 masl, marbled cat *(Pardofelis marmorata)* at 4,326 masl, Himalayan wood owl *(Strix nivicolum)* at 4,194 masl, and grey-headed flying squirrel *(Petaurista caniceps)* at 4,506 masl. The elevation records documented

for the common leopard, clouded leopard, marbled cat, Himalayan wood owl, and grey headed flying squirrel were the highest in India to date and may exceed previously known global elevation limits.

The record of Pallas's cat, while slightly lower than the absolute global maximum (~5,050 masl), remains highly significant. Globally listed as Least Concern on the IUCN Red List, this cold-adapted wild cat is one of the most elusive, rarely photographed and therefore remains one of the least studied feline species. Its documentation in Arunachal Pradesh significantly extends the known distribution of the species in the eastern Himalaya, adding to earlier confirmed records from Sikkim in India, Bhutan, and eastern Nepal.

In a rare behavioural observation, the camera traps documented a snow leopard and a common leopard scent-marking at the same location, offering fresh insight into how these big cats share fragile alpine habitats. Notably, the survey also captured images of the Brokpa herding community and their livestock, underscoring centuries-old pastoral traditions that have enabled coexistence between people and wildlife in these high-altitude rangelands.

Taku Sai, Senior Project Officer, WWF-India, said, "The findings of this survey are remarkable and the discovery of multiple wild cats at such extreme elevations opens exciting new opportunities for ecological research and conservation."

Dr Rishi Kumar Sharma, Head-Science and Conservation, Himalayas Programme, WWF-India said, "The discovery of Pallas's Cat in Arunachal Pradesh at nearly 5,000 metres is a powerful reminder of how little we still know about life in the high Himalayas. That a landscape can support snow leopards, clouded leopards, marbled cats, and now Pallas's cat alongside vibrant pastoral traditions speaks to its extraordinary richness and resilience. These findings highlight why community-led conservation, grounded in science and local knowledge, is indispensable for securing the future of our fragile rangelands."

Shri Ngilyang Tam, PCCF & CWLW (Wildlife and Biodiversity), Forest Department, Government of Arunachal Pradesh said, "The discovery of 'Pallas's cat in Arunachal Pradesh is a milestone for wildlife research in the eastern Himalayas. These findings reaffirm the state's importance as a global biodiversity hotspot and highlight the need for continued investment in scientific monitoring and conservation. The survey is a unique effort undertaken through collaboration between the Forest Department, WWF-India, and local communities. The active participation of herders and villagers demonstrates that conservation, traditional knowledge, and their livelihoods can go hand in hand in protecting our fragile mountain ecosystems."

This initiative builds on WWF-India's broader conservation efforts in the Western Arunachal Landscape, which include snow leopard and red panda conservation, protection of high-altitude wetlands, and the pioneering Community Conserved Area (CCA) model developed with Monpa communities since 2004. Together, these efforts showcase an integrated approach that safeguards fragile ecosystems while enhancing the resilience and livelihoods of local communities. ■

Source: https://www.wwfindia.org

Lepas anatifera

Microplastic Indicator

In this article, **Chaithanya M K** highlights that *Lepas anatifera* is a barnacle commonly known as the goose barnacle. It is a biomonitor species, and because it is cosmopolitan, it is found almost everywhere. When subjected to gastrointestinal (GIT) testing, the species has been found to contain microplastics, which in turn indicates rising pollution levels in ocean and sea waters. These goose barnacles attach to floating plastic debris in the sea, as well as to drifting wooden logs. When they wash ashore, they indicate the presence of microplastics, cotton, cellulose, and other pollutants. For this reason, they are also called "dirt barnacles," highlighting their unique ability to signal plastic and water contamination.

We humans have not only polluted the land with plastic but have also dumped enormous amounts of plastic and pesticides into the seas. Our growing greed has left almost no space untouched by waste. We often fail to understand the hardships animals face due to plastic pollution. Many turtles and aquatic species are dying because of microplastics. Plastic pollution threatens marine life through entanglement, ingestion, and chemical exposure, causing injury, starvation, and death. Microplastics disrupt the food chain and affect the health and reproduction of marine organisms. Therefore, we must act responsibly and allow other living creatures to thrive. Every nation must undertake microplastic assessments to reduce not only microplastics but all pollutants contaminating beaches, seas, and oceans.

Lepas anatifera is a barnacle commonly known as the goose barnacle. It belongs to the phylum Arthropoda and the family Lepadidae. It is a biomonitor species, and because it is cosmopolitan, it is found almost everywhere. When subjected to gastrointestinal (GIT) testing, the species has been found to contain microplastics, which in turn indicates rising pollution levels in ocean and sea waters. Barnacles are crustaceans that as adults are sessile, gregarious and attached to hard substrata or hard parts of other organisms. Stalked barnacles are often confused with molluscs because their body is completely enveloped in a carapace that looks like a sea-shell. Species of barnacles occur in all marine environments. *Lepas anatifera* has a cosmopolitan distribution and is found in tropical and subtropical seas worldwide. The first time that *Lepas anatifera* has been recorded as an epibiont of a crocodile. An epibiont (from the Ancient Greek meaning "living on top of") is an organism that lives on the surface

Lepas anatifera attached to cuttle fish bone

of another living organism, called the basibiont ("living underneath"), here crocodile is basibiont and *Lepas anatifera* is epibiont which is harmless to host.

Environmental Significance

We often hear about indicator species—such as those that signal pollution levels, pollution-free environments, or specific forest types. Here, we highlight a special species found on a few beaches around the world that indicates the presence of microplastic contamination. Barnacle crustaceans, due to their high tolerance to environmental stresses, are commonly used in marine pollution monitoring programmes in coastal areas. Over the past decade, plastic items of various morphologies (e.g., macro litter items, fragments, fibres, beads, etc.) and sizes—macro (>25 mm in the longest dimension), meso (25–5 mm), micro (5 mm–1 µm), and nano (<1 µm)—have emerged as pervasive pollutants of global concern due to their negative impacts on organisms, ecosystems, and human livelihoods. Rather, it is a biomonitor species. Because it is cosmopolitan, it is found almost everywhere. When subjected to gastrointestinal (GIT) testing, it has been found to contain microplastics. These goose barnacles attach to floating plastic debris in the sea, as well as to drifting wooden logs. When they wash ashore, they indicate the presence of microplastics, cotton, cellulose, and other pollutants. For this reason, they are also called "dirt barnacles," highlighting their unique ability to signal plastic and water contamination.

Lepas anatifera exhibits opportunistic feeding behaviour and commonly attaches to floating bodies. Its position near the water's surface makes it a suitable species for assessing the presence and distribution of microplastics and fibres in surrounding waters. By subjecting *Lepas anatifera* to GIT analysis, scientists have detected microplastics, cotton, and cellulose within the cut-open specimens. This ability to reveal the presence of microplastics and other pollutants in ocean waters has become increasingly important in today's context of rising marine pollution.

Lepas anatifera attached to cuttle fish bone

These barnacles are omnivorous, feeding opportunistically on neustonic zooplankton and other organisms found in the neuston. *Lepas anatifera* is also useful in forensic investigations involving water environments. In some cases, corpses and even the soles of shoes recovered from water have been found colonized by this barnacle species. Analysis of the barnacles growing on the body helped determine how long the corpse had been floating, thereby assisting in estimating the minimum time since death. ■

Chaithanya M K is currently pursuing BSc (Hons) degree in Forestry at Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Iruvakki, Shimoga. She has a strong interest in writing about nature, environmental issues, and reviewing research articles.

Digital Transformation in Agriculture

Opportunities and Challenges for Entrepreneurs

In this article, **Rajesh Aggarwal** highlights the tremendous promise that digital transformation holds for Indian agriculture. He explains how technologies such as precision farming, digital marketplaces, farm-management software, and blockchain are empowering farmers, improving productivity, and creating exciting opportunities for entrepreneurs. He emphasizes that agritech is placing farmers at the centre of the ecosystem while strengthening supply chains and boosting national growth. Though challenges like digital awareness and affordability remain, the author expresses strong optimism that innovation, collaboration, and farmer-centric solutions will drive a more sustainable, profitable, and modern agricultural future for India.

India, a global agricultural powerhouse, has long been dependent on its agrarian infrastructure, with a significant portion of its population relying on agriculture for their livelihoods. The agricultural sector, contributing over 20 per cent to India's income, remains a central pillar of the economy. As of now, the agricultural sector continues to make remarkable contributions to the Gross Domestic Product (GDP), and by 2030, it is projected to contribute around $600 billion to India's GDP.

Agriculture, often termed as the backbone of India's economy, is currently undergoing a substantial revolution fuelled by digital transformation. This metamorphosis, driven by the integration of technology into agricultural practices, has presented entrepreneurs with unprecedented opportunities to contribute to the sector's growth. Agtech, emerging as a catalyst, holds the promise of making Indian farmers more profitable while boosting the overall contribution of agriculture to the nation's economy. Traditionally, farmers were just one among many stakeholders in a market centred around *mandis*. However, the digital era, coupled with the evolution of numerous agritech solutions, has placed the farmer at the core of the entire ecosystem. The digitization of various aspects, including finance, inputs, and advisory services, is now directly targeting and benefiting the farmer.

Opportunities in the Digital Landscape

In the segment of digital opportunities, precision farming emerges as a transformative pathway. Armed with data analytics, sensors, and satellite imagery, entrepreneurs can empower farmers with real-time insights into crucial factors such as soil health, weather conditions, and crop performance. This wealth of information becomes a potent tool for farmers, enabling them to make informed decisions, optimize resource utilization, and ultimately enhance productivity.

E-marketplaces and supply chain management are undergoing a paradigm shift through digital platforms. Entrepreneurs can craft solutions connecting farmers directly to consumers, eliminating intermediaries

and streamlining the supply chain. These digital marketplaces not only ensure fair prices for farmers but also make quality produce more accessible to consumers.

The evolution of user-friendly farm management software is another noteworthy opportunity. Entrepreneurs can develop solutions aiding farmers in planning, monitoring, and analysing their agricultural activities. Covering a spectrum of tasks from crop rotation to pest management, these digital tools act as comprehensive guides for farmers seeking to optimize their operations.

Blockchain technology, known for transparency and traceability, finds its place in agriculture. Entrepreneurs can design blockchain solutions to trace the journey of agricultural products from farm to fork, assuring consumers of quality and authenticity, thereby cultivating trust in the supply chain.

The entrepreneurial landscape is ripe for startups addressing specific agricultural challenges. Water management, pest control, and sustainable farming practices are focal points for innovative solutions. Entrepreneurs can carve out niches, developing solutions that cater to the unique needs of Indian farmers and contribute to sustainable agricultural practices.

Challenges on the Horizon

However, amid these opportunities lie challenges. One primary challenge is the digital literacy of the farming community, especially in rural areas. Entrepreneurs must design user-friendly solutions and invest in training programmes to bridge this gap. In remote agricultural regions, inadequate infrastructure and inconsistent internet connectivity pose significant challenges. They must consider these limitations and design solutions that can function in low-connectivity environments.

Also, one would need to consider that all the agritech companies are working with a very niche segment of farmers till date and commercialization on a large scale where these technologies will be available at a cost within the reach of even small and marginal farmers. We need to wait and watch for the same as before this, it is really difficult to ascertain the real benefits of technology in agriculture. Although things are moving in the right direction and we all are very optimistic for the same.

The cost of implementing digital technologies can be a barrier, particularly for small-scale farmers. Entrepreneurs need to create scalable and affordable solutions to ensure widespread adoption across different economic strata within the farming community. Cybersecurity concerns also loom large, given the sensitive nature of agricultural data. Entrepreneurs must prioritize the development of secure platforms to safeguard farmers' information. As the regulatory landscape in agriculture evolves, entrepreneurs need to navigate and comply with existing regulations while advocating for policies that promote the seamless integration of digital technologies into the sector.

Digital transformation in agriculture presents a myriad of opportunities for entrepreneurs in India. By addressing the challenges head-on and developing innovative, farmer-centric solutions, entrepreneurs can contribute significantly to the modernization of Indian agriculture. ■

Mr Rajesh Aggarwal, Managing Director, Insecticides India Ltd.

Earthshot Prize Names State of Gujarat a Finalist

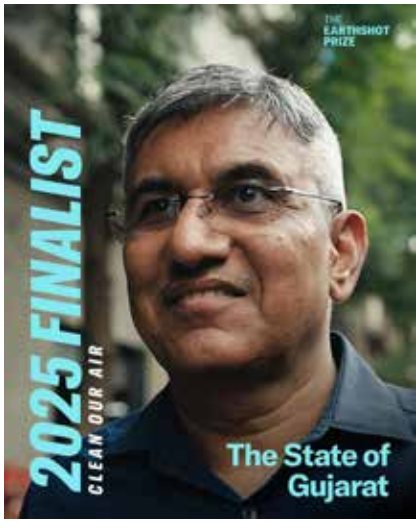
For Groundbreaking Work on Air Pollution

Researchers affiliated with the Emissions Market Accelerator helped the Indian state of Gujarat design and launch the world's first particulate pollution market. That project is now a finalist for the world's most prestigious and impactful environmental award, The Earthshot Prize.

The Earthshot Prize recognized the Emissions Market Accelerator (EMA)—a groundbreaking initiative that helps governments in the Global South design and implement market solutions to reduce pollution and foster economic growth—as the implementation partner of the Indian state of Gujarat, one of three Clean Our Air finalists for the 2025 award. EMA-affiliated researchers worked with the Gujarat Pollution Control Board to design and deploy the world's first cap-and-trade market for particulate pollution in the city of Surat. Through an experiment conducted by the researchers, the pilot market was found to have dramatically raised compliance with the law, sharply reduced particulate pollution, and increased industry profits. The Emissions Market Accelerator is a joint initiative of the Energy Policy Institute at the University of Chicago (EPIC) and Abdul Latif Jameel Poverty Action Lab (J-PAL).

"The Gujarat Emissions Trading Scheme is an excellent testament to how financial market-based approaches can address severe pollution challenges in rapidly developing economies around the world," says Jason Knauf LVO, Chief Executive of The Earthshot Prize.

Michael Greenstone, co-chair of the EMA and one of the researchers who led the Gujarat emissions market experiment, says, "We are beyond thrilled that the Earthshot Prize has recognized our partners in Gujarat and the Emissions Market Accelerator as a finalist for their prestigious award. For decades, emissions markets were seen as something that was almost exclusively a regulatory tool for the US, EU, and other rich countries. The Gujarat market serves as an important proof of concept that emissions markets can work beyond these regions. In fact, markets are uniquely well positioned to help countries where economic growth is an urgent priority and where much of the world's pollution and greenhouse gas burden exists today."



Forty-nine of the top 50 countries with the most polluted air are located

in the Global South. Further 82 per cent of CO2 emissions over the remainder of the century are projected to occur there. Yet, many of these countries haven't had the tools to address these environmental burdens without compromising economic growth. Some, including India, have relied on command-and-control style regulatory approaches that are costly and difficult to enforce. By contrast, emissions markets are a flexible, transparent approach that allow for stronger compliance and greater pollution reductions at lower cost.

Greenstone and his colleagues Rohini Pande and Nicholas Ryan from Yale University and Anant Sudarshan from the University of Warwick, in collaboration with EPIC and J-PAL, worked with the Gujarat Pollution Control Board to set up the pilot market as an experiment, so the results from facilities participating in the market could be compared to a control group of facilities following existing, conventional air pollution rules.

The researchers' study[1] was published in a leading economics journal and found:

- Firms in the market reduced pollution by 20–30 per cent more than those following the old rules.
- It cost industries in the market 11 per cent less to comply, and their profits increased.
- The market reduced non-compliance from about a third of all plants at any point in time to less than 1 per cent ever.

Of the results, Bala Srinivasan, co-chair of the EMA, says, "The market proved to be an important policy tool that is very much in line with the Government of India's efforts to pursue environmentally-friendly economic policies. Gujarat opened the door to an entirely new way of approaching environmental and economic policies in emerging economies. With the Emissions Market Accelerator, we're scaling up their trailblazing efforts."

Following the success of the Surat market, the Gujarat government launched a second market in the city of Ahmedabad. Today, 20 million people are breathing cleaner air in Gujarat due to these markets. The EMA team is also working with the Gujarat government to establish a sulphur dioxide trading market and a wastewater pollution market.

"Becoming an Earthshot Prize Finalist is a proud milestone for the

1 Details available at https://epic.uchicago.edu/working-papers/can-pollution-markets-work-in-developing-countries-experimental-evidence-from-india/

Gujarat Pollution Control Board and the Emissions Market Accelerator," says Shri Devang M Thaker, Member Secretary of the Gujarat Pollution Control Board. "It is an international recognition of a solution born in Gujarat that has the potential to transform how the world addresses industrial pollution. For us, this moment validates over a decade of commitment to building a regulatory system that is both innovative and practical—one that protects public health while enabling industries to thrive. The international platform provided by The Earthshot Prize will help us show that emissions trading can deliver cleaner air without hindering growth, so other emerging economies worldwide can follow India's lead."

Building on Gujarat's momentum, the EMA team is now supporting a sulphur dioxide market in Maharashtra and is beginning to design a market in Rajasthan. Discussions are also underway to expand to several other Indian states, as well as internationally. "Gujarat's leadership in testing and scaling emissions markets shows how governments in emerging economies can drive large-scale solutions that benefit people, the economy, and the planet," says 2019 Nobel Prize in Economic Sciences winner Esther Duflo, the Abdul Latif Jameel Professor of Poverty Alleviation and Development Economics at MIT and co-founder and director of J-PAL. "J-PAL is proud to have worked alongside the Gujarat government and EPIC for more than a decade to pilot, evaluate, and scale this innovative approach and now through the Emissions Market Accelerator expand it further across India and other countries."

The Earthshot Prize was launched by HRH Prince William in 2020 to identify, celebrate and back solutions to repair the planet. This year's cohorts were selected from nearly 2,500 nominees submitted by the Prize's network of 575 nominators from 72 countries. The 15 Finalists were chosen based on assessments done by The Earthshot Prize's selection partners and Expert Advisory Panel, a global group of more than 100 subject-matter experts with deep backgrounds in conservation, science, technology, business, finance, academia, and policy. The five winners of this year's Prize will be selected by Prince William and fellow members of the prestigious Earthshot Prize Council, a diverse group of individuals dedicated to protecting the climate and our natural environment. ■

Source: www.emissionsmarkets.org

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

Indian International Conference on Air Quality Management 2025
December 15–19, 2025
New Delhi, India
https://10times.com/

International Conference on Recycling and Waste Management (ICRWM-2025)
December 21, 2025
Aurangabad, India
https://allconferencealert.net/

International Conference on Thermoelectric Materials for Clean Energy Transition (ICTMCET-2026)
January 4, 2026
New Delhi, India
https://allconferencealert.net/

International Conference on Freshwater Ecosystems, Wetland Conservation and Biodiversity (ICFEWCB-2026)
January 10, 2026
New Delhi, India
https://allconferencealert.net/

World Sustainable Development Summit 2026
February 25–27, 2026
New Delhi, India
https://wsds.teriin.org/2026

TerraGreen

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

December 2025

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

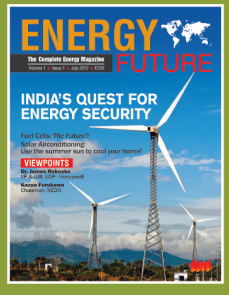
ENERGY FUTURE

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