

TerraGreen

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VOLUME 17 | Issue 3-4 | June-July 2024

Heatwaves in India

A Growing Public Health Crisis

20 Years ANNIVERSARY

SPECIAL HIGHLIGHTS

Awasthis Engineers Environmental Harmony
Clear Air Turbulence and Jet Streams

TERRA YOUTH

Trees Matter

IN CONVERSATION

Dr Anil Pratap Singh,
Founder Director & General Secretary
of the Global Science Academy (GSA)





TERI Information Digest on Energy and Environment*

TIDEE aims to keep policy-makers, scientists, and technologists abreast of the latest developments in the fields of 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.

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Editor: Dr. P K Bhattacharya, TERI, New Delhi

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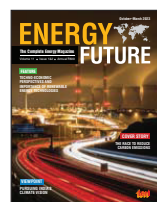
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TerraGreen is India's most respected monthly magazine dedicated to informing and enlightening its readers on issues of environment, energy, and sustainable development. Launched in 2004, TerraGreen has made an indelible impression on the minds of readers, 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.

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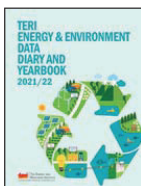
Energy Future

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

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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 x 280mm • ₹1995/\$129 (Online only)

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EDITORIAL



“Heatwaves endanger India’s food security with implications on our economic stability, potentially affecting the public healthcare services.”

India being a tropical country is accustomed to hot summers, but summer this year has proven to be the hottest ever on record with the world’s average temperature reaching 1.64 Celsius above pre-industrial levels. In India, temperatures have reached alarming levels, consistently over 45°C, with Mungeshpur in the national capital of Delhi recording 52.3 degrees Celsius—the highest temperature ever recorded in the country. These extreme heat events pose a significant threat to public health with wide-ranging impacts.

This month, our cover story on heatwaves in India reveals that the public health implications of heatwaves extend far beyond immediate risks such as heatstroke and dehydration. Heatwaves exacerbate chronic conditions, increase hospital admissions, and strain the already overburdened healthcare system. Heatwaves also endanger India’s food security with implications on our economic stability, potentially affecting the public healthcare services. Heat exhaustion decreases productivity, proving detrimental to the country’s economy. Additionally, intense and untimely onset of summers damages crops and affects cropping cycles, leading to food shortages and higher prices for essential commodities such as cereals and pulses. Not all are equally equipped to deal with such acute and unforeseen crises, and the effects of such intense heatwaves are disproportionately borne by the urban poor, outdoor workers, and marginalized communities. People living in inadequate housing without air conditioning are more vulnerable to heat-related illnesses. Outdoor workers, including farmers, construction labourers, and street vendors, endure prolonged exposure to extreme heat, heightening their risk of heat stress and dehydration. Cities face an added challenge during heatwaves due to the Urban Heat Island (UHI) effect. Studies across several Indian cities such as Delhi, Mumbai, Kolkata, Surat, Nagpur, Lucknow, and Guwahati illustrate the deleterious impacts of urban areas becoming heat islands. Concrete and asphalt surfaces absorb and retain heat, causing cities to experience higher temperatures compared to rural areas. This not only raises the risk of heat-related illnesses but also strains infrastructure and energy resources, especially with increased demand for air conditioning.

Recognizing the seriousness of the issue, several Indian states and cities have developed Heat Action Plans (HAPs). These plans are comprehensive frameworks aimed at reducing the health impacts of heatwaves by enabling authorities to prepare for, respond to, and adapt to the increasing frequency and intensity of heatwaves. The HAPs prescribe coordinated efforts among government agencies, public health officials, and local communities to implement specific actions. The fight against heatwaves cannot be the government’s burden alone. It requires a concerted effort from all sectors of society. Communities must adopt and promote sustainable practices, such as rainwater harvesting and tree planting. Private enterprises can contribute by creating and managing more green spaces, promoting green buildings and providing heat-resilient cooling spaces for their workers, and supporting community cooling initiatives.

I am confident that the articles in this edition of *TerraGreen* will resonate strongly with our readers. Your insightful suggestions have greatly improved the publication, and I eagerly encourage you to continue sharing your valuable ideas and feedback.

A handwritten signature in black ink that reads "Vibha Dhawan".

Vibha Dhawan
Director-General, TERI



I liked reading the cover story of the May 2024 issue of *TerraGreen*. I agree with the author that Indian industry can benefit significantly from collaboration with the Nordic countries, which are known for their advanced water technologies and sustainable practices. This collaboration can take the form of technology transfers, joint ventures, and R&D projects. For example, Nordic innovations in water purification, wastewater management and efficient water use could be adapted to the specific needs of various sectors in India, including agriculture, manufacturing, and urban development. By utilizing the expertise and cutting-edge technologies from the Nordic region, Indian industries can improve their water management systems, reduce pollution, and increase resource efficiency.

Keval Krishna Arora
Lucknow, Uttar Pradesh

I liked reading Special Report published in the May 2024 issue of *TerraGreen*. The carbon market in India is an emerging and rapidly evolving sector aimed at addressing climate change by regulating greenhouse gas (GHG) emissions. As a developing country, India faces the dual challenge of pursuing economic growth while reducing its carbon footprint. The carbon market operates through mechanisms like the Clean Development Mechanism (CDM) and the newly introduced Indian carbon trading scheme. The CDM allows Indian companies to earn carbon credits by implementing projects that reduce emissions, which can then be sold to developed countries. Recently, India has been developing its own carbon trading market under the Paris Agreement framework, focusing on creating a robust domestic carbon credit system. This market encourages industries to adopt greener technologies and practices by putting a price on carbon emissions, thus incentivizing reductions. The carbon market in India holds significant potential for both environmental sustainability and economic development, offering opportunities for businesses to innovate and align with global climate goals.

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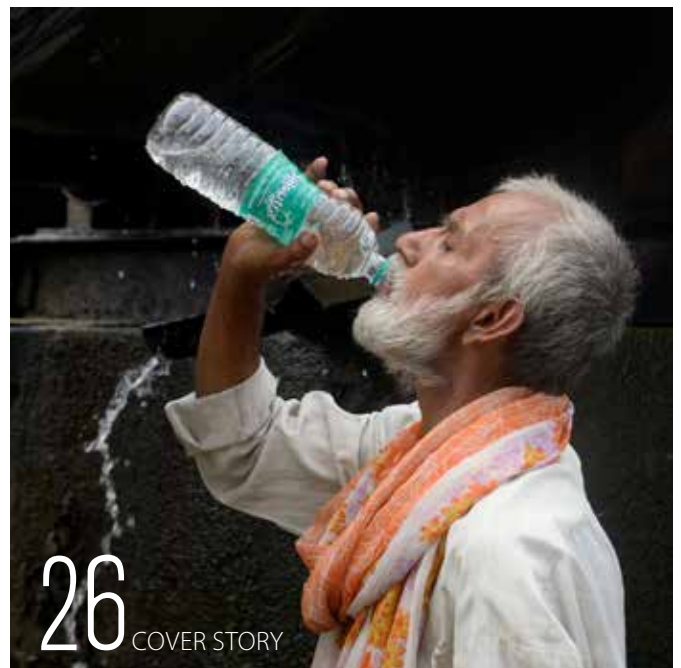
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COVER STORY





To Curb Air Pollution in Winter, Govt. Starts Preparations Early

The Delhi Government has launched an early initiative to address the anticipated rise in air pollution during the winter season. Environment Minister Shri Gopal Rai announced the commencement of preparations following a high-level meeting with key officials from the Environment Department, Delhi Pollution Control Committee (DPCC), and Development Department. Emphasizing the importance of proactive measures, Rai said, "This year, the main objective of our government will be to control pollution through public participation." He added that a 'Save Environment' round table conference will be organized on August 21 at the Delhi Secretariat, where environmental experts will come together to draft a comprehensive 'Winter Action Plan'. "The plan will be prepared based on the opinions and suggestions of experts," Rai added.

Source: <https://www.tribuneindia.com/>

International Tiger Day: Big Cat Mortality Drops 29 Per Cent So Far in 2024

In a positive turn for wildlife conservation, the number of tiger deaths in India has significantly decreased, with 81 reported fatalities from January 1 to July 29, 2024, compared to 114 during the same period last year. This represents a 29 per cent decline in tiger deaths, according to the National Tiger Conservation Authority's (NTCA's) mortality data. Additionally, the mortality rate among tiger cubs has also seen a reduction, with 8 cub deaths reported this year, down from 13 in 2023. The year 2023 was the worst for the tiger population, recording the highest number of mortalities in a decade with 178 tigers dying.

Source: <https://www.business-standard.com/>



Gaur Deaths Rise as Railway Tracks Get Busy in North Karnataka

At least 21 Indian gaur have been killed in the past three years in train accidents on the Hosapete-Vasco Da Gama and Khanapur-Miraj routes, with doubling of tracks and speeding by loco pilots being cited as two major reasons for the deaths. Thirteen of these deaths were reported between January and July this year, making it clear that there is a problem on hand. Activists worry that completion of the doubling could imperil the Indian gaur, a scheduled-I/ vulnerable species protected under the Wildlife Protection Act of 1972, and other wildlife. Between 2014 and 2021, the 85-km railway route that snakes through the thick forests of Alnavar (Dharwad), Londa & Khanapur (Belagavi) and Tinaighat & Castle Rock (Uttara Kannada) saw 60 wild animal deaths.

Source: <https://www.deccanherald.com/>



Visakhapatnam to Lose 5 Per Cent of Its Coastal Area by 2040

A recent study conducted by the Centre for Study of Science, Technology and Policy (CSTEP) revealed that about 1 to 5 per cent of Visakhapatnam could be submerged by 2040 due to rising sea levels. As per this study, around 6.96–7.43 sq. km of sand dunes along the coast will be lost due to the erosion caused by the advance of the sea. Sea level has been rising steadily between 1992 and 2021, gaining 2.38 cm in 20 years at a rate of 0.181 cm year, according to historical statistics. The main cause of sea level rise is the melting of ice caps due to global warming. The second reason is that the hills on the coast of Visakha have penetrated the sea but the natural movement of sand is being obstructed by Yarada Hill.

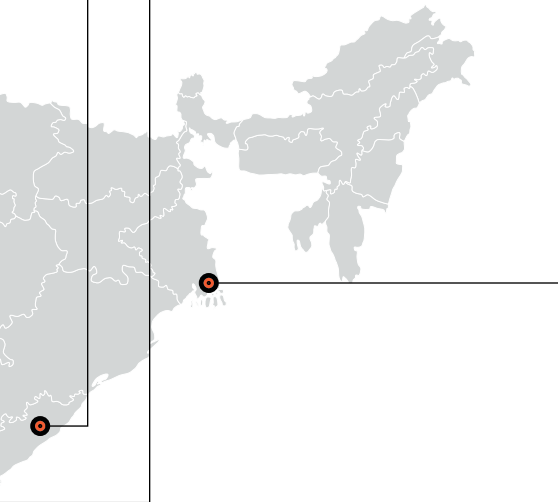
Source: <https://www.etvbharat.com/>



Maharashtra Leads in Electric Buses in India

Maharashtra has the most electric buses, with Delhi coming a close second in data released by the Ministry of Road Transport and Highways. Maharashtra had 2,111 electric buses and Delhi has 2,011 as of July 19 this year. The data includes buses, omni buses, and 'educational institution buses'. Karnataka tops the list for hybrid buses with 84, along with 1,195 electric buses. Gujarat has 895 electric buses. The data was gathered from the Vahan 4 database, which includes all states and union territories except Lakshadweep and Telangana, and presented in the Lok Sabha as a written reply.

Source: <https://www.livemint.com/>



Microplastic in Digha and Puri Seawater at Alarming Levels

A recent study—funded by the Centre's Science & Engineering Research Board—has found alarming levels of microplastics in the coastal waters and sediments of Digha and Puri, two of eastern India's most popular beach destinations. It highlights serious concerns about the impact of microplastics on marine life and the health of millions of visitors. Researchers found an average of 5.3 microplastic items per litre of water on the Digha beach and 6.4 microplastic items per litre on the Puri beach. The sediments revealed even more troubling data, with Digha recording 173.4 items per kg and Puri reaching 190.4 items per kg. These numbers suggest that plastic pollution is a growing crisis in these coastal regions, potentially affecting the future of these tourist spots.

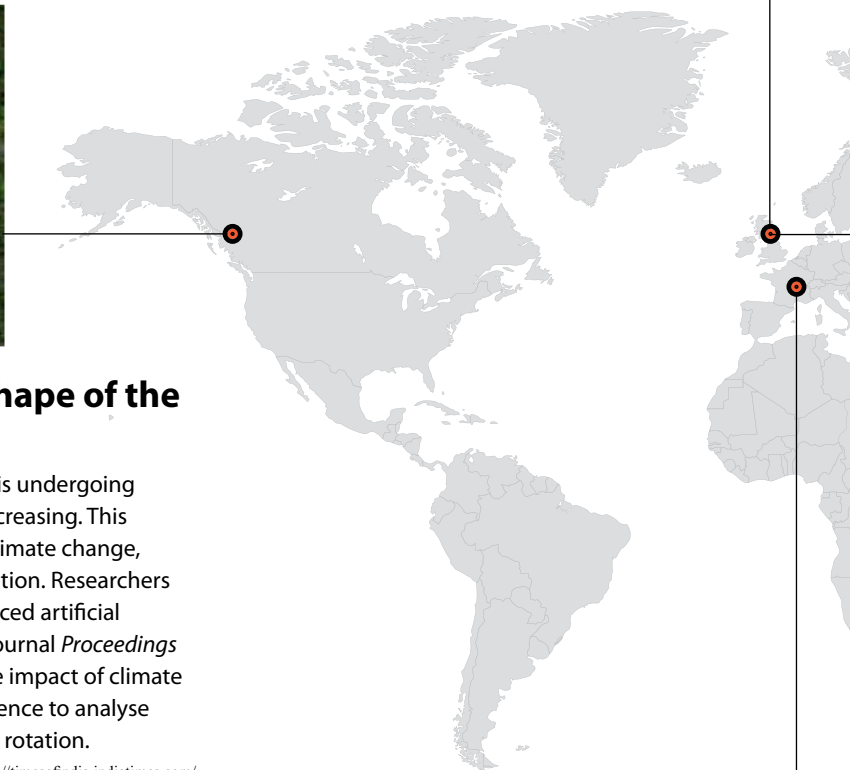
Source: <https://timesofindia.indiatimes.com/>



Garden Planted to Cope with Weather Extremes

A Mediterranean-inspired garden has been planted at a North Yorkshire stately home to suit the changing climate, the National Trust said. The garden at Beningbrough Hall, near York, opened recently and featured more than 4,000 herbaceous perennials, grasses, trees and shrubs from across the globe. Designer Andy Sturgeon said climate change had meant landscapers needed to start “changing the way we garden” to cope with warmer summers, prolonged dry periods and drought. The garden also included a stormwater tank to reduce the impact of flash flooding, with the stored rainfall used for watering.

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



Climate Change is Impacting the Shape of the Earth and its Timings

Recent scientific studies have revealed that Earth’s shape is undergoing subtle changes, and the length of our days is gradually increasing. This phenomenon is primarily attributed to human-induced climate change, which is causing significant alterations in the planet’s rotation. Researchers have been closely monitoring these changes using advanced artificial technologies. A study published on July 15, 2024, in the journal *Proceedings of the National Academy of Sciences (PNAS)* highlighted the impact of climate change on Earth’s spin. The study utilized artificial intelligence to analyse real-world data and predict future changes in the planet’s rotation.

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

Climate Change Threatens Sports

Climate change is already impacting all aspects of human life and nature, including sports and the performance of athletes. Driven by human-caused climate change and the natural El Niño weather event, 2023 was the hottest year on record, which could be surpassed in 2024. The last few months have broken all records. For example, June 2024 was the hottest June since records began. Europe, in particular, has experienced more heatwaves than other regions, and the 2024 Olympics are taking place in Paris. This record global warming has contributed to many other extreme weather events across the globe, such as heat waves, wildfires, prolonged droughts, and flooding. There are concerns about the potential impact of any heat wave during the Olympics. Studies show that any outdoor sports activity during heat stress events can be detrimental to the human body.

Source: <https://www.deccanherald.com/>





Azerbaijan Launches Climate Fund

Azerbaijan, host of the UN COP29 climate summit, announced recently that it will launch a new climate fund that will aim to mobilize \$1 billion to support developing countries' new national climate targets. The climate summit host hopes the new fund, which will be housed in the capital city of Baku and overseen by a multi-national board of shareholders, will be capitalized with contributions from 10 fossil-fuel producing countries as well as oil and gas companies. Azerbaijan had initially sought a levy on fossil-fuel production to raise funds for tackling climate change, but changed course after facing resistance from some countries.

Source: <https://www.deccanherald.com>



Beach Cages to Help Protect Threatened Birds

Bird cages are being placed along beaches to help protect a threatened bird. The Royal Society for the Protection of Birds (RSPB) and Natural England are working together to install the cages along the coast in Cumbria to protect ringed plovers. The birds are red listed, meaning they have special protection, and the project was set up in response to the growing number of "failed nests," the RSPB said. RSPB conservationist Steph Leow said only five out of 30 breeding pairs of ringed plover on a three-mile stretch of coast had managed to hatch chicks, and only two had got chicks to a fledgling stage.

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

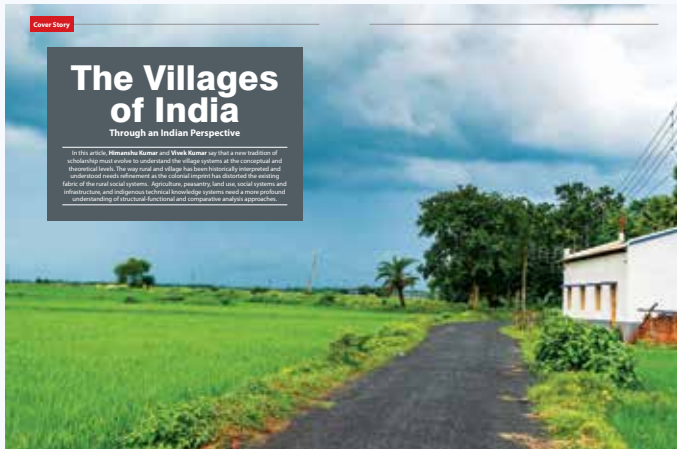
Blue-Green Algae Could Pose Serious 'Health Risks'

Blue-green algal blooms in Lough Neagh could have a profound ecological impact and present potentially significant environmental and public health risks, researchers at Queen's University Belfast (QUB) have found. Their work has confirmed the lough's hypertrophic status—the worst category of waterway nutrient pollution. More than 80 per cent of the bacterial DNA tested from algal mats belonged to potentially hazardous microbes, including *E.coli*, *Salmonella* and 11 others that can cause human illness. The scientists tested samples from mats of algae at Toome Lock, Rea's Wood, Antrim Boathouse and Ram's Island in the East of the Lough in 2023. They found the samples to be "dominated" by bacteria associated with wildfowl or livestock faeces or human-effluent wastewater treatment.

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



2023-24 Reminiscing the Year Past



Cover Story

The Villages of India

Through an Indian Perspective

In this article, **Himanshu Kumar** and **Wahid Kumar** say that a rich tradition of knowledge must thrive to understand the village systems at the ecological and theoretical levels. The way rural and village has been historically misrepresented and undervalued needs reformation as the colonial impact has distorted the existing fabric of the rural social systems. Agriculture, peasantry, land use, social systems and infrastructure, and indigenous technical knowledge systems need a more profound understanding of structural-functional and comparative analysis approach.



Cover Story

Brahmapuram Landfill Fire

Points towards the Need for Decentralized Waste Management

In this article, **Sharda Balakrishnan** highlights that a series of fires have been breaking the year after year at the Brahmapuram landfill in Kerala. It is not just a local issue. This year, the massive uncontrolled fire breakout urged the Kochi Corporation to take immediate steps to resolve this issue as it impacts the health of people, and the environment. Brahmapuram is the only landfill that is a bone of contention in Kerala where solid waste management, collection is decentralized and systematic. Plans are underway to solve this crisis that the Kochi Corporation is facing after the Brahmapuram incident.



Cover Story

Educating about Environment is of Dual Concern

Sustenance and Sustainability

In this article, **Dr. Unwin K. Kabbani** says that acquiring green skills has become an essential requirement of our time as green skills pave the way for job opportunities that contribute to the preservation of ecosystems and biodiversity. Change of quality education and training opportunities for young people is a pre-requisite for enhanced employability under the sector of green skills. Institution design activities and projects to meet the rising expectations of the young minds, to be able to match requirements of green jobs to be created in future, a timely investment in Education for Sustainable Development (ESD) is therefore highly recommended.



Cover Story

Drinking Water Security in Gujarat

The Current Scenario

Water security entails guaranteeing access to safe drinking water, efficiently managing water resources, and mitigating the threat of water-borne diseases. In this article, **Anshu Bhattacharya** presents a situational analysis of drinking water security in Gujarat, highlighting the government's initiatives to ensure access to safe drinking water in the State. Additionally, the author delves into the groundwater quality monitoring plan in Gujarat, emphasizing the idea that by purifying water today, we can ensure cleaner drinking water for the future.



Cover Story

Sand Alert

Dredging Endangers Sand and Aquatic Life

Sand is vital for a country like India due to its wide-ranging uses in construction and consumer needs. In this insightful article, **Dr. Indrani Samalsharma** highlights that dredging is the process of removing sand, silt, and other sediments from the bottom of water bodies to improve navigation. Dredging is limited only for various purposes such as flood, navigation and maintaining waterways. In the coastal regions of India and Asia, however, sand dredging could do more harm than good if not adequately planned. With great awareness of the importance of sand and the drastic effects of dredging is the first step to saving sand. Over the last decade, the Government of India has passed several regulations to curb sand mining, which could serve as a starting point.



Cover Story

Seeds of Contamination

Microplastics in Agroecosystems Impacting Soil and Human Health

Microplastic pollution in terrestrial environments poses a significant threat to ecosystems and human health. These tiny plastic particles can be found in agricultural soils, sediments, and even in the air. Once in the soil, microplastics can disrupt soil structure, affecting water retention and nutrient cycling, thus impacting the growth and health of plants. There are concerns about the potential transfer of microplastics to crops consumed by humans, raising questions about their impact on human health. **Anshu Bhattacharya** delves into the microplastic pollution in agricultural settings, exploring the pathways of contamination and the potential for microplastic transfer to crops. This article offers insights into the persistence and toxicity of microplastics in the terrestrial environment.

20th Anniversary Issue

Cover Story

Towards a Circular Plastics Economy

India's Actions to #BeatPlasticPollution

World Environment Day 2022 serves as an important reminder that the actions we take to mitigate plastic pollution have a significant impact. This year, there were over 100 events globally, these efforts and justify nomination to a circular economy. **Asmita Roy-Basu** and **Geeta K Bhatnagar** speak at the World Environment Day 2022 occasion on "Solutions to plastic pollution under the campaign #BeatPlasticPollution". It is crucial to understand that each one of us has multiple roles to play to address this global crisis.

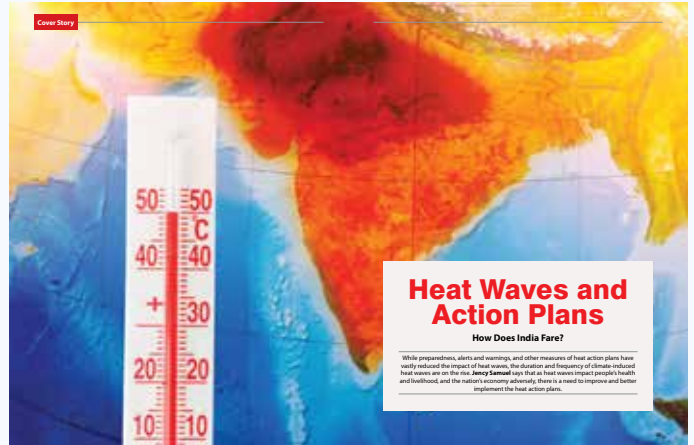


Cover Story

Heat Waves and Action Plans

How Does India Fare?

While preparations, alerts and warnings, and other measures of heat action plans have nearly reduced the impact of heat waves, the duration and frequency of climate-induced heat waves are on the rise. **Jeremy Samuel** says that as heat waves impact people's health and livelihoods, and the nation's economy adversely, there is a need to improve and better implement the heat action plans.



Cover Story

People, Profits, and Planet

Joint Responsibility for Working towards Sustainable Development

This summer highlights the need to focus on inclusive economic growth that benefits all stakeholders. In today's rapidly evolving world, the demands of governments, people, and all stakeholders on business are changing – innovation and agility are more important than ever. A cultural identity and ambition to create long-term value is needed to simplify complex issues and use technology and innovation to gain actionable insights, streamline complex challenges, or leverage business models based on cross-sectoral financing – what's the key? As crucial business need to be evaluated their investment portfolios, procurement strategies and supply chains. However, companies cannot do this alone. Government policies a crucial role to play.



Cover Story

COP28

Drove Momentum towards a Sustainable Future

The UN Climate Change Conference, also known as COP28, recently concluded in Dubai, UAE. COP28 made significant progress on various issues, including the operationalization of the Loss and Damage Fund established at COP27. It also concluded the inaugural Global Stocktake, and laid the groundwork for a final and decisive outcome through a groundbreaking decision. In this article, **Dr Anil Pragas Singh** sheds light on the deliberations that transpired at COP28, emphasizing India's pivotal role in the conference.



Cover Story

Bengaluru Left High and Dry

Water Crisis Hits the Ershihale Garden City

Bengaluru is currently facing an acute water crisis, exacerbating the city's long-standing struggle with water scarcity. Rapid urbanization, coupled with inefficient water management practices and erratic rainfall patterns, have pushed the city to the brink. Residents are grappling with dwindling water reserves, relying heavily on tankers for their daily needs. The crisis has prompted city leaders to take urgent action, with reports advocating for sustainable solutions such as rainwater harvesting and wastewater recycling. In this article, **Indumathi Simambhar** discusses the water crisis situation in the city along with some immediate and long-term steps to control the situation.

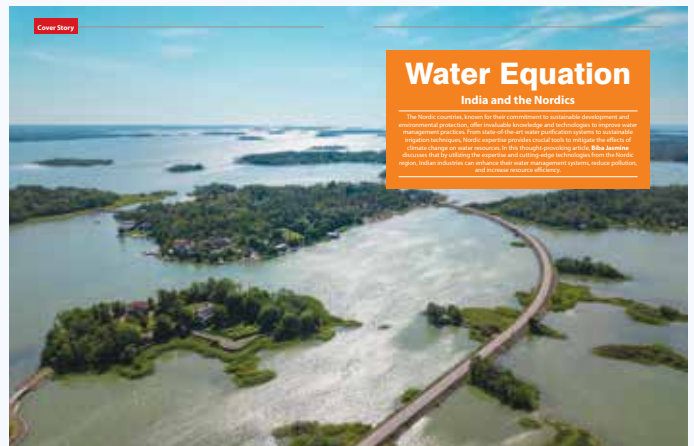


Cover Story

Water Equation

India and the Nordics

The Nordic countries, known for their commitment to sustainable development and environmental protection, offer valuable knowledge and technologies to improve water management practices. From state-of-the-art water purification systems to sustainable irrigation techniques, Nordic expertise provides crucial tools to mitigate the effects of climate change on water resources. In this thought-provoking article, **Rishi Jain** discusses the role of utilizing the expertise and cutting-edge technologies from the Nordic region. Indian innovative law enhances their water management systems, reduces pollution, and boosts resource efficiency.



TERI Celebrates 50 Years

of Environmental Excellence and Innovation

The Energy and Resources Institute (TERI) celebrated its 50th anniversary on June 18, 2024, with a grand event. The celebration highlighted TERI's five decades of groundbreaking work in sustainable development, environmental research, and resource management, marking a significant milestone and paving the way for growth for the next 50 years.

The Energy and Resources Institute (TERI) celebrated the momentous occasion of its 50th anniversary on June 18, 2024 with a grand celebration. The day-long event highlighted TERI's five decades of pioneering work in sustainable development, environmental research, and resource management, marking a significant milestone and setting the stage for growth for the next 50 years.

The day began with the inauguration of the exhibition by Mr R Mukundan, Managing Director & CEO of Tata Chemicals and Governing Council Member of TERI. Congratulating TERI, Mr Mukundan said, "TERI provides an important platform for the Indian companies as the Indian economy is moving towards being the third largest economy in the world. TERI's role—in building the sustainable development

discourse for the entire globe by enabling India to move in that direction—is going to be immensely important not just for India but for the entire world. TERI will play a pivotal role in this journey and we should work to enable TERI to gain more power and momentum in this direction."

Mr Nitin Desai, Chairman, TERI, set the tone for the day with his welcome address with the walk down the memory lane, talking on how TERI was



Shri Suresh Prabhu, Former Union Cabinet Minister and Chancellor of Rishihood University lighting the lamp on the occasion with Mr Nitin Desai, Chairman, TERI, Ms Leena Nandan, Secretary, Ministry of Environment, Forest and Climate Change (MoEFCC), and Dr Vibha Dhawan, Director General, TERI.



Cultural performance during the event



on the world map, Mr Sinha said, "It is a special occasion for an institute or individual as it shows longevity, sustainability, state power, and an inherent strength and vitality that one needs to have so as to sustain for so many years. TERI's role in the context of the current world, as an organization of this stature, should focus on climate change, energy transition, carbon markets, artificial intelligence with respect to energy transition and energy mapping of what is happening on ground," he further added.



The rest of the day featured a series of programme presentations covering a wide range of topics crucial to sustainable development. These presentations underscored TERI's multidisciplinary approach and its commitment to addressing various facets of sustainability. Welcoming attendees for the evening session, themed 'TERI's 50 Years: Gratitude & Growth' Mr Nitin Desai, Chairman, TERI, emphasized the importance of collaborative efforts in achieving sustainable development and urged the youngsters to be more forthcoming towards addressing the issue of climate change.



conceptualized. Dr Vibha Dhawan, Director General, TERI, delivered the opening address, which was followed by an inspiring keynote speech from Mr Sumant Sinha, Chairman and CEO of ReNew. Speaking on TERI's remarkable contribution towards putting India

Dr Vibha Dhawan expressed her views that TERI as an organization has been ahead of the curve. She shared the recommendations on the various topics which have been made to the newly formed government. Further, she underscored the commendable work being done in the area of carbon credits. "Punjab Forest Department, with support from TERI and VNV Advisory had developed Carbon Finance Project for the agroforestry plantations in Punjab.

The revenue of approximately INR 44 crore from the sale of carbon credits will be distributed to the registered farmers," she added.

Ms Leena Nandan, Secretary, Ministry of Environment, Forest and Climate Change (MoEFCC), delivered a special address, recognizing TERI's contributions to environmental conservation. "TERI had started when no one was thinking about environment and sustainability. It had clear understanding of the path it had to traverse, aligning itself with the country's development goals." "Building on the strength of innovation of the country is important. TERI must set itself up to take on the start-up and innovation space," she further added.

Shri Suresh Prabhu, Former Union Cabinet Minister and Chancellor of Rishihood University, delivered the ceremonial address, highlighting TERI's role in shaping India's environmental landscape. "TERI has shown a way to implement ideas on the ground. TERI is the flag bearer of India and does us proud," he added on the commendable work done by TERI in the past 50 years.

The event also featured the launch of the book 'Creating Impacts, Transforming Lives: Success Stories from TERI' commemorating TERI's milestones and contributions. Reflecting on TERI's journey and future aspirations, Dr Ajay Mathur, Director General of the International Solar Alliance (ISA), emphasized that TERI as an organization has always been conscious to undertake work that will have an impact. "TERI can provide a climate ready solution, which is the need of the hour," he added. He was joined virtually by Dr Saroj Pachauri, and Dr Shailesh Nayak in commemorating TERI's contributions and milestones.

The evening concluded with reflections by Governing Council members and partners, followed by a cultural performance and a networking dinner. Dr Dipankar Saharia, Senior Director, TERI, extended a vote of thanks expressing gratitude to all attendees and contributors to TERI's journey. ■

Revolutionizing Horticulture

Solar-based Cooling Solution for Small Farmers in Karnataka, India

The Energy and Resources Institute (TERI) has taken up an initiative to introduce solar-based cooling solution to help farmers to preserve their produce more effectively. By harnessing renewable energy, this project aims to provide a sustainable, reliable, and cost-effective cooling solution that will enhance the income and livelihoods of small farmers in Karnataka. TERI with the financial support of EKOenergy (a non-profit organization located in Finland), in cooperation with the Department of Horticulture, Government of Karnataka, and Sadaliamma Horticulture Farmers Producer Company, Sadali village, Sidlaghatta (T), Chikkaballapura (D), Karnataka, implemented the project “Solar-based cooling solution for horticulture produce to improve the income of small and marginal farmers in Karnataka state, India.”

Keep reading to know more...

Agriculture forms the backbone of India's economy, supporting nearly 60 per cent of the population. In Karnataka, 64.6 per cent of the state's geographical area, amounting to around 123,100 square kilometres, is under cultivation. Among the state's farmers, 6.981 million small and marginal farmers are engaged in growing horticultural crops. These farmers are

vital to the state's agriculture, producing a variety of highly perishable fruits, vegetables, and flowers that need proper storage to maintain their freshness and market value. However, they consistently face challenges due to inadequate storage facilities and an unreliable power supply, leading to significant post-harvest losses ranging from 4.58 per cent to 15.88 per cent. Traditional preservation

methods are often inefficient, resulting in substantial wastage and negatively impacting farmers' income and livelihoods.

In response to these challenges, The Energy and Resources Institute (TERI) has taken up an initiative to introduce solar-based cooling solution to help farmers to preserve their produce more effectively. By harnessing renewable energy, this project aims to provide a sustainable, reliable, and cost-effective cooling solution that will enhance the income and livelihoods of small farmers in Karnataka.

Small and marginal farmers in Karnataka face substantial post-harvest losses due to inadequate storage facilities and an unreliable power grid. Horticultural produce, being highly perishable, requires immediate and efficient cooling to extend its shelf life. Traditional preservation methods are often inefficient, leading to significant wastage. This issue not only affects farmers' incomes but also contributes to



food wastage. It is estimated that 25–30 per cent of post-harvest losses are due to inadequate cold storage, required transport, poor handling, insufficient processing, and other value addition facilities. Thus, there is a crucial need for a reliable, sustainable, and affordable cooling solution to address this pressing issue.

To tackle this challenge, TERI with the financial support of EKOenergy (a non-profit organization located in Finland), in cooperation with the Department of Horticulture, Government of Karnataka, and Sadalamma Horticulture Farmers Producer Company, Sadali village, Sidlaghatta (T), Chikkaballapura (D), Karnataka, implemented the project “Solar-based cooling solution for horticulture produce to improve the income of small and marginal farmers in Karnataka state, India.” This is an innovative initiative to introduce solar-powered cold room for storing horticulture produce in Sadalamma FPO, Sadali village, Sidlaghatta Taluka, Chikkaballapura District, Karnataka. This cold room utilizes solar energy to provide a sustainable and cost-effective solution for preserving perishable goods. By leveraging solar power, farmers can access reliable cold storage facilities, even in remote areas with unreliable power supply. Presently, conventional cold storage charges a rent of INR 2/ kg/5 days on an average to store 1 kg of perishable goods, whereas FPO charges INR 1/kg/5 days for storing in solar cold room this will save more than 50 per cent cooling cost compared to conventional cooling thereby reducing nearly 5–10 per cent of food wastage.

The project involves several key components:

- **Installation of Solar-Powered Cold Rooms:** Presently installed 5 MT (metric tonne) capacity cold room in the site. These cold rooms powered with 5 kW off-grid solar PV systems harness the sun’s energy to power refrigeration unit. This set-up ensures



a consistent and eco-friendly energy supply, reducing dependency on the erratic power grid and minimizing operational costs.

- **Operation and Maintenance:** The solar-based cold storage facility is operated by a 7-member team called the EKOenergy Solar-based Cold Room Committee (EKOSCC), under the leadership of the Farmer Producer Organisation (FPO). This committee is responsible for the day-to-day operation, maintenance, and administration of the cold storage facility. Additionally, the local community, particularly farmers, will be actively involved in the project to ensure its long-term sustainability.
- **Working of the Equipment:** The solar-based cold storage operates using a 5 kWp solar PV system that charges during the daytime and keeps the cold room cool 24 hours a day without the need for any battery, diesel, or conventional energy backup. This unique thermal energy-based

technology optimizes compressor usage and provides up to 30 hours of battery-less backup with minimal maintenance requirements.

- **Training Programmes for Farmers and Entrepreneurs:** Comprehensive training programmes are conducted to educate farmers on the operation and maintenance of the solar-powered cold rooms. This training empowers farmers with the necessary skills to manage the technology effectively and maximize its benefits. The entrepreneurs were trained on operation and maintenance of the solar-powered cold room, explained technicalities of the system, business techniques, financial loans available from banks, connected to the technology suppliers and FPOs in Karnataka.
- **Development of Processing, Packaging, and Marketing Techniques:** To enhance the value of their produce, farmers are trained in processing and packaging techniques



that maintain the quality of the produce during transportation and storage. Additionally, marketing strategies are developed to help farmers for better access to markets and fetch higher prices for their crops.

- **Stakeholder Workshop:** To share the learnings of the project, a district-level workshop was held on June 14, 2024 in Chikkaballapura, where TERI team shared its experiences and learnings with the government, non-governmental organizations, private entrepreneurs and technical education institutions, anticipating that this pilot implementation will be replicated successfully. This workshop has also created a platform for the convergence of ideas and pooling of experiences from academicians, researchers, practitioners, and manufacturers. More than 100 people have attended the workshop.

The community-supported and community-driven initiative of implementing a solar-based cold storage facility, led by the Farmer Producer Organisation (FPO), has the potential to significantly enhance the entrepreneurial capabilities of FPOs. By actively involving local stakeholders, particularly farmers, in the operation and maintenance of the

cold storage facility, FPOs can develop valuable skills and expertise in managing renewable energy technologies and post-harvest infrastructure.

Furthermore, by fostering a sense of ownership and responsibility among FPO members through their involvement in the project, the initiative can create a sustainable model for future community-driven initiatives. This approach not only benefits the local community by improving livelihoods and reducing post-harvest losses but also sets a precedent for collaborative and inclusive development efforts in other regions.

Impact of the Solar-Based Cooling Solutions

The implementation of solar-powered cold room has shown several significant benefits to the horticulture farmers:

- **Reduction in Post-Harvest Losses:** With access to reliable cooling facilities, farmers can significantly reduce post-harvest losses. The extended shelf life of horticultural produce allows farmers to sell their goods for an extended period, avoiding the pressure to sell immediately at lower prices. Farmers can store produces from 4 days to

12 months depending on produce's physical condition.

- **Improved Income and Livelihoods:** By reducing spoilage and maintaining the quality of their produce, farmers can achieve better market prices. This increases their income, enhances their livelihoods, and provides them with





financial stability to invest in better farming practices and technologies.

- **Promotion of Sustainable Horticulture:** The use of solar energy for powering cold rooms promotes sustainable horticulture practices. This initiative reduces the carbon footprint associated with conventional refrigeration methods, contributing to environmental sustainability.
- **Enhanced Food Security:** By minimizing food wastage, the project contributes to improved food security in the region. The ability to store and preserve horticultural produce effectively ensures a more stable supply of fresh produce for local communities.
- **Economic Empowerment:** The project empowers farmers by providing them with the tools and knowledge to manage their produce efficiently. This empowerment leads to increased economic participation and growth at the grassroots level.
- **Demonstrated Project contributes to Sustainable Development Goals (SDGs):** Implementing food waste reduction systems directly addresses Sustainable Development Goal (SDG) 12: Responsible Consumption and Production. These systems also indirectly support SDG 2: Zero Hunger by improving food security. Furthermore, by relying on renewable

energy, these systems contribute to SDG 7: Affordable and Clean Energy.

- **Storage:** FPO currently stored 10 MT of material (cucumber, tomato, and flowers) in the solar cold storage and earned about INR 10,000. Every farmer has stored materials up to 5 days.

Future Prospects and Expansion Plans

The success of the pilot project has set the stage for broader implementation across Karnataka and potentially other states in India. Key expansion strategies include:

- **Scaling Up Installations:** Plans are underway to increase the number of solar-powered cold rooms across various districts in Karnataka. This expansion aims to reach more small and marginal farmers, replicating the success seen in the pilot regions.
- **Collaborations with Local Cooperatives:** Partnering with local farmer cooperatives can enhance the project's reach and impact. Cooperatives can facilitate collective access to cold storage facilities, ensuring that even the smallest farmers benefit from the technology.
- **Policy Advocacy and Support:** Engaging with government bodies to advocate for supportive policies and subsidies for solar-powered cold storage solutions can accelerate

adoption. Government support can also help in scaling the project to a national level.

- **Research and Development:** Continuous research and development efforts are essential to improve the efficiency and cost-effectiveness of solar-powered cold rooms. Innovations in solar technology and refrigeration can further enhance the benefits for farmers.

Conclusion

The solar-based cooling solution project holds immense potential to transform the lives of small farmers in Karnataka, paving the way for a more sustainable and prosperous agricultural sector. By leveraging renewable energy sources and innovative technologies, this initiative exemplifies a holistic approach towards enhancing food security, promoting economic development, and fostering environmental sustainability in the region. Through collaborative efforts, training programmes, and strategic expansions, the project aims to empower farmers, reduce post-harvest losses, and ensure better market access, ultimately contributing to the overall growth and resilience of India's agricultural sector. ■

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Awas Engineers Environmental Harmony

Improving Quality of Life and Safeguarding Environment

In this article, **Gajanan Khergamker** highlights how the residents of Awas, alongside the Gram Panchayat, have developed a strong bond with nature, driven by a commitment to conservation. Through careful planning and community involvement, Awas has turned its fragile coastline into a green and rocky haven. Additionally, their innovative water management has resolved water scarcity and improved living standards.



School children cleaning up the Awas beach

In the tranquil seaside village of Awas, nestled within the picturesque Konkan coastline in Maharashtra's Raigad, lies a remarkable tale of community-driven environmental preservation. Unlike its bustling neighbours, such as Alibag and Kihim, Awas has chosen a path less travelled, one that prioritizes the protection of its natural surroundings above commercialization and mass tourism.

At the heart of Awas' environmental ethos lies a profound dedication to safeguarding its pristine coastline and lush landscapes. Here, the local inhabitants, in concert with the Gram Panchayat, have forged a symbiotic relationship with nature, guided by a shared commitment to conservation.

Central to Awas' environmental narrative is the strategic plantation of coconut and Suru trees along its shoreline. This concerted effort serves as a bulwark against the erosive forces of nature, particularly in the aftermath of recent cyclones that have ravaged coastal communities. Through meticulous planning and community

engagement, Awas has transformed its once-vulnerable coastline into a resilient bastion of greenery and rocky beaches.

The success of Awas' environmental initiatives extends beyond mere landscape preservation; it is a testament to the harmonious coexistence between humans and nature. By nurturing a thriving ecosystem teeming with biodiversity, Awas has emerged as a sanctuary for both residents and visitors alike, offering a peaceful retreat from the frenetic pace of urban life.

In contrast to the commercialized beaches in the zone, where hordes of tourists vie for space amidst a cacophony of activity, Awas remains an untouched sanctuary, where the rhythmic lapping of waves and the gentle rustle of coconut palms provide the soundtrack to a simpler way of life. Here, sustainable tourism practices are not just encouraged but ingrained in the fabric of daily life, ensuring that the delicate balance of the ecosystem remains undisturbed.

The essence of Awas' environmental philosophy resides in the vibrant engagement of its residents, who

perceive themselves not just as passive dwellers but as custodians of the land's ecological legacy. This sense of ownership is palpable in every aspect of community life, manifesting in a myriad of initiatives aimed at nurturing and safeguarding the natural splendour that defines their home.

Picture a typical morning in Awas: the sun lazily rising over the horizon, casting a golden hue upon the still waters of the Arabian Sea. As the village stirs awake, groups of residents gather eagerly, armed with shovels, saplings, and bags for debris collection. Their mission being: to embark on yet another tree plantation drive, a communal effort to replenish the canopy that adorns their coastline.

With unwavering determination and a sense of purpose, they set about their task, carefully selecting optimal locations for each sapling, ensuring that their efforts will yield not just immediate gratification but long-term ecological benefits. As the first rays of sunlight filter through the branches, illuminating their faces with hope and optimism, it becomes abundantly clear: this is more

than just a symbolic gesture; it is a tangible expression of their commitment to the land they call home.

But the residents' dedication to environmental management extends far beyond tree planting alone. Throughout the year, they organize and participate in a multitude of beach clean-up campaigns, each one showcasing their unwavering resolve to protect the pristine beauty of their surroundings. Armed with gloves and garbage bags, they scour the shoreline, painstakingly removing every last scrap of litter and debris, restoring the beach to its natural state of purity.

As Awas charts its course forward, it confronts a host of challenges, from the ongoing maintenance of environmental initiatives to the looming spectre of climate change. Yet, buoyed by a spirit of resilience and a deep-seated reverence for the natural world, Awas remains steadfast in its commitment to safeguarding its environment, come what may.

The distinctive rocky terrain of Awas beach offers a peaceful retreat, a rare find amidst the vibrant tourist



Awas villagers performing a cleaning operation

hotspots of neighbouring beaches. Unlike other beaches teeming with water sports and food stalls, Awas offers the perfect getaway. However, it also faces challenges, such as the annual appearance of large puddles of oil or tar balls during the monsoon season, likely stemming from ships offshore, a predicament common to many coastal regions in India.

But the locals of Awas don't merely

accept this situation. They actively participate in beach clean-up operations, rallying the entire village community, including school children, to clear the beach of tar balls and other debris. While efforts are made to clean up plastic and other debris, the community lacks the resources to address this type of pollution effectively, highlighting the urgent need for intervention to protect marine life.

Interestingly, the efforts of the residents of Awas go beyond the village, extending to the nearby Khanderi Island, also known as Kanhoji Angre Island—a popular tourist spot, where they conduct regular clean-up drives to tackle plastic pollution left by visitors.

Furthermore, in the absence of formal waste management systems, the residents of Awas have come up with innovative solutions. They plan to dig trenches along the coastline to bury waste, converting it into compost for the trees, thus promoting an organic approach to waste disposal. In addition, Awas is adopting sustainable energy initiatives, with plans to utilize the abundant solar power for self-sufficiency. With Maharashtra poised to boost solar energy sources, Awas is positioned to seize this opportunity. The village has been in close communication with state authorities, eagerly awaiting the chance



Tar-ball and scrap cleaning at the Awas beach

to become self-reliant through renewable energy.

Despite its rural setting, the village strives to provide modern amenities to its residents. Recognizing the importance of energy self-sufficiency, the village is exploring solar power as a viable solution. The potential of solar energy in Awas is substantial, making it a practical choice for meeting the community's electricity needs. In fact, several businesses have already installed solar panels to reduce dependency on traditional source of electricity and cut down on power bills and, in the process, carbon emissions.

This multifaceted approach to environment protection reflects Awas' deep-rooted commitment to sustainability. By integrating eco-friendly practices into their daily lives and actively addressing environmental challenges, the villagers of Awas are not only safeguarding their own community but also setting a powerful example for others to follow. In the mornings, it is a common sight to see local residents leisurely strolling along the beach or taking a moment to relax on the stone benches scattered along the shore. They

take pride in their surroundings and are quick to admonish any tourists or newcomers who carelessly litter in public areas.

The Suru trees, with their towering presence and leafy canopy, provide a picturesque backdrop to the beach, enhancing its natural beauty. Ten-year-old Bhumi Rane eagerly participates in tree plantation drives, excitedly preparing potted plants for an upcoming event aimed at greening the area before the arrival of the monsoon rains. Her mother, Minakshi, watches with quiet pride as she tends to her duties, preparing delicious batata vadas to sell at their family food stall near the Gram Panchayat office in Awas' main square. The stall, named Bhumi Hotel after the young girl, attracts mostly locals and travellers passing through the village.

The pathways of the immaculate village are noticeably devoid of litter, presenting a serene scene especially at noon when they appear almost deserted, save for the occasional elder peeking out to greet a rare visitor. While nearby beaches in Alibag may allure tourists with their lively atmosphere and recreational activities, Awas boasts a distinctive



Ten-year-old Bhumi Rane readying plants for Awas plantation drive

clientele of its own, comprising loyal visitors who have cherished its unspoiled charm for years.

In an all-inclusive approach, Awas caters to residents of all ages. An 'Anand Ashram' has been established within the local school campus, providing a space for senior citizens to gather, share meals, and socialize, nurturing a sense of community and belonging for all. In addition to its efforts in environmental conservation and community welfare, Awas also prioritizes the well-being and



inclusivity of its residents. By creating such a space, Awas has enabled a sense of belonging and companionship among its elderly population, enriching their lives and strengthening community bonds.

Awas remains vigilant in addressing environmental challenges, particularly those posed by pollution and waste management. While the village takes pride in its pristine surroundings and endeavours to keep its pathways clean and litter-free, it also acknowledges the need for proactive measures to combat pollution. Through community-led initiatives and collaboration with local authorities, Awas seeks to develop effective strategies for mitigating environmental degradation and safeguarding the health of its coastal ecosystem.

In essence, Awas' holistic approach to sustainability encompasses not only environmental conservation but also social welfare and energy independence. By prioritizing inclusivity, renewable energy adoption, and proactive environment handling, the village is paving the way for a more resilient and thriving community, where residents of all ages can flourish in harmony with their natural surroundings.

In the scenic landscapes of Raigad, the Awas Gram Panchayat has, more recently, embarked on a remarkable endeavour to tackle the region's water challenges with innovation. Their solution being: the introduction of Smart Card-based Water ATMs, a cutting-edge approach aimed at addressing long-standing water issues.

The rollout of RO Water Plants is unfolding systematically, driven by the overwhelming support from villagers for the existing facilities. Each phase of installation is met with eager anticipation and fervour, underscoring the community's collective resolve to ensure a sustainable water future.

Thanks to these forward-thinking initiatives, residents of Awas now have access to clean, drinkable water at a nominal cost of Rupee 1 for every 20

Trupti Patil at the RO Water Plant at Ranjanpada in Awas



litres. This transformation hasn't gone unnoticed. Trupti Patil, a resident of Ranjanpada, reflects on the significant impact, expressing appreciation for the newfound convenience and improved quality of life provided by the water plants.

She maintains, "It is now very convenient for us to get water that too at an affordable cost. Earlier, getting clean water was a challenge in the zone but now I can simply walk to the nearest Water ATM, tap my Smart Card and get a 20-litre-can of water easily and quickly. Our water worries are a thing of the past now."

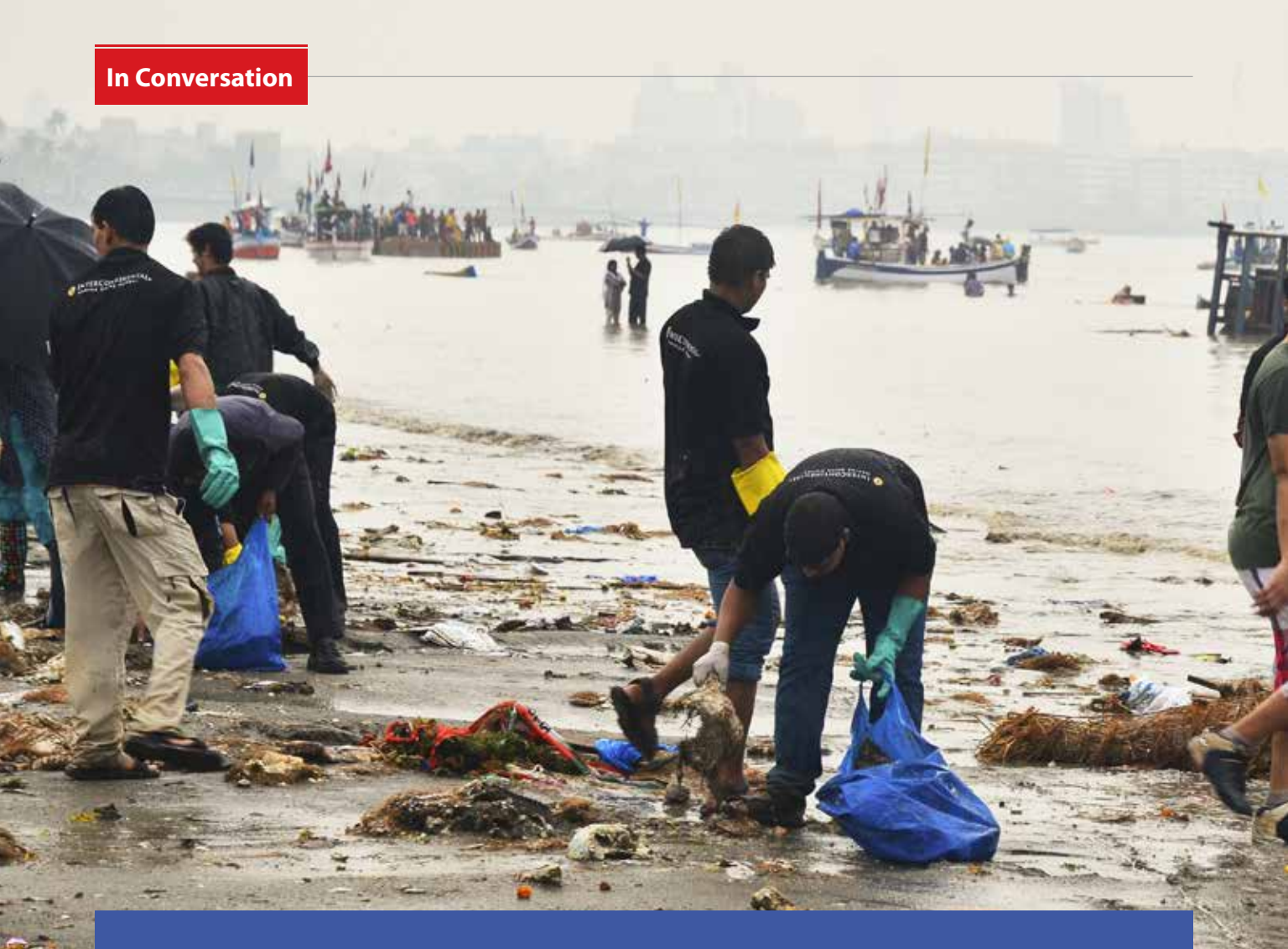
Likewise, resident Ajay Mhatre highlights the tangible benefits, noting the markedly better quality of water compared to previous sources. He says, "This water tastes so good unlike what we received earlier and it's so cheap to boot as well. The new RO Water Plants have made life more convenient now."

Awas' innovative approach to water management has not only addressed the longstanding water scarcity but has also enhanced the residents' standard of living. This marks a significant milestone in the community's journey towards sustainability and well-being.

Furthermore, the implementation of these water management initiatives in Awas has garnered attention beyond the village boundaries. The success of the Smart Card-based Water ATMs and RO Water Plants has become a shining example of effective community-driven solutions to water scarcity issues. It also underlines the importance of clean and accessible water sources to ensure water security and for a healthy living.

A regular source of clean potable water and easy access guarantee a disease-free and healthy environment for the locals. Water-borne diseases are now a thing of the past as storage issues and chances of contamination are eliminated. From the initial planning stages to the final implementation, every step is marked by the collective determination of the community to overcome water scarcity challenges. Their active involvement and support demonstrate a shared vision of improving their quality of life and safeguarding their environment. ■

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Healing the Blue Lung

A Decade of Ocean Action

Dr Anil Pratap Singh, Founder Director & General Secretary of the Global Science Academy (GSA), a non-profit organization based in Basti, Uttar Pradesh, working on science, environment, and societal issues since 1996, engages in a conversation with Abhas Mukherjee for *TerraGreen*. Dr Singh, a passionate advocate for aligning development goals with the United Nations' (UN) agenda, is currently dedicated to the success of the UN Decade of Ocean Science for Sustainable Development (2021–2030). He, a leading science and environment author, unlocks the ocean's potential as a source of life and breath, while also unveiling the UN Decade's ongoing efforts and plans for a thriving ocean.



How has our scientific understanding of the ocean's role in oxygen production evolved over time and how do you see the UN Decade of Ocean Science for Sustainable Development contributing to a greater public understanding of the ocean's importance?

Through my work on the UN Decade of Ocean Science for Sustainable Development (2021–2030), I often witness the wonder in people's eyes when I share that the ocean is the Earth's primary source of oxygen, the very breath of all living creatures. This amazement isn't limited to children, whether students or not, but extends to the general public as well. However, insights into understanding this hidden ocean superpower had a fascinating journey in itself.

Scientists gradually uncovered the ocean's role in oxygen production. Early ideas lacked evidence, but experiments by Lavoisier and others laid the groundwork. Marine science advancements in the 19th century like Humboldt's work on marine life helped pave the way. By 20th century, scientists identified phytoplankton as the main oxygen producers in the ocean, crucial for sustaining life on Earth. Thus, the story of discovering the ocean's oxygen-producing power is not just about scientific progress, but also a testament to humanity's enduring curiosity and ongoing exploration of Earth's complex natural systems.

The UN Decade of Ocean Science for Sustainable Development is making a powerful connection between a healthy ocean and a healthy planet. Public awareness campaigns are underway, highlighting how everyday choices—like using reusable bags or choosing sustainable seafood—can make a real difference. Success stories in ocean conservation and restoration are being showcased, inspiring public action and building a global movement to protect our precious oceans. Moreover, scientists, educators, and policymakers are working together to create fresh educational resources. Citizen science initiatives are also flourishing, allowing the public to participate in data collection and research projects. By identifying critical ocean challenges, breakthroughs are being made by researchers worldwide and the public is getting fascinating glimpse into the ocean's intricate systems and how they impact everything from climate change to our food supply. News media and documentaries are actively involved, translating complex science into engaging stories about the exciting work of oceanographers.

In your opinion, which ocean challenges are the most pressing that the UN Ocean Decade is working to address?

The UN Ocean Decade is tackling a



Dr. Anil Pratap Singh

wide range of critical issues facing our oceans, e.g., battling ocean pollution and developing solutions to mitigate them as fatality ranges from plastic waste clogging our waters to harmful chemicals and so on. The Decade is also revitalizing ocean ecosystems. Coral reefs, mangroves, and other marine habitats are crucial for a healthy ocean and efforts are underway on understanding the threats these ecosystems face and developing strategies to restore them. It is actively promoting sustainable fishing practices and exploring alternative seafood sources in order to ensure sustainable seafood for all.

The ocean plays a vital role in regulating our climate. Researchers are currently investigating how the ocean can be part of the solution to climate change. In both my individual and professional capacities through the Global Science Academy (GSA), which I head, I am actively engaged in tackling climate change using ocean-based approaches. I have contributed to various platforms, including the United Nations Framework Convention on Climate Change (UNFCCC), where the topic of 'climate change and the role of the ocean' has been discussed with due emphasis. The ocean, teeming with life (around 80% of all species!), is a vital source of food, minerals, and energy. It sustains billions of people and plays a

crucial role in climate change. Tiny ocean plants, phytoplankton, use sunlight and carbon dioxide (CO₂) to create oxygen which we breathe, while also absorbing massive amounts of CO₂ (a greenhouse gas). This “blue lung” of the planet helps regulate our climate and contributes to achieving Sustainable Development Goal 13 (climate action) and we all need to conserve it.

Moreover, the Decade is working to ensure fair access to the ocean's resources and benefits for all nations, considering scientific research, economic development, and cultural connections by ensuring equitable ocean access. Besides, the Decade is boosting Ocean Science and Technology and actively building this capacity through various initiatives. A new way of thinking about oceans is now fostering a global sense of shared responsibility for their well-being. Researchers are also investigating connections between marine diseases and human health, and the impact of pollution on seafood safety. The Decade further bridges the gap and ensures ocean management decisions by policymakers based on the latest scientific findings. More importantly, the Decade is transforming our relationship with the ocean by actively raising public awareness about the ocean's vital role in sustaining life on Earth. By fostering a deeper understanding of this amazing ecosystem, we can inspire a new generation of ocean stewards.

Thus, the Decade is harmoniously advancing 14th Sustainable Development Goal, i.e., ‘Life below Water’ in order to conserve and sustainably use oceans, seas as well as marine resources. The UN's climate science panel, i.e., the Intergovernmental Panel on Climate Change (IPCC), is also confronting climate change as a two-pronged approach: reducing the release of heat-trapping greenhouse gases and enhancing natural systems that absorb them. These “sinks” include oceans, forests, and soil.

Dr Singh, your answer provided a fascinating overview of various initiatives tackling ocean challenges. Could you elaborate on a few initiatives, even from outside the UN Decade, which you find particularly successful, considering both their impact on waste removal and their potential for broader application?

There are many initiatives working to address various ocean challenges. For instance, Marine Protected Areas (global) are designated areas of the ocean that are protected from human activities such as fishing and development. This protection allows marine ecosystems to recover and flourish, promoting biodiversity and healthy ocean environments.

In Thailand, the “Bring Waste to Shore – Keep the Sea Clean” initiative, eliminated plastic waste in the ocean and had yielded impressive results

with more than 400,000 kg of waste removed from Thai waters, which can be recycled into marketable products like clothes. For example, plastic waste can be turned into filaments that are mixed with other fibres to make breathable and comfortable shirts. One shirt is made from 8.5 plastic bottles through a process that primarily uses renewable energy and has low carbon emissions. Likewise, Ocean Cleanup being an international organization based in the Netherlands also deployed advanced technology to remove plastic waste from the world's oceans. Under Coral Reef Restoration Projects, many organizations worldwide are working on innovative techniques to restore damaged coral reefs and promote their growth. Another global movement, named as Project Aware, encourages responsible diving practices and educates divers on how to collect marine debris while underwater, and raising awareness about ocean conservation. Bycatch Reduction Initiatives avoids unintentional capture of unwanted animals in fishing gear in order to minimize bycatch and thus protecting marine life and promoting sustainable fishing practices.

In India, the Pradhan Mantri Matsya Sampada Yojana (PMMSY) was launched in 2020, aiming to bring about a “Blue Revolution” in the country's fisheries sector through sustainable and responsible development initiatives such as: a) Modernizing fishing infrastructure and providing better equipment to fishers; b) Promoting aquaculture (fish farming) practices that minimize environmental impact; c) Developing fishing harbours and cold chain facilities to reduce post-harvest losses; and d) Skill development and training programmes for fishers' community. Not only this, India in its Swachh Sagar Abhiyan which was inspired by the Swachh Bharat Abhiyan (Clean India Mission) focuses on cleaning India's beaches and coastal waters. In this campaign, along with beach clean-up drives involving volunteers and coastal communities,



awareness is being raised about marine pollution and the importance of responsible waste management. The campaign also encourages the use of alternatives to plastic and promotes environmentally respectful beach tourism. Research institutions, NGOs, and coastal communities are all playing their roles in protecting India's vital marine ecosystems. Global Science Academy (GSA), as not-for-profit organization, also continued raising awareness, mainly at coastal areas, on surface-to-sea pollution, sustainable fishing and; beyond the blue, unveiling the ocean's role in climate change along with such other allied issues.

How is climate change transforming the health of our oceans, and what solutions are available at both large scale and individual levels?

The ocean is facing a multitude of threats from climate change. Global warming is disrupting the delicate balance of ocean ecosystems, harming countless marine creatures and contributing to rising sea levels that threaten coastal communities. Ocean acidification as well as reduced oxygen levels are spoiling marine life. Glaciers and ice sheets are melting which are not only contributing to the rising of sea levels but also threatening coastal communities and ecosystems therein. Phytoplankton are the base of the ocean food web which also gets impacted by climate change. These changes are interconnected and can have cascading effects. For example, warming waters can lead to coral bleaching, which can then reduce the biodiversity of an ecosystem and make it less resilient to other stressors. Many fish species are sensitive to changes in water temperature and may migrate to cooler waters as the ocean warms. This can disrupt fishing industries and marine food webs.

Mitigation and adaptation are two point approaches which are key to solving climate change induced alteration of the health of our oceans. Hence, mitigation strategies are to be



undertaken by aiming the reduction in the root cause of the problem, i.e., greenhouse gas emissions by transitioning to renewable energy sources such as solar, wind, and geothermal energy systems. Implementing energy-efficient technologies in buildings, industries, and transportation can significantly reduce energy consumption and related emissions. Implementation of energy-efficient technologies in buildings, industries, and transportation are the need of the hour which can significantly reduce energy consumption and related emissions. Phytoplankton in the oceans and seas, as well as forests, need to be protected so that they can absorb carbon dioxide and help mitigate climate change.

Adaptation policies should not be limited to large-scale initiatives such as enhancing Marine Protected Areas (MPAs), promoting sustainable fishing practices, implementing ocean acidification mitigation techniques, and restoring coral reefs. They should also foster individual awareness, responsibility, and action to reduce one's carbon footprint. This can include using energy-efficient appliances, conserving water, and choosing sustainable transportation options. Additionally, when making sustainable seafood choices, it is important to look for labels that endorse sustainable fishing practices.

One of the biggest help at individual level in this context is opting for reusable bags and containers in order to avoid single-use plastics, whenever possible,

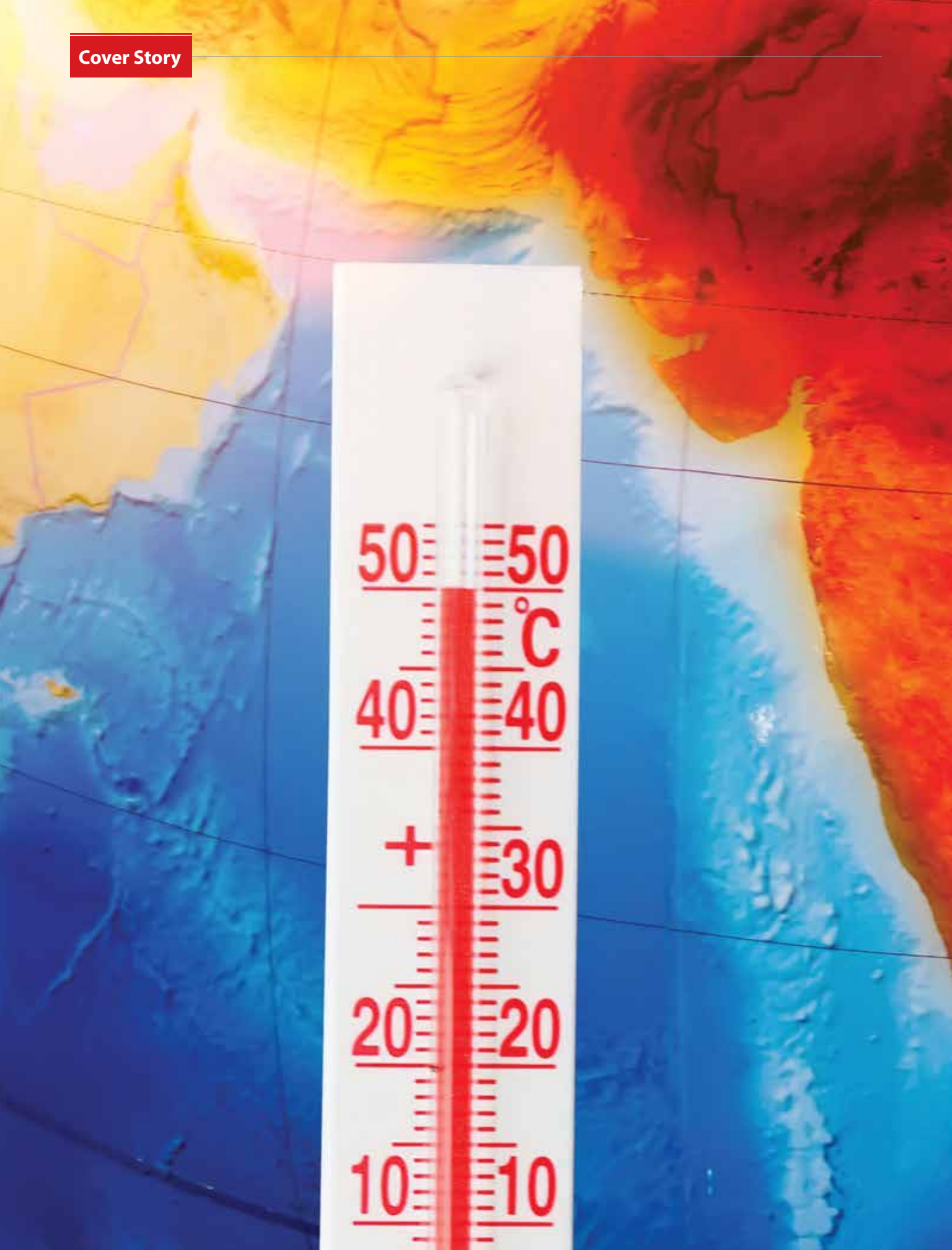
so that plastic pollution would not harm marine life any further. Moreover, extend supporting hands for ocean conservation organizations like GSA and others. Such strategies are essential towards a healthier ocean that is more resilient to climate change.

Your answer is both inspiring and informative. What is the core message you want to convey, and how can we translate that message into tangible actions for ocean conservation?

The ocean has always held a special place in my heart which is not only a source of inspiration and wonder but is also the very breath of our planet. But its future is threatened. We must understand that ocean's health is intricately linked to our own well-being and protecting the ocean is not just about saving marine creatures, it's also about preserving the very foundation of life on Earth. Protecting the ocean starts with everyday choices, e.g., reducing plastic use, supporting sustainable fishing practices, and educating others about the importance of our oceans. We must act now to combat pollution, overfishing, and climate change.

Each year, on June 8, World Ocean Day also conveys the ocean's significance and concludes with a powerful call to action. Participation along with taking specific actions through such an event too can make a difference.

Together, these engagements will create a powerful wave of change in order to ensure a healthy ocean for ourselves and generations to come. ■





Heatwaves in India

A Growing Public Health Crisis

In this article, **Dr Richa Sharma** discusses the adverse public health implications of heatwaves in India. Heatwaves exacerbate chronic conditions, increase hospital admissions, and strain the already burdened healthcare system. They also impact India's food security and economic stability. She highlights that several Indian states have pioneered Heat Action Plans (HAPs), which are comprehensive frameworks designed to minimize the health effects of heatwaves by preparing, responding, and adapting to their rising frequency and intensity. By combining government initiatives, community engagement, and climate-adaptive strategies, we can mitigate the impacts of heatwaves and safeguard public health.



India is no stranger to scorching summers, but the recent heatwaves, which have claimed several lives in the country, have reached a terrifying new level with temperatures consistently exceeding 45°C. In some places, such as Nagpur, temperatures have even crossed 55°C. These episodes of extreme heat are not just a matter of discomfort but they pose a serious and severe threat to public health with far-reaching consequences.

What is a Heatwave?

As per the IMD definition, a heatwave is declared if the maximum temperature recorded at a station is 40°C or more in the plains, 37°C or more in the coast, and 30°C or more in the hills.

The Domino Effect of Heatwaves in India

Heatwaves often referred to as the “invisible or silent killer” has devastating impacts that are not as immediately apparent as those of other extreme events

such as cyclone. The dangers of extreme heat are often insidious and underestimated. However, the health consequences are profound. Prolonged exposure to extreme heat can cause heat exhaustion, heat stroke, dehydration, and can exacerbate chronic conditions such as cardiovascular and respiratory diseases and in more severe cases leading to mortality.



A recent study covering 10 major Indian cities highlighted a significant increase in mortality rates correlated with intense heatwaves. The study reported that when high mean temperatures (temperatures >97% days in a year) are recorded for a day a 12.2 per cent increase in daily mortality is observed. However, when it continues for two consecutive days the daily mortality goes up by 14.7 per cent and when continued for three days it becomes 17.8 per cent. When such high temperatures continue for a continuous duration of five days, the daily mortality can increase up by almost 20 per cent. Globally, one-fifth of the heatwave-related deaths occur in India annually, highlighting the severe vulnerability of the population to extreme heat events. The ongoing heatwaves in India are posing severe threats to public health and the overall well-being of its population leading to health warnings, school closures, and significant pressure on power grids.

The public health implications of these heatwaves extend beyond immediate health risks such as heatstroke and dehydration. They also exacerbate chronic conditions, increase hospital admissions, and put pressure on the already strained healthcare system. Heatwaves also impact India's food security and economic stability which then adversely impacts the public health. Heat exhaustion can lead to decreased productivity, impacting the economy. The intense heat can also damage crops, leading to food shortages and increased prices affecting essential commodities such as cereals and pulses.

Vulnerable Population Bearing the Brunt

The impact of heatwaves is not evenly distributed among the population and geographies. The urban poor, outdoor workers and marginalized communities are disproportionately affected. Those living in



substandard housing, those lacking access to air conditioning or cooling centres, are more susceptible to heat-related illnesses. Outdoor workers, such as farmers, construction labourers, and street vendors, face prolonged exposure to extreme heat, increasing their risk of heat stress and dehydration. For instance, 7 out of 9 people who died in Jharsuguda (Odisha) were truck drivers passing through the industrial town while transporting minerals. Eleven of the 16 people who lost their lives during the heatwave in UP, were polling personnel. Thirteen out of the 16 victims were in 50+ years age group. Another 10 polling personnel lost their lives to heatwave in Bihar.

While heatwaves can affect any region, certain areas are more prone to extreme temperatures. Northern and central parts of India including states like Rajasthan and Uttar Pradesh, for instance frequently experience severe heatwaves, with temperatures often exceeding 45°C. Coastal cities such as Mumbai and Kolkata, while slightly cooler in terms of absolute temperatures, suffer from a combination of high temperature and high humidity, compounding the physiological stress on the human body. In cities, where concrete jungles dominate, the urban heat island effect intensifies temperatures, making life unbearable particularly for those living in slums with inadequate access to cooling resources. These regional disparities necessitate tailored approaches to heatwave management and public health responses.

Why are Heatwaves Becoming Deadlier?

Climate change is an undeniable driver of the increasing frequency and intensity of heatwaves. As global temperatures rise, India must brace for more severe heat events such as the current one we faced. As per the Intergovernmental Panel on Climate Change (IPCC),



the Earth's average temperature has increased by approximately 1.1°C since the pre-industrial era due to human activities, primarily the burning of fossil fuels and deforestation. The Assessment Reports of the IPCC have directly linked this rise in temperature to more frequent and severe heatwaves. Studies by the World Weather Attribution initiative and others also highlight this connection. Climate change makes heatwaves significantly hotter and more likely. An analysis suggests the recent extreme temperatures in India were 45 times more probable due to climate change. WMO studies indicate that the number of heatwave days has increased globally. For example, Europe, North America, and Asia have experienced significantly more heatwave events over the past few decades. Heatwaves are becoming more frequent and intense in India as well. Past few years have seen record-breaking temperatures, exceeding historical trends. The heatwaves are observed to be starting earlier, affecting a larger area, and lasting longer than previously.¹ In addition, the intensity of heatwaves has also risen. Higher peak temperatures are being recorded, with some regions experiencing unprecedented heat. This rise in heatwaves is exposing a larger portion of the Indian population to health risks. Over 90 per cent of Indians are estimated to be more vulnerable to heatstroke, dehydration, and death due to climate change-fuelled heatwaves.²

Cities in particular have their additional burden of heatwaves due to the phenomenon of Urban Heat Island or UHI. A number of studies from various cities in India including Delhi, Mumbai, Kolkata, Surat, Nagpur,

¹ Coleman, J., 2024. Chance of heatwaves in India rising with climate change. *Nature*.

² Details available at <https://economictimes.indiatimes.com/news/india/heatwaves-may-burden-health-agriculture-in-india-cambridge-study/articleshow/99632725.cms?from=mdr>

Lucknow, Guwahati have demonstrated how the urban areas in the country are turning into islands of heat. Concrete and asphalt surfaces absorb and retain heat, causing urban areas to experience higher temperatures than their rural surroundings. This phenomenon not only increases the likelihood of heat-related illnesses but also places additional strain on infrastructure and energy resources, as air conditioning use soars. In densely populated urban areas, the lack of green spaces and inadequate housing further intensify the impact. UHI also exacerbates the health risks for urban dwellers, especially those living in inadequate housing conditions without access to air conditioning or cooling centres.

What Measures are We Taking?

Recognizing the gravity of the situation, several Indian states and cities have pioneered Heat Action Plans (HAPs). HAPs are comprehensive frameworks designed to minimize the health effects of heatwaves by helping the authorities prepare, respond, and adapt to the rising frequency and intensity of heatwaves. These plans outline a series of coordinated actions involving various stakeholders, including government agencies, public health officials, and local communities.

Ahmedabad's HAP stands as a model of proactive governance. Introduced after a deadly heatwave in 2010, it includes early warning systems, public awareness campaigns, capacity building for healthcare professionals, and infrastructural changes like tree plantation and reflective roofing. This holistic approach has proven effective, significantly reducing heat-related fatalities. Other cities to come up with such action plans are Thane (Thane Heat Action Plan 2024), Delhi (Heat Action Plan 2024–25), and Rajkot (2024).

At national level, the National Disaster Management Authority (NDMA) has issued guidelines for drafting HAPs, providing a framework for states to develop their



own plans. Twenty-three states in India have formulated HAPs, with over 120 districts/cities adopting localized plans tailored to their specific needs. Odisha, a state frequently affected by heatwaves, implemented its own HAP with several measures to mitigate heat-related risks. The key components of its HAP include monitoring and surveillance with enhanced weather forecasting and heat alert systems, strengthened healthcare infrastructure including facilities and training for treating heat-related illnesses, and intensifying the community outreach through programmes to educate vulnerable communities on heat prevention and safety. Odisha's proactive approach has helped reduce heat-related deaths and has increased public awareness about the dangers of extreme heat. Maharashtra is another state to have developed a Heat Action Plan to combat extreme heat conditions. The key elements on which the plan is based include instituting Heatwave Response Protocols including guidelines for municipal corporations and health departments, establishment of cooling centres in public places to provide relief during peak heatwave periods, and increased public awareness through campaigns to inform citizens about heat-related risks and safety measures. These measures have enhanced the state's preparedness and response to heatwaves, protecting vulnerable populations and reducing heat-related health impacts. With help from the India Meteorological Department (IMD), based on the weather forecasts, the State Disaster Management Authorities (SDMAs) in most states of India issue heat alerts for public disseminated through personal SMS, and public messaging over media sources such as radio, and television as well as social media platforms. Another state performing inspiringly well in managing heatwaves is Kerala. The Kerala State Disaster Management Authority (KSDMA) has declared heatwaves, sunstroke, and sunburn



as state-specific disasters. KSDMA also initiated educational campaigns to inform the public and set up a monitoring network for UV index to keep track of dangerous ultraviolet radiation. In addition to the State Heat Action Plan, Kerala is developing Local Heat Action Plans in collaboration with local governments. The state's HAP goes way beyond the immediate physical harms, including mental health risks, and even the human-animal conflict risk that might arise due to the constrained resources and altered weather patterns.

What More could be Done?

To begin with, we need to review the very definition of a heatwave in the wake of global climate change. With climate change, not only the absolute values but the overall patterns of extremes are changing. Currently, the definition of heatwave for India is based on exceeding normal maximum temperatures for a specific region, with some variations for plains and hilly areas. However, some places experience increased apparent or real feel temperatures due to changes in humidity patterns, even though the departure from normal absolute temperature might not be relevant from the definition perspective. Additionally, urban areas might experience a heatwave well before the surrounding areas owing to the phenomenon of UHI. Hence, the heatwave definition should be reviewed to include the compounded effect of heat and humidity and the urban areas need to be monitored separately for a heatwave condition. Also, the current definition is based on maximum temperatures; however, more and more studies highlight the dangers of high night time temperatures on human body. Hence, while defining a heatwave, minimum temperatures also need to be considered.

In terms of understanding the health impacts of heat in the population, we need more accurate data. It is often cited that the health statistics related to heat impacts in India are pretty under-reported. We not only need to strengthen surveillance and data collection but there is also the need for development of robust templates for data collection. Such robust templates could help improve efficiency and quality of data collection promoting India-specific attribution studies, which in turn would improve the heat-related morbidity and mortality estimates, facilitating the planning and policymaking process for safeguarding public health against heat. In this regard, the National Centre for Disease Control (NCDC) has published guideline to identify, and categorize heat-related deaths. Such measures would greatly contribute towards standardization of data collection on heat-related mortality across the country.

Although one observes that several states and cities have successfully developed and implemented their HAPs, but it is also true that not all regions have been as proactive. Many areas still lack comprehensive plans, leaving populations vulnerable. In addition, the implementation of HAPs needs to be more widespread and rigorously enforced. Public awareness campaigns should become fundamental, educating people about the dangers of heatwaves and simple measures to mitigate their impact, such as staying hydrated and avoiding peak sun hours. In this context, in May 2024, WHO has released a factsheet on 'Heat and Health' listing measures that could be taken up by public to prevent heat-related risk to their health. For urban areas in particular, extra efforts are required by the city authorities to mitigate the UHI effect, by integrating climate resilience into urban planning and development policies such as nature-based solution for expanding green spaces, investing in sustainable and heat-resistant infrastructure, and enhancing water management



systems could be some of the crucial steps.

From the perspective of developing adaptive measures towards extreme heat, we can learn a lot from the traditional knowledge that certain tribes and communities hold. These tribes have been thriving in harsh conditions using their know-how in shelter construction and home architecture, clothing and personal protection, water management, dietary practices, traditional herbal knowledge, and healing techniques, in a localized context. Hence, focused initiatives could be undertaken to document and validate these traditional practices through scientific research, thereby enhancing their credibility and integration into mainstream healthcare systems.

All said, the fight against heatwaves cannot be the government's burden alone. It requires a concerted effort from all sectors of society. Communities must adopt and promote sustainable practices, such as rainwater harvesting and tree planting. Private enterprises can contribute by creating more green buildings and providing heat-resilient cooling spaces for their workers. They can also support community cooling initiatives.

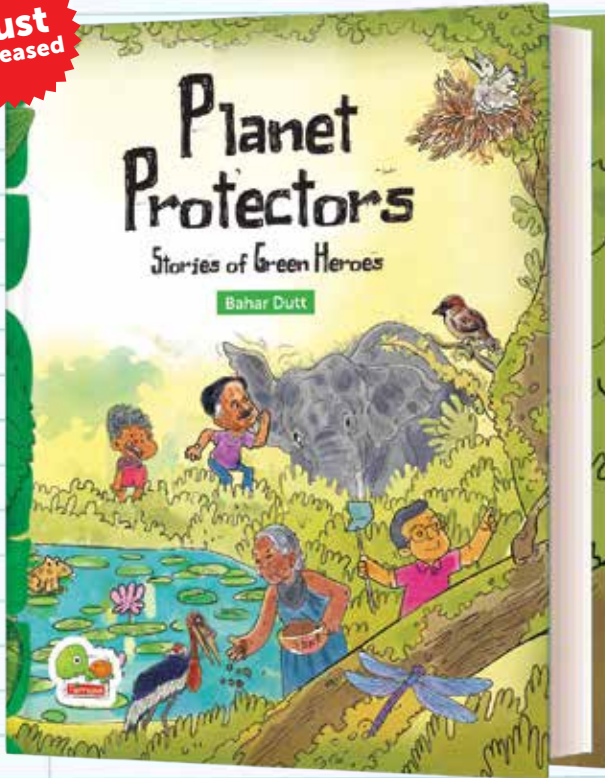
Conclusion

Heatwaves in India are a growing public health crisis that demands immediate and sustained action. By combining government initiatives, community engagement, and climate-adaptive strategies, we can mitigate the impacts of heatwaves and safeguard public health. Consolidated and continued efforts and adaptations are necessary to enhance resilience against the growing threat of heatwaves in India. Working together, can ensure that India survives not just the summer, but the scorching reality of a warming climate. ■

Dr Richa Sharma, Fellow & AC, Environment and Health Assessment area, Air Quality Research division, TERI, New Delhi.

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Clear Air Turbulence and Jet Streams

Will Climate Change Make Air Travel Disaster-Prone?

Although air travellers worldwide are familiar with turbulence during monsoon flights, clear air turbulence (CAT) has been relatively rare. Recently, however, instances of severe CAT have increased, often leading to significant injuries and even fatalities. According to a study, the severity of CAT has grown by 55 per cent over the past decade. In this article, **Dr Rina Mukherji** explores the phenomenon of air turbulence, jet streams, and their impact on aircraft, while also examining expert opinions on how climate change might make air travel more disaster-prone.

The recent past was marked by two major incidents of aircraft turbulence that left many passengers and crew severely injured, with one dead. In the first incident, a Singapore Airlines flight from London to Singapore was hit by severe air turbulence over the Irrawaddy basin in Myanmar, leaving 70 persons injured, and a septuagenarian passenger dead. The incident occurred when the flight had flown over 10 hours and breakfast was being served. The plane had to be diverted and landed at Bangkok's Suvarnabhoomi airport, given the medical emergency.

In the other incident, only six days later, on May 27, 2024, 6 passengers and 6 crew members aboard a Qatar Airways flight from Doha to Dublin were injured by turbulence when flying over Turkey.

On December 28, 1997, a similar incident occurred when a United Airlines flight flying from Tokyo to Honolulu met severe air turbulence, seriously injuring 15 passengers and 3 crew members, leaving a 32-year-old Japanese woman, dead. This incident occurred when the plane was flying at 31,000 feet.

While air travellers the world over are not new to turbulence during monsoon flights, cases of clear air turbulence (CAT)

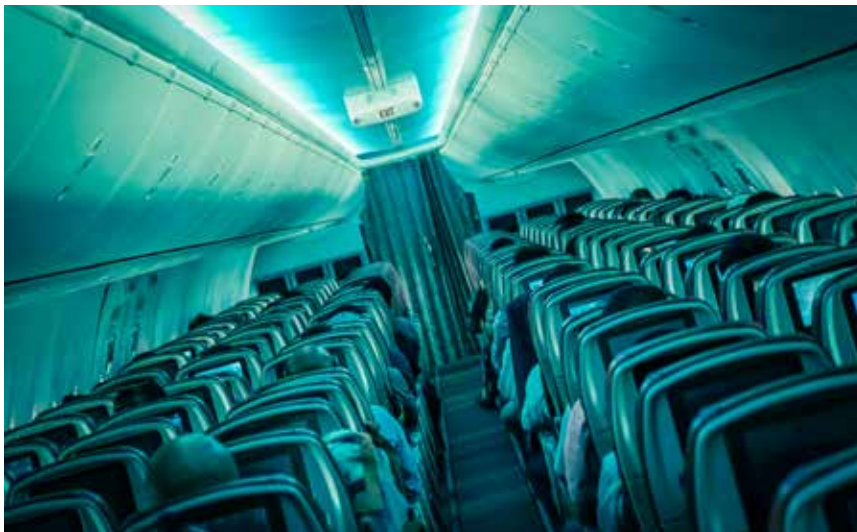
were hardly encountered. Of late, though cases of severe CAT are no longer rare, with many instances resulting in severe injury and even, death. The severity of such CAT has, as per a study, grown by 55 per cent, over the past decade.

Turbulence: what causes it?

Turbulence is defined by the Federal Aviation Administration (which operates under the US Department of Transportation) as air movement that normally cannot be seen and often occurs unexpectedly. It can be created by many different conditions, including atmospheric pressure, jet streams, air around mountains, cold or warm weather fronts, or thunderstorms.

Turbulence can even occur when the sky appears to be clear, and such turbulence is defined as CAT, or "clear air turbulence." CAT is normally encountered at high altitudes over mountains, above 15,000 feet or so. Unlike the turbulence encountered during stormy weather, or cloudy conditions, CAT is difficult to detect.

Studies show that incidents of moderate to severe turbulence have increased markedly over the past decade or so. If one examines the





aforementioned incidents, one finds that the worst turbulence is faced around 31,000 feet and thereabouts. Besides, the incidents were faced when flying above Turkiye, Myanmar, and East Asia. The regions over which the incidents occurred are, incidentally, majorly affected by climate change, and global warming.

So, is there some truth in what some scientists suspect, that heightened cases of clear air turbulence in recent years are related to climate change? Let us examine the facts.

Climatic Conditions over Turkiye and Myanmar

Turkiye, notably, is one of the countries worst affected by climate change. With a 1.5 degree rise in temperature, Turkiye is faced with mucilage formation in its

seas, with fish catch dropping by half.¹ The conditions have so worsened that the ruling government has been forced to take note.

Myanmar is another country that faces the worst variability in its monsoon weather patterns. In examining the influence of two major teleconnections, namely, El Niño Southern oscillation (ENSO) and Pacific decadal oscillation (PDO) on the summer monsoon precipitation of Myanmar, researchers, studying 52 years (1951–2002) monthly precipitation data from a high-resolution gridded dataset developed by the Climate Research Unit (CRU), found an overall negative relationship between ENSO and precipitation patterns across Myanmar, with substantial regional level variations in the strength of the

¹ Details available at <https://www.aljazeera.com/news/2021/6/7/climate-change-sea-snot-killing-turkeys-marmara-sea#>

relationship. The role of ENSO on the resulting precipitation patterns, during El Niño years was stronger during the cold phase of PDO, whereas the reverse occurred during La Niña years.²

Even otherwise, rainfall over Myanmar has large inter-annual variability causing droughts and floods in many years. In this study, rainfall variability (in monthly scale) over Myanmar during summer monsoon has been examined using observed data. It was found that monthly rainfall in June, July, and August months do not have any relation with each other, indicating that monthly rainfall received in Myanmar in these 3 months varies due to different mechanisms.³ Deficiency of rainfall occurs when

² Details available at <https://rmets.onlinelibrary.wiley.com/doi/full/10.1002/joc.2065>

³ Details available at <https://doi.org/10.1002/joc.4741>



south-westerly winds at 850 hPa are weaker over the region in June. During excess rainfall years, south-westerly wind anomalies seen in June turn to stronger and milder westerly winds in July and August, respectively. Notably though, a cyclonic anomaly is seen over the North Bay of Bengal adjoining the western coast of Myanmar in all the 3 months. Incidentally, rainfall in Myanmar is positively correlated with the sea surface temperature over central Pacific Ocean.

As for East Asia, a study done by researchers using 41 years' reanalysis data and published in the *Journal of Geophysical Research* in January 2023, showed a high frequency of moderate or greater (MOG) level of CAT potential over East Asia, Eastern Pacific and northwestern Atlantic regions, especially in winter. The most affected region happened to be East Asia; this was because of strong meridional temperature gradients in the mid-

troposphere, induced by warming in the tropics and cooling in eastern Eurasia.⁴

To understand the phenomenon of air turbulence, jet streams, and how they affect aircraft, though, we must start from the basics. Jet streams are massive rivers of air that keep blowing all over the planet, and help aircraft to fly. These jet streams blow from the west to the east and are dubbed the westerlies, and are especially very strong in the mid-latitudes. These winds are a result of the temperature gradient we encounter between the tropics and the poles. Of course, the Coriolis Effect due to the movement of the Earth also plays a role here.

In both the Northern and Southern hemispheres, this temperature gradient generates westerly winds that strengthen with height—vertical wind shear—as a consequence of thermal wind balance. Since the mid-latitude meridional temperature gradients are now being modified by anthropogenic climate change, the jet streams are seen to possibly adjust in response.



⁴ Details available at <https://doi.org/10.1029/2022JD037679>

Expert View

Going through the details of such incidents, one discerns a common thread. Most instances of CAT occur at higher altitudes (i.e., above 15,000 feet above sea level). A recent study by Lee et al. (2023) noted that high frequencies of CAT tend to occur in the upper tropospheric (8–12 km) westerly jet stream over the East Asian, Eastern Pacific, and Northwestern Atlantic areas during the winter months.

Explaining the phenomenon, Indian Institute of Tropical Meteorology (IITM) Director Dr Raghavan Krishnan says, “This is because it is at this altitude above the earth’s surface the mid-latitude westerly jet streams during the winter months are the strongest and are associated with strong vertical wind shears. The strong westerly jet streams are maintained by the north-south temperature gradient between the warm tropics and the cold polar regions. The westerly jet streams are always there, and help aircrafts fly faster at these altitudes. There are several factors which must be taken into account. Over East Asia, during winters, the westerly jet streams are very strong and have speeds of around 180 km/hour near the altitudes of the upper-troposphere (~ 12 km). The vertical wind shear of the westerly jet stream supports the development of synoptic weather disturbances, also known as baroclinic systems in meteorological parlance. For example, regions over Himalayas and northern India often experience cold weather, rainfall, and snowfall during winter months in association with Western Disturbances (WDs) that originate from the Mediterranean region and propagate eastward. The WDs are synoptic weather systems that are embedded in the westerly jet stream. According to Lee et al. (2023), high frequencies of CAT tend to occur in the upper tropospheric (8–12 km) westerly jet stream over the East Asian, Eastern Pacific, and Northwestern Atlantic areas during the winter months, since



the strong vertical shear of the winter westerly jet stream over East Asia in the upper troposphere provides a conducive environment for CAT to occur.”

Dr Krishnan’s observations are in line with a paper authored by Simon H Lee, Paul D Williams, and Thomas H A Frame and published by *Nature* in 2019.⁵ However, the reasons for CAT over the tropics appear to be rather different from the mid-latitudes, in Dr Krishnan’s opinion. Noting that the recent Singapore Airlines incident occurred over the Irrawaddy basin in Myanmar in the pre-monsoon season, Dr Krishnan says, “The tropical atmosphere is prone to deep convective activities. Especially, pre-monsoon thunderstorms over the Indian subcontinent are associated with deep convection, cumulonimbus clouds, and strong vertical motions; this appears to be a plausible mechanism for the recent CAT event over the Irrawaddy basin.”

It should be noted that this year has seen extremely high summer temperatures all over India, which could have exacerbated conditions for CAT over the Irrawaddy basin. Given the

kind of local conditions in the tropics, skilful predictions of CAT by numerical weather prediction models are always challenging, in Dr Krishnan’s opinion. So, he feels that the “key to reducing uncertainty in projections of future CAT is in improving clear air turbulence diagnostics rather than climate models, akin to what is felt by researchers Paul D Williams and Luke N Storer?”⁶

“Climate models are for projection. To be effective, a climate model needs certain features. We need technologically advanced, high-resolution climate models, and also data-driven (AI-ML) models to succeed here.” Referring to the unpredictability of tropical weather systems, Dr Krishnan says, “We have significantly improved the skill of tropical cyclone prediction over the last 10–15 years. To better understand localized phenomena, extreme precipitation events, and CAT, a lot more research is needed.”

And therein lies the key to safer flights the world over, and especially over our region. ■

Dr Rina Mukherji regularly contributes articles in *TerraGreen*.

⁵ Details available at <https://www.nature.com/articles/s41586-019-1465-z.epdf?>

⁶ Details available at <https://doi.org/10.1002/qj.4270>

Promoting Agriculture-linked SDGs with Youth

Improving Livelihoods and Empowering the Agricultural Community

In this article, **Dr Neetika W Chhabra** and **Dr Livleen K Kahlon** highlight that youth involvement in sustainable agriculture is crucial for achieving many Sustainable Development Goals (SDGs). With active youth participation, India can become self-sufficient in food production, retain farmers and rural youth in agriculture, improve livelihoods, and empower the agricultural community.

India is an agrarian society and the agriculture sector contributes 14 per cent to the country's GDP.¹ It moved from 'ship to mouth' to self-sufficiency, post green revolution. Enhanced productivity though led to food surplus reserves but had a deleterious impact on natural resources of the country, leading to receding water table, poor soil health, and increased pollution. Agriculture today is getting seriously impacted because of increase in temperature, abrupt weather conditions, increased incidence of pests and pathogens, etc. This is making agriculture highly unprofitable.

India has one-fifth of the world's youth population.² However, the current population of farmers is aging and simultaneously, there is drifting of farmers and rural youth from agriculture.³ This will threaten our food security. Therefore, youth need to take the responsibility to stop this migration through different interventions and



reverse the trend.⁴

The youth through innovation and, entrepreneurship create opportunities of growth and newer avenues for income. Being digitally savvy, adolescents and youth can adapt to new and emerging technologies. This helps them acquire greater knowledge, develop new-age skills, and gain the courage to take risks and innovate.

India being signatory to 2030 Agenda for Sustainable Development Goals, realizes the importance of making

agriculture sustainable. It has played a major role in crystallization of global Sustainable Goals and committed itself towards them much before they took shape. The 17 Sustainable Development Goals (SDGs) were established by the United Nations in 2015, as part of the 2030 Agenda for Sustainable Development. These goals invoke global partnerships for creation of just, peaceful, and a healthy planet. To take these goals forward not only governments, institutions, state-machineries, NGOs, etc., have to collaborate, but youth also has a major role to play in achieving these goals.

¹ Details available at https://mospi.gov.in/sites/default/files/Statistical_year_book_india_chapters/Agriculture_writeup.pdf

² Details available at <https://indbiz.gov.in/one-of-the-youngest-populations-in-the-world-indias-most-valuable-asset/>

³ Details available at <https://www.ifad.org/en/web/latest/-/empowering-youth-to-drive-sustainable-development>

⁴ Details available at <https://fsii.in/encouraging-youth-in-agriculture/#>

The Himalayan Centre, TRISHA's main aim was to develop crop value chains as a viable approach for providing financial security to the marginal farmers of the Himalayan villages. The Centre also has residential facility where workshops are organized for different stakeholders to help them understand hill ecosystem.

Food security is one important dimension which is of concern and is critical to achieve SDGs. Agriculture is not limited to food security but has overarching impact on poverty, water and energy usage, it is responsible for climate change, unsustainable production–consumption, health, nutrition, etc. Reaching the SDG targets simply will not be possible without a strong and sustainable agricultural sector.

Sustainable agriculture as the name suggests fulfils current needs of society for food, clothing and timber without compromising those of future generations. It is practised by adopting interventions which are environment-friendly and enrich health of natural resources and biota.⁵ Agriculture helps in achieving majority of the SDGs by adopting strategies which help in improving human-health; eradicating hunger; reducing inequality; preserving land, water, and air quality.

The Energy and Resources Institute (TERI) a global think tank, under Environment Education and Awareness (EEA) Division works with different stakeholders and primarily with school children and youth, trying to bring about behavioural change in them towards the environmental and sustainability issues. It advocates judicious and sustainable use of resources and tries to steer young minds towards ways in which it can be achieved. The group realizes that behavioural change can be achieved

⁵ Details available at <https://www.nal.usda.gov/farms-and-agricultural-production-systems/>



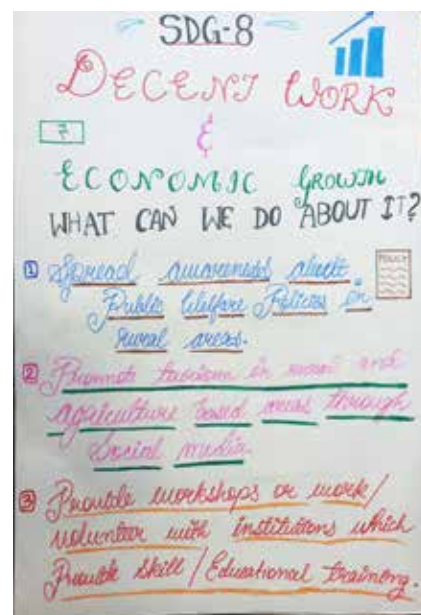
by following a two-prong approach: (a) sensitizing the target group, followed by (b) a well-designed strategy for effective implementation to actualize the envisaged change. TERI organizes dedicated workshops for children and youth to sensitize them on issues of sustainability and encourages them to share their thoughts on the issues.

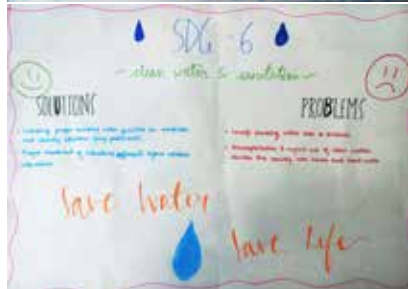
Recently, TERI organized a workshop for Senior Secondary School children at its Himalayan Centre at Supi (Mukteshwar), TRISHA (TERI's Research Initiative at Supi for Himalayan Advancement) established in 2003. The centre supports local communities by introducing various agricultural interventions, which involve efficient soil and water resources as these resources are highly limited in the hill farming ecosystem. The workshop engaged students to think about sustainable agriculture and the role youth can play to achieve the SDGs through agriculture. Children were divided into groups and each group was asked to select an SDG by rolling a dice. Almost all SDGs are impacted by sustainable agriculture but in the workshop the ones which were majorly focused were:

- SDG 1 No Poverty
- SDG 2 Zero Hunger
- SDG 3 Good Health and Well-Being
- SDG 6 Clean Water and Sanitation
- SDG 8 Decent Work and Economic Growth

- SDG 13 Climate Action Students brainstormed and presented their views creatively through posters, songs, skits, etc. The activity provided forum to children, to stretch their thoughts to how best they can contribute in achieving the SDGs through sustainable agriculture. Some of the suggestions were out of the box and captured in the posters in this article.

Some of the ways in which adolescents and youth can contribute and bring about the desired change by practising sustainable agriculture are as follows:





- Mobilizing rural youth to practice agriculture:** Urban/rural youth can mobilize next generation farmers to stay-put in agriculture and adopt innovative/latest technologies to improve their yields and earn higher revenues.
- Make agrarian community aware of the schemes available in the farming sector:** There are multiple schemes launched by the government to help farmers to increase their incomes and work in an organized fashion. For instance, Government had launched 10,000 Farmer Producer Organization (FPO) scheme to help farmers through collectivization, work efficiently and effectively. Youth can help farmers understand various schemes/subsidies which come associated with centre sector schemes for FPOs.
- Impart/undergo training on the latest technologies in agriculture:** Youth can undertake training of farmers and youth in rural areas on the latest agri-technologies (IoT, drones, newly developed varieties, hydroponics, etc.) including sustainable technologies. As youth are early adopters, application of innovative technologies and their implementation is very natural to them. This shall ensure fulfilment of SDG 4 (Quality Education) and SDG 8 (Decent Work and Economic Growth).
- Facilitate farmers to procure loans and subsidies by liaising with the financing organizations:** Farming community may or may not be aware of the procedures to procure loans. Youth can tie up with different financial institutions including banks, and help farmers understand the modalities for raising loan application.
- Promotion of tourism in rural areas so that agriculture gets recognition and tourists gets sensitized to the concerns related to agriculture:** Promoting tourism in the rural areas will give visibility to the sector and help farmers earn additional revenue. This would also help voice concerns of farmers reach, far and wide. This will help alignment with SDG 8 (Decent Work and Economic Growth).
- Work closely with organizations/institutions which provide skill on agriculture technologies:** To make agriculture sustainable and with advances in technology, it is important that the farming community is upskilled. Youth can

play a major role by collaborating with agricultural institutes/agri-based industries/KVKs, etc., and help farmers acquire the desired skills. This shall help their livelihood security and is aligned with SDG 4 (Quality Education).

- **Influence formulation of policies:** Youth can play a crucial role in shaping farm-related policies by conveying farmers' concerns to policymakers and informing farmers about existing policies.
- **Networking and creating platforms for voicing farmers concern:** Youth can participate extensively in global events and help establish necessary tie-ups with the international bodies/companies who can help in financing agriculture-related projects including infrastructure and fetch greater revenue to farmers. This shall help fulfil SDG 8, SDG 9 and SDG 13, which will help farmers get decent work, enable economic growth, help in development of infrastructure and foster partnerships for growth.
- **Entrepreneurship:** As youth have access to vast knowledge resources, are digitally savvy and have great risk appetite, they can set up agri-based enterprises which can provide livelihood to farmers and rural youth. They can set up enterprises for production of biofertilizers, biopesticides, vermicomposting, hydroponics, secondary agriculture products, value-added products,



- post-harvest processing technologies, processing of agriculture waste, etc.
- **Mitigate pollution due to agriculture:** Youth can also be very instrumental in preventing different kinds of pollution caused by agriculture. They can help prevent pollution caused by burning of crop residue through devising innovative solutions or link up different industries which will use crop residue as feedstock. Likewise, promoting chemical-free farming will reduce land, water and air pollution and will help in saving the biodiversity. All the initiatives will help in achieving SDG 5 (Clean Water and Sanitation), SDG 14 (Life below Water), and SDG 15 (Life on Land).
 - **Help adopt climate resilient agriculture in wake of climate change:** In the wake of climate change, there is lot of unpredictability in terms of sowing seasons, local weather conditions, heat-/drought-/temperature-sensitive varieties. Youth can be instrumental in adoption of climate-resilient agriculture through usage of resilient varieties/crops/sustainable technologies, devising innovative solutions, etc. This shall help in ensuring food and nutritional security, thereby, attaining SDG 1 (No Poverty), SDG2 (Zero Hunger), and SDG13 (Climate Action).
 - **Market intelligence:** In order to grow what has a demand, youth can provide market intelligence to the farmers informing them which commodity will have a demand,

- how much area should be cultivated, etc., by using various ICT tools or by setting up the desired network of commodity-based organizations. This shall prevent over-production of the crops, production of the desired crops, and help farmers fetch the right price for their produce. This shall help in attaining SDG 12 (Responsible Consumption and Production).
- **Building market linkages:** Selling the crop in the right market and at the right price is a major challenge for the farmers. Youth can help farmers establish right market linkages and sell their produce profitably and without any post-harvest losses. Thereby achieving SDG 1 (No Poverty).
 - **Community-based projects:** Based on the geography being worked upon and the local issues, youth can attract funding for targeted community-based proposals to suitable companies/organizations and help provide livelihood to the local youth. This is in alignment with SDG 8 (Decent Work and Economic Growth).

By engaging in sustainable agriculture, youth can play a significant role in achieving the SDGs. Only with the active participation of youth India can hope being "self-sufficient" in food, prevent farmers and rural youth drift away from agriculture, improve livelihoods, and empower agricultural community. ■

Dr Neetika W Chhabra, Fellow, Environment Education and Awareness division, TERI and Dr Livleen K Kahlon, Senior Fellow & ADIR, Environment Education and Awareness division, TERI.

World Environment Day

Where India Stands and What More Needs to Be Done?

World Environment Day is a global platform aimed at raising awareness and taking action on pressing environmental issues. In India, this day holds significant importance as the country grapples with challenges such as pollution, deforestation, and climate change. While India has made strides in renewable energy and conservation efforts, there is still a pressing need for stronger policies, public awareness, and community involvement to address these environmental concerns comprehensively.

“Our Land, Our Future. We are #GenerationRestoration” was the theme for World Environment Day 2024, which focused on land restoration, desertification, and drought resilience. The theme “Our Land, Our Future” reflects a lot about where we stand in terms of sustainable living. Reforestation is widely recognized as one of the best methods for carbon offsets, yet we still have a long way to

go. According to a March 2023 report by Utility Bidder, a UK-based comparison site for energy and utility costs, India’s deforestation challenges are particularly complex. It takes resilience and knowledge to devise solutions without becoming disheartened by issues such as inadequate policies affecting farmers, the destruction of forests, and the widespread felling of trees for various projects. Despite these challenges, India

has been a significant participant in the voluntary carbon market (VCM). While it may be difficult to envision our cities as ‘Bicycle Metropolises’ or ‘Bicycle Heavens,’ there are other promising solutions we can explore.

Since the delicate balance of our planet depends on a handful of precious resources in addition to looking at responsible consumption of the same as a solution to problems that arise due to





exploitation of resources, renewable and non-renewable experts are turning to upscaling biodigesters to help mitigate climate change. All carbon negative countries and those on their path to carbon neutrality have a reputation for dense forests and involving businesses and citizens in the mission.

On one hand lot of money (running in crores) is allocated for waste management and on the other hand, municipal solid waste in India is estimated to be around 150,000 tonnes per day as per the *State of India's Environment 2023 report*. Thus, our ambitious steps towards net zero emissions keep faltering day after day. One of the important reasons why biodigesters are a "go to solution" is the unending struggles with waste

management. India has a proud history of anaerobic digestion that began in the leper colony in Mumbai in 1859. Thus, hope was once born here. England followed suit in 1895 and Germany took to it in the early 20th century. Strangely, food waste and municipal waste, whatever definitions they might take or whichever way they are categorized presents a dirty picture to the rest of the world. Hence, biodigesters are almost everywhere. They have become part of households, hospitality industries, dairy farms, and agriculture sectors.

Policies and Acts on Low Carbon and Green Growth have been in force in our country, which has stimulated a transition from other energy-oriented to carbon-oriented indicators. Carbon-oriented evaluation helps with precise

mitigation target management and imposing of economic penalties. A paradigm shift is occurring in waste policy from the prevention of pollution towards comprehensive waste management through improved productivity. The main objective of this shift is to eventually create a society where environmental damage is minimized or put to an end by controlling waste emissions. From another angle, it is a social system in which there is no one-way flow of materials and resources that end with discarding stuff but a cyclical one. Systems installed or implemented with the hope of reaching the reduction goal are not always successful as the temperatures inside and outside the biodigesters affect anaerobic digestion in full-scale and the removal of organic matter and CH_4 yield. Though biodigesters stand out because of their operational simplicity and low construction costs, the fact that these systems are totally dependent on the local climatic conditions calls for continuous monitoring, real time or remote. Purpose-built remote monitoring operational technologies help with predictive maintenance practices, identifying issues before they escalate and to schedule maintenance proactively. Avoiding unplanned shutdowns is about increasing overall equipment efficiency for we know equipment failure equates to



productivity loss.

This is where entrepreneurs who build paths to a sustainable future through scalable and adaptable Industrial Internet of Things (IIoT) solutions pitch in. Having graduated from the University of Greenwich, a place globally known for maintaining its 'First Class Award' in the People & Planet University Green League since 2012, Robin Thomas founded Olive IoT and developed products and remote access/monitoring solutions specifically for bioenergy plants and digesters, with a core focus on carbon offset monitoring. Statistical analysis and meticulous calculations go into designing and minimizing cost. If Ireland, Canada, the USA, Croatia and Australia are availing the services of



Olive IoT, then aspiring entrepreneurs have reasons to think along the lines of Robin. An impressive workforce that models and develops solutions for electronic monitoring in real time using a computational technological system that will be responsible for the collection storage and analysis of a variety of parameters through electronic sensors says a lot about goals and commitment towards a clean world. The data will be automatically uploaded to a cloud server, allowing for remote monitoring around the clock by authorized personnel. Regular performance evaluation of a

biogas digester through IIoT solutions is thus integrated into a broader corporate strategy. This approach ensures continuous oversight and optimization, enhancing efficiency and reliability.

Finding solutions to climate change begins with identifying the problems and the gaps. Whatever be our field of study, each one of us can do our part. For example, physicists play a role in the advancement of renewable energy technologies by applying principles of fluid dynamics, thermodynamics, electromagnetism, etc. Chemists learn green chemistry. The attention restoration theory of Stephen and Rachel Kaplan is well taken. On Earth Day and Environment Day, architects and designers are celebrated as well. Monitoring devices, remote sensing applications, surgical robots, lasers and IIoT devices scream about the special contributions of electronics and communication engineers towards sustainability and carbon offsetting.

Remember, all commitments stem from goals. Therefore, committing ourselves towards initiating a small change could get the ball moving on this environment day. ■

Article contributed by Dr Elsa Lycias Joel. She regularly writes articles on pertinent environmental topics for TerraGreen.





Terra Youth

Joining Hands
for a Greener
Tomorrow

Trees Matter

Let's Correct Them

Trees play a crucial role in providing food, oxygen, and shelter while mitigating climate change and pollution. However, urbanization has stressed trees, leading to poor growth and vulnerability to extreme weather. **Dr Inderdeep Kaur** feels effective tree management, such as staking and protective measures, is essential to support healthy growth and prevent damage. Successful examples from countries like Thailand highlight the importance of ongoing care. Community involvement in tree maintenance and correction, rather than just planting, is vital for urban sustainability and environmental health.

“The best time to plant a tree was 20 years ago. The second best time is now.”

– Chinese proverb.

Trees play several important roles in human life. Besides food and oxygen, trees provide shade, medication, wood products, and above all shelter and niche for fauna, and

green spaces to humans. They lock up atmospheric carbon and help fight climate change. However, the urban sprawl has put additional pressure on trees. They have been referred to

frequently as the ‘lungs of the cities’ as they can mitigate pollution, and provide fresh air, besides checking noise pollution (green mufflers) and performing ecosystem services. With





several types of birds and small animals seen hopping and resting in the canopy, they add colours to the otherwise mundane and concrete landscape of the cities. Caring for trees is caring for Mother Nature. Tree watching can be a stress-busting activity after a busy day. Research emphasizes that relaxing under trees helps in lowering the release of the stress hormone, cortisol in our brains. This reduces anxiety and loneliness. In Japan 'Shinrin-yoku', a forest bathing trip is a common practice. It is a short leisurely visit to the woods that affects olfactory nerves and provides aromatherapy.¹

With trees, we learn to share and care.

¹ Details available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2793341/>

If trees do so much for us, should we not be passionate about our 'caregivers'? You may say we are doing our bit as residents by organizing regular plantation drives, and observing World Environment Day, and Paryavaran Saptah. The premier educational hub of the country, the University of Delhi through its novel programme 'Environmental Education to Environmental Action' encouraged the youth seeking admission (2022) to help make the planet green. They were asked to plant at least one tree or adopt some and submit a progress report of the same. Sadly enough there is no follow-up of such activities. After a plantation drive many saplings may not get established, some may remain weakly rooted while several others may

end up in a crooked growth. Such trees with poor morphological traits may be a failure which in outdoor recreation sites may result in property damage or human injury. The monsoon fury in Delhi in previous years resulted in many trees being uprooted across the capital and it is getting worse with each year. It is time to ponder why such a large number of trees get uprooted every year. One of the reasons according to ecologists is the weak root system which results in several deformities in growth.

There are some 'veteran and senior' trees whose branches have either become weak and are therefore vulnerable to thunderstorms and heavy rain or the branches are too heavy and drooping that they succumb under

pressure. Some of these trees may be historical and/or have religious sentiments attached to them. Such trees are made to undergo 'surgery' and corrections by metallic braces and supporting pillars. But such trees are only a few, about 16 in Delhi, and stand on the premises of old monuments, the 'historical heritage'. These trees have been provided with protection by the Department of Environment majorly because of the 'natural heritage' tag they adorn.²

What about the trees planted along the roadside, in MCD parks, in neighbourhoods, and on marginal land? Who do they belong to? Even a casual glance reveals that many of these trees have crooked growth and lean precariously. They become an eyesore to neighbours as they damage fences or walls they lean against. They are a nuisance to vehicular traffic and pedestrians on congested roads. Additionally, they pose a danger when entangled in electric poles, being prone to uprooting under the slightest pressure. In summary, they often fail to withstand strong winds and rains, a common occurrence during Delhi's monsoon season. People then adopt illegal ways to deal with such trees which either is to face the wrath of the axe in the wee hours or residents put chemicals that weaken the roots and the tree dies.

Is it not criminal to remove a young tree that would have lived for many more years and benefitted us or an old tree that has toiled for several years to reach maturity and now sustains an ecosystem of its own with birds, insects, and animals interacting in its canopy? Why did we allow a tree to lean in the first place and not adopt any aftercare measures when it was planted? We could have simply provided it some support to achieve straight growth.

A practice to provide aftercare to a

² Details available at <https://www.downtoearth.org.in/wildlife-biodiversity/heritage-trees-of-delhi-58172>



Figures A-E: Tree corrections. (A) An old sacred tree in Reru Sahib Gurdwara in Ludhiana, supported by pillars and braces. Such surgical interventions are awaited in Delhi; (B) A neem tree leaning on the fence of an MCD park; (C & D) Wooden stakes to check the leaning of trees in Thailand; (E) Baffles put around palms in Thailand are made of eco-friendly material and cut the path of critters

newly planted tree, and help it grow straight and not lean is known as staking which can be done either aboveground or underground. In the former case, stakes are installed low in position to give freedom to the upper branches to move with wind and the trunk to taper in growth. This also secures the root ball which gains strength as the tree gains height. The choice of stake material—metal or wood; the choice for the duration of stake—just a year or two for not so spreading trees and about five years for perennial trees with a spread out canopy, number of stakes to use, are some important parameters to consider while staking. However, in either of the cases, the stakes must be periodically inspected and adjusted for damage prevention to the tree.

Some countries such as China, the USA, Australia, and Indonesia are extremely thoughtful about their trees. Even in Asian countries such as Thailand with a heavy international tourist footfall, people are committed to tree management. It is difficult to find any deformed or leaning tree in

this popular destination and staking is a common practice. On the roadside and in tall apartments trees are cared for and as a result, the landscape is extremely aesthetic. Another practice seen in these countries is to provide protection to specific trees such as palms. Thailand with its beautiful beaches has majestic





tall palms which stand straight and add to the beauty of the beaches and the resorts. These trees play a significant role in the lives of animals such as squirrels. The rodents may live year-round on the palms, eat the fruits, consume phloem sap, and also get protection from predators. In the process, the palm stem (or trunk) surface may get damaged and tear up making the tree prone to infection. To check this, the palm plantations are provided with baffles which may be metal bands or ropes of plant origin that are wrapped around midway up a tree trunk, a practice that is not only affordable but also harmless to the tree. The primary function of baffles is to discourage critters (and rodents) from climbing and nesting on top.

Delhi has quite a few environmentalists and tree and nature lovers who breathe greenery and inspire

others to do the same. Delhiites must be familiar with the names and activities of the “Nest Man,” Mr Rakesh Khatri, and environmental activist Mr Verhaen Khanna. While the Nest Man is striving to bring sparrows back to nest in the city, Mr Khanna is a nature crusader passionately correcting “tree blindness” among residents. He started a New Delhi Nature Society which is deeply involved in mobilizing and sensitizing children, adults, and the elderly to tree plantation, nature walks, tree census, bird watching, tree-hugging, nature awareness, and composting. Others like Swami Prem Parivartan, popularly known as Peepal Baba, Pravin Mishra, Ms Anubha Jain, Mohammad Sarfaraz and Ms Ranju Minhas are working passionately towards greening Delhi. With several clubs, societies and groups headed by such efficient nature lovers who are tirelessly

working in the city, it should not be difficult to lend a healing touch to our ‘care givers’.

The schools are doing their share of responsibility by inculcating in children, respect for trees but Delhi needs each one of us to join the mission. It is time for Residents’ Welfare Associations and the common man to come forward, adopt the trees, and provide necessary support to the saplings planted in the area. Let us propagate the idea that it is not only tree plantation that can save the city from pollution and climate change but tree correction is the thrust area that needs to be looked into seriously and devotedly. Help the trees to grow straight and strong and they will challenge the Monsoon 2024! ■

Dr Inderdeep Kaur, Professor in Botany, Sri Guru Tegh Bahadur Khalsa College, University of Delhi, Delhi.

Bizarre Facts



1. The shortest war in history lasted only 38 minutes.
2. You travel 2.5 million km (about 1.5 million miles) a day around the sun.
3. Bees can get drunk on fermented tree sap.
4. There are more possible variations of a game of chess than there are atoms in the known universe.
5. One cloud can weigh more than a million pounds.
6. The first alarm clock could only ring at 4 a.m.
7. Your brain is constantly eating itself.
8. Research has found that the average human is around 56 per cent bacteria. Wow!
9. Bees may fly up to 60 miles in one day.
10. Animals can be allergic to humans.



Did You Know?

- Human teeth are the only part of the body that can't heal themselves.
- The smallest bone in the human body is the stapes bone in the ear.
- Wearing a tie can reduce blood flow to the brain by 7.5 per cent.
- A group of pugs is called a grumble.
- A group of flamingos is called a "flamboyance."
- Honey never spoils.
- Hippopotamuses can't swim.
- Your nails grow faster in the summer.
- You'll more likely remember your dreams better after a bad sleep than a good one.
- "Stewardesses" is the longest word that is typed with only the left hand.



Source: <https://www.weareteachers.com/weird-fun-facts/>

Solartive Forays into Power Transmission

Aims to Foster Robust Development Across Jharkhand

Solartive Techno Industries Pvt. Ltd has secured a tender for developing a transmission line awarded by the Jharkhand Bijli Vitran Nigam Limited (JBVNL) for electrification of un-electrified habitations/Tolas/households of rural and urban areas under Mukhyamantri Ujjawal Jharkhand Yojana. This landmark project represents a significant stride towards bolstering the state's infrastructure and driving economic growth. The tender focuses on enhancing the power transmission infrastructure and supporting various sectors, including residential, commercial, and agriculture. By improving the efficiency and reliability of power distribution, this project aims to foster robust development across Jharkhand, benefiting local communities and industries.

The successful implementation of this transmission line project will significantly enhance Solartive's contribution to Jharkhand's development by supporting

efficient energy distribution and fostering economic growth. With their extensive experience and dedication to green energy, Solartive Techno Industries is well-positioned to make a profound impact on the state's infrastructure and overall development.

While shedding light on the impact of this transmission project, Mr Fayyaz Ashraf, Managing Director of Solartive Techno, stated, "We are well-aligned with Jharkhand Government's progressive vision for inclusive development. Being the backbone of modern infrastructure, the energy sector has to play a pivotal role in supporting agriculture, industries, and local communities. We have a successful track record of accomplishing such projects, and we will replicate the same level of commitment once again."

Over the years, the company has successfully implemented various ESCO, Solar, IoT-based IT, and infrastructure projects under various central and state

government initiatives such as Jal Jeevan Mission, PM-Kusum, Panghat Yojna, etc. Through this latest development, Solartive reaffirms its commitment to delivering value through innovative products and services, driving the adoption of green energy solutions and contributing to a sustainable future for Jharkhand.

About Solartive Techno

With its decade and a half-old legacy, Solartive Techno Industries Pvt. Ltd, is a top-notch water infra and management company in India. Currently, it is managing the water supply of 1,00,000+ villages and 20+ cities across the country through a team of 1000+ professionals, innovative use of technology, renewable energy, and efficient management skills. As a reputed manufacturer of solar pump sets, it has a fabrication capacity of 1000 tonnes a month.

Solartive has a proven track record of accomplishing targets by being firm on its business values, embedded with honesty, dignity, and transparency. From its registered office in Ranchi, Solartive's leadership team seamlessly manages the solar water pump units in Greater Noida, the fabrication plant in Ranchi, and more than ten service centres in Jharkhand, Rajasthan, and Madhya Pradesh.

With a well-illustrated vision to make infrastructure smart and efficient, as well as clean water and electricity accessible to all, Solartive's R&D team is constantly working on developing innovative solutions with improved product quality and design. ■





NASA Data Shows July 22, 2024 was Earth’s Hottest Day on Record

July 22, 2024, was the hottest day on record, according to a NASA analysis of global daily temperature data. July 21 and 23 of this year also exceeded the previous daily record, set in July 2023. These record-breaking temperatures are part of a long-term warming trend driven by human activities, primarily the emission of greenhouse gases. As part of its mission to expand our understanding of Earth, NASA collects critical long-term observations of our changing planet. “In a year that has been the hottest on record to date, these past two weeks have been particularly brutal,” said NASA Administrator Bill Nelson. “Through our over two dozen Earth-observing satellites and over 60 years of data, NASA is providing critical analyses of how our planet is changing and how local communities can prepare, adapt, and stay safe.”

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

Scientists and Climate Change: Extreme Concern and High Level of Engagement

Scientists from across academic disciplines are extremely concerned about climate change. Many of them have already changed their own lifestyles or engaged in advocacy and protest, with even more being willing to do so in future. This is evident from a large-scale survey of scientists from all over the world, conducted by an international research team led by the University of Amsterdam. The researchers not only looked at the views of scientists and the extent to which they are engaged in climate action, but also at how the involvement of scientists with climate change can be increased. The research was published on Monday, August 5, in the journal *Nature Climate Change*. Scientists are well placed to help tackle climate change beyond conducting academic research. However, little is known about their wider engagement with the issue.

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



To know more... Read



ISBN: 9788195077687

POLLUTION SOLUTIONS FOR A CLEANER, GREENER EARTH

Urmi A Goswami

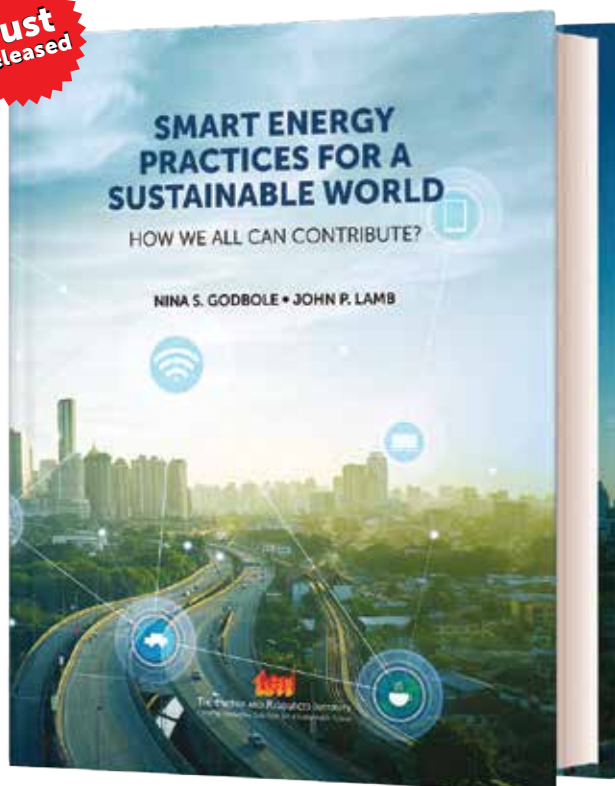
We are living in a fast changing world. Pollution of natural resources, such as air, water, and land is one of the biggest banes of our times. Under such precarious circumstances, it is needed that the young generation is not only made aware about the different kinds of pollution but also about the solutions. 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](https://www.amazon.in) [flipkart](https://www.flipkart.com) [amazon kindle](https://www.amazon.com/kindle) [Google play](https://play.google.com/store/books) [teri bookstore](https://www.teribookstore.com)

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- Worldwide Case Studies for Green Practices

ISBN: 9789394657113 • Price: ₹1195.00

This book stresses the need for us to judiciously, sustainably, and smartly harness and use energy techniques in order to effectively combat climate change. The book also gives an in-depth discussion on utilization of artificial intelligence and information technology to realize energy efficiency in various sectors of economy including such as transportation, buildings, infrastructure, health care, and other services.

Text is supplemented by case studies that depict ground-level reality to facilitate comprehension of the subject matter. The appendices serve as an extended learning of the concepts discussed in the chapters. The publication would serve as a valuable reference for both scholars and researchers engaged in the domain, in addition to, being a guide to industry and the academic world.

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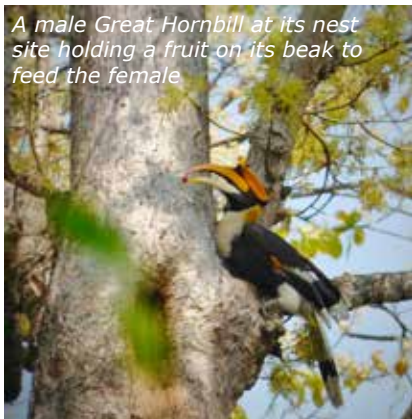
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A Summer with the Hornbills

My Journey in Conservation

The article describes **Dr Arkajyoti Shome's** experience observing Indian grey hornbills and recounts his work on hornbill conservation. The author details the challenges of locating hornbill nests, often relying on local intel and tracking male birds. A notable success was finding a Rufous-necked hornbill nest. The author explains the hornbills' crucial role in seed dispersal and forest rejuvenation, highlighting their ecological importance.

As I stood down below the Gulmohar tree observing a pair of Indian grey hornbill, a middle-aged man prompted while completing his evening walk, "I see this big bird often near this tree; I think they like this tree and its flowers," and continued walking. Well, the man was right on one of the counts; the hornbill liked the tree not because it had flowers but because there was a cavity in the tree. Well, it's early summer now and it's breeding time for the hornbills. Hornbills are secondary-cavity nesters who can't make their nest cavity but have to rely on cavities on the trees formed due to natural phenomena (rotting of the trunk, fallen branches, etc.).



A male Great Hornbill at its nest site holding a fruit on its beak to feed the female

As I stood there observing the pair, I remembered that I had time to travel back to the year 2018 when I was in Buxa TR working on hornbill conservation in the landscape. My field partner Sitaram and I had come across multiple such nests of hornbills during our field days. For our research on hornbill breeding biology, we needed to identify multiple such nests and conduct nest watches (observing the nest for substantial hours every week during the breeding cycle, which varied from 3–4 months, depending upon hornbill species). The challenging part of this job was not observing the nest for such a long time but finding a nest in the first place.

Nest searches would take days and sometimes weeks. Occasionally, we would receive intel about a nest from a local forest guard or a villager, and in some cases, we would have to track the birds ourselves. Before the start of nesting season, tracking would often be an easier task, as the pairs would often stick around the probable nest for most of the day. They would have courtship rituals and clean the nest, which would give a brief idea that the nest is somewhat nearby. However, after the onset of nesting, it becomes challenging. In that case, we would often have to

track a solitary male and its direction of movement from one point to the next for a couple of days. The reason for such a modus operandi is that after the onset of nesting season, the female partially seals herself within the cavity, and it's the responsibility of the male to feed the female at least 5–6 times a day. Most of the time, these nests are at conspicuous locations to avoid attention, but given the lack of resources (i.e., the optimal size of the secondary cavity, competition within and among hornbill species), sometimes, they often nest in areas which are near anthropogenic activities.

I remember one such interesting nest. In the initial months of the nesting season, Sitaram and I had already tracked down the nest of three species of hornbills (Great Hornbill, Wreathed Hornbill, and Oriental Pied Hornbill) either by tracking the male bird (as it ferried the food) or with the help of villager. But we were unable to track any nest of the elusive and vulnerable Rufous-necked Hornbill.

We had spread ourselves in the region for the search and visited every location that we had been tipped off. Until we were informed by a tourist guide that a male Rufous-necked hornbill was spotted near the river bank, a well-

known tourist spot. Following the tip, we remained vigilant for the next few days in that region. While snacking on some creamy biscuits and roasted peanuts for hours, we used to stalk the male bird as it flew to and fro across the banks, occasionally getting hidden in the dense vegetation across the banks. Adding to our agony were the tourists who crossed that area on their way to the tourist spot were eccentric, looking at these two guys in their mid-twenties sitting by a secluded spot involved in some 'suspicious' activity! This routine continued for the next three days, but we knew it was a game of patience before the male bird led us to his nest. Luckily, the wait was not long enough as, on the fourth day, early morning, just a couple of minutes after sunrise, the male Rufous-necked hornbill emerged from the adjacent hilltop and swooped into a tree cavity opposite to us. As I saw the male swooping inside the cavity, it was a 'eureka' moment for the team.

While I stood there recalling this moment, a voice echoed, "Hey, you are still here!" and I was brought back from my time travel to bustling Delhi again. It was the same person who spoke to me while on his evening rounds, and this time, he didn't pass by but stood there for a couple of seconds and asked—"why are you watching them so patiently? Apart from looking attractive, what speciality do they have?" I smiled at him



The 'particular' male Rufous-necked Hornbill from the story, perching on a trunk in front of its nest. Image courtesy: Arkajyoti Shome

and shared a quote I had heard from Dr Aparajita Datta, a prominent ecologist who has been working on hornbill conservation for the past three decades and who was also my supervisor when I was working on hornbill conservation. She told me that hornbills are noted as 'farmers of the forest'. They disperse the seeds of fruiting trees they feed on across the landscapes, which help in the growth and rejuvenation of the forest landscapes. Studies have shown that some of the hornbill species can disperse the seeds as far as 25 km away from their parent tree, spreading the forest land as far as they can. Hearing this, the person expressed that he never expected such

an important role this bird has in this ecosystem, and he remarked, "I hope they can survive ongoing human and weather atrocities" and he glanced away with his evening walk. In this context, Dr Datta and her team have been working in the northeast Indian landscape, implementing community conservation initiatives with the support of various local stakeholders to support the conservation of these birds. However, regarding climate or weather atrocities, I am not sure because recent reports and observations from Africa and India have highlighted anomalies in hornbill nesting in the last couple of years and a reduction in successful breeding attempts. Time and substantial data are needed before concluding how weather changes will impact these magnificent and important birds.

While I gazed at the Gulmohar with this gloomy notion, the hornbill pair flew off to their roosting site for the night, a silent reminder of the resilience of nature and the enduring hope for a brighter future. ■

Dr Arkajyoti Shome, Research Associate, Centre for Resource Efficiency and Governance, TERI. He is Commission Member: IUCN CEM Wetland Specialist Group and IUCN SSC Hornbill Specialist Group.



The landscape around the nest site. Image courtesy: Sitaram Mahato

Vegetarian and Vegan Food Movement in India

Aligns Perfectly with the “Go Green” Mantra

The “Go Green” movement in Indian metros is a powerful testament to the evolving food preferences driven by health, environmental, and ethical considerations. In this article, **Manu Shrivastava** says restaurants and food outlets are setting new standards for culinary innovation and sustainability. With continued education, advocacy, and support from technological advancements and government policies, the future of vegetarian and vegan diets in India looks promising. This transformation not only enhances individual health but also contributes to a more sustainable and compassionate world.

The world is witnessing a sharp rise in consciousness regarding health issues related to diet, prompting consumers worldwide to seek healthier food choices. India has not been left behind in this global trend, as more people from urban centres start choosing vegetarian and vegan options over meat-based foods due to increasing awareness of their health benefits. Restaurants and food outlets across the country have responded by shifting their focus towards plant-based dishes, contributing significantly to the evolving landscape of Indian cuisine.

Global studies indicate that consumption of processed meats increases cancer risks while consuming

fruits, vegetables, grains, legumes, nuts, and seeds decreases the risk levels. People are now realizing these facts, leading them to incorporate more fresh produce into their diets. In line with this international movement, many Indian consumers are also seeking alternatives to animal products for environmental reasons or ethical considerations tied to animal welfare. As awareness grows among Indians about the negative impacts of meat consumption, it creates demand for healthy alternatives like vegetarian and vegan food options.

Recognizing this emerging market opportunity, numerous restaurants in Indian cities are expanding their menus to include more vegetarian and vegan

items. Major fast-food chains have launched several vegetarian variants of popular menu offerings in major Indian cities. Additionally, local cafes, fine dining establishments, bakeries, street food vendors, and traditional Indian restaurants are incorporating plant-based ingredients into their dishes, catering to diverse dietary preferences.

One of the primary motivators driving consumers' interest in plant-based eating is the realization of its associated health advantages. Studies show that individuals following vegetarian or vegan diets tend to experience lower rates of heart disease, hypertension, diabetes, and obesity than those who consume meat regularly. Moreover, vegetarian and vegan food options generally contain fewer saturated fats and cholesterol compared to meat-based meals. This realization influences customers' decisions when selecting meal options at restaurants and grocery stores alike.

The flurry of all-vegetarian cake shops across Mumbai bears testimony to the recent trend in favour of vegetarianism. “Here, if I have to buy something, whether a pastry or a puff, I know that there'll be no egg in it. I won't need to ask to check every time I buy anything from here,” says regular buyer, Chandni

Go Green Nursery. Picture credit: Manu Shrivastava, 'The Draft'



Goel. So, from “egg-less” cake and pastry options available in shops, they’re all egg-less and vegetarian to boot now. The stretch from Chowpatty at the fag end of Marine Drive all the way down till Nariman Point, is all vegetarian. “It’s much easier that way for us vegetarians who don’t need to worry if an item contains egg or not,” adds Chandni, “for the other non-vegetarians, there are options aplenty all over the city.”

Yet, despite the growing trend, there are still challenges faced by businesses trying to accommodate plant-based needs amidst changing consumer habits. Infrastructure limitations pose obstacles for small vendors and rural areas where sourcing fresh fruits and vegetables can be challenging. Furthermore, navigating complex regulatory frameworks surrounding food labelling poses difficulties for manufacturers looking to provide transparent information about their product ingredients. Educating consumers further on the nutritional value and benefits of plant-based eating will play a critical role in solidifying this trend nationwide.

While India continues to embrace modern lifestyles influenced by western cultures, awareness around



Go Green Nursery owner Bharat Soni.
Picture credit: Manu Shrivastava, 'The Draft'

health concerns sparks greater attention towards personal wellness and sustainable living practices. This paradigm shift presents exciting opportunities for restaurateurs, retailers, and suppliers to innovate and expand their offerings accordingly. Ultimately, promoting healthier food choices through increased access to vegetarian and vegan options contributes positively to both individual well-being and ecological sustainability—two essential factors crucial for humanity’s continued survival. As our understanding deepens concerning the importance of good food for healing and bad food for killing, we anticipate ongoing growth and evolution

within India’s gastronomic landscape shaped by informed consumer behaviour.

The mantra ‘Go Green’ has gained substantial traction, reflecting a growing preference for preservative-free, natural vegetarian, and vegan food options. This trend is reshaping the culinary landscape, influencing restaurants, food outlets, and even weekend resorts. Go Green Nursery owner Bharat Soni, who also runs a pure-veg restaurant Pantree in Panvel, Maharashtra on the Mumbai–Goa Highway says, “Vegetarianism is in vogue these days and more and more people are making a statement by adopting a vegan or vegetarian diet. Here, in Panvel, situated in the Konkan–Malvan belt, non-vegetarian food has always been the primary food choice which leaves the vegetarian-eating visitors with no option as they prefer to eat in restaurants that are offering pure-veg food only. So, we offer authentic homely food and pure vegetarian food, and the demand is only increasing by the day.”

Today, as more and more people are facing health problems, the role of food and diet cannot be emphasized enough. “Vegetarian food is not only more sustainable environmentally but there are several health benefits to boot too,” says Mr Soni as he plucks fresh *doodhi*, *bhindi*, cucumber and *turai* from his home-grown garden at Go Green.

Recent studies and surveys indicate a marked rise in the number of Indians opting for vegetarian and vegan diets.



According to a report by Euromonitor International, the Indian packaged vegan food market is expected to grow at a compound annual growth rate (CAGR) of 10 per cent from 2021 to 2026. This surge is driven by increased health consciousness, environmental awareness, and ethical considerations regarding animal welfare.

A 2023 survey by French Market Research Company Ipsos found that 63 per cent of urban Indians are willing to reduce their meat consumption, with 34 per cent expressing a strong preference for vegetarian or vegan food. Additionally, a study by the Vegan India Movement highlighted that nearly 1.5 million Indians identified as vegan in 2022, a significant increase from previous years.

Responding to this shift, many restaurants and food outlets in Indian metros are revamping their menus to cater to the growing demand for vegetarian and vegan options. Popular chains such as Sattviko, which offers a range of traditional Indian snacks with a healthy twist, and eateries like The Bombay Canteen, which emphasizes locally sourced vegetarian ingredients, are thriving.

High-end restaurants are also embracing this trend. For instance, Delhi's renowned Indian Accent now offers an extensive vegetarian tasting



menu, and Bengaluru's Green Theory is celebrated for its diverse vegan menu, featuring dishes made from organic and locally sourced ingredients.

The trend extends beyond urban eateries to weekend resorts and wellness retreats. Places like SwaSwara in Gokarna and Ananda in the Himalayas have integrated vegetarian, gluten-free and vegan cuisine into their wellness programmes. These resorts focus on holistic health, combining yoga, meditation, and spa treatments with plant-based diets to offer a comprehensive wellness experience.

The shift towards vegetarian and vegan diets is driven by multiple factors.

Health benefits such as lower risks of heart disease, diabetes, and certain cancers are significant motivators. A study published in the *Journal of the American Heart Association* found that plant-based diets can reduce the risk of cardiovascular diseases by up to 16 per cent.

Environmental concerns also play a crucial role. The United Nations' Food and Agriculture Organisation (FAO) reports that the livestock sector is a major contributor to greenhouse gas emissions, deforestation, and water pollution. By adopting vegetarian and vegan diets, Indians are contributing to a reduction in their carbon footprint, promoting sustainability.

The "Go Green" movement is more than just a passing trend in Indian metros; it represents a fundamental shift in how people perceive food and its impact on health and the environment. As more Indians embrace vegetarian and vegan lifestyles, the food industry is adapting to meet this demand, offering healthier, more sustainable, and ethically conscious options. This transformation not only benefits individual health but also contributes to a greener, more sustainable planet.

Despite the positive momentum, the vegetarian and vegan movement in India faces certain challenges. One





significant hurdle is the perception that plant-based diets lack adequate nutrition, particularly protein. Addressing this concern, nutritionists and dietitians are increasingly advocating for balanced vegetarian and vegan diets rich in legumes, nuts, seeds, and fortified products to ensure comprehensive nutrition.

Accessibility and affordability are also critical issues. While metros have been witnessing a proliferation of vegetarian and vegan options, smaller cities and rural areas may not have the same access. Efforts to make these diets more affordable and widely available are essential for broader adoption.

Education and advocacy play crucial roles in promoting vegetarian and vegan diets. Organizations like the Vegan Outreach India and Sharan India are working tirelessly to spread awareness about the benefits of plant-based diets. They conduct workshops, cooking classes, and public seminars to educate people about nutritional balance and the environmental impact of their food choices.

Social media influencers and celebrities are also significant drivers of this change. Public figures such

as Virat Kohli, Anushka Sharma, and Sonam Kapoor, who openly advocate for vegetarian and vegan lifestyles, inspire millions of followers to consider these dietary choices.

The rise of vegetarian and vegan trends is further fuelled by technological innovations in food production. Start-ups in the plant-based food sector are developing alternatives that mimic the taste and texture of meat and dairy products. Companies like GoodDot and Imagine Meats are leading the way in India, creating plant-based meat products that cater to traditional Indian tastes.

Moreover, the advent of plant-based dairy alternatives, such as almond milk, soy milk, and coconut yogurt, provides consumers with a variety of choices that cater to their dietary preferences without compromising on taste or nutrition.

Government policies and support can significantly impact the growth of vegetarian and vegan diets. Initiatives that promote organic farming, subsidies for plant-based food production, and awareness campaigns about sustainable eating can accelerate this shift. In some states, school meal programmes are already incorporating more plant-based

options to instil healthy eating habits from a young age.

The “Go Green” movement in Indian metros is a powerful testament to the evolving food preferences driven by health, environmental, and ethical considerations. As the demand for preservative-free, natural vegetarian, and vegan food continues to rise, it signals a broader shift towards a more conscious and sustainable way of living.

Restaurants, food outlets, and weekend resorts are not only responding to this demand but also setting new standards for culinary innovation and sustainability. With continued education, advocacy, and support from technological advancements and government policies, the future of vegetarian and vegan diets in India looks promising. This transformation not only enhances individual health but also contributes to a more sustainable and compassionate world, aligning perfectly with the “Go Green” mantra. ■

Manu Shrivastava is a journalist and lawyer with DraftCraft International. She writes widely on environment, climate change, women laws, and policy perception. This article first appeared on 'The Draft' here: <https://tinyurl.com/3ks76tns>

Yoga for Sustainable Living

A Holistic Approach to Environment Conservation

The UN International Day of Yoga is celebrated on June 21 every year. The theme for this year is "Yoga for Self and Society." Here, **N Kalyani** shares her views and ideas on how a holistic approach that integrates education, experiential learning, values and yoga can promote environment conservation and sustainable living. The ancient Indian art and science of yoga is universal and is as relevant today in the big picture.

Education is central to promoting environment conservation. This also includes the incorporation of the principles of ethics and values. All of this together can help us lead a sustainable and happy human life. What helps these

aspects work in tandem? Could the ancient Indian art and science of yoga also help?

Education by way of the education system can be a potent way to disseminate knowledge on the

environment and environment conservation among students and the youth in the formal mode of education. Then there are innumerable other ways to inform and sensitize people on how to protect and conserve our environment.



Education with regard to environment and its conservation needs to be real world and real time. Then it can be a powerful tool in meeting the purpose of protection and conservation. Similarly, education can help, in a big way, in inculcating values in children, students and youth for their day-to-day living. Education must incorporate values, both in the textbooks and classrooms, as also in its translation in the real world.

It is in this way that the means and methods of protecting our environment become practical and do-able.

Education and value inculcation is linked to creating awareness and sensitizing individuals. For instance, one does not realize the importance of water when it is flowing freely in the taps of one's house; one has to go and see the ground reality of the impact of paucity of water on humans, other life forms, and the ecosystem. Then one realizes the importance of water in life, the detrimental effect of lack of water on life, and the imperative and urgent need to conserve water and use it judiciously. Can those who have not gone and actually seen for themselves a drought-hit area indulge in wastage of water if they do have quite a liberal and generous supply of water? Here education, creating awareness and sensitization plays a role. For it can help in the conservation of water by the general public taking positive actions in the direction.

Experiential learning is a powerful means of understanding the real world in real time, and it comes from engaging in activities that enrich our lives by the values they help in developing in us. When children and youth are imbued with ethics and values the influence is broad-based, widespread, and futuristic.

Let us see how experiential learning can be useful.

For example, on nature walks we come closest to the flora and fauna of the ecosystem and appreciate the diversity and inter-connectedness in nature and the need to respect it. Or, by giving of



our time freely to inmates of an old age home, an orphanage or a hospice we appreciate the extent of human suffering and the need for kindness and compassion. Likewise, by giving of our time and resources that we can at the time of disasters whether it is a cyclone or drought, whether it is a flood or a landslide, we can discover how the small efforts of many compassionate humans can alleviate human sufferings. Or, by interacting and working with a rural community on their agricultural farms there is a realization and appreciation of how our food reaches

our malls and our tables and there is thus a respect for food and the need to consume it optimally, not waste it. Such activities and interactions therefore help in developing such values and ethics in us as respect for nature, environment conservation, compassion, simplicity, honesty, empathy, respect for others, giving dignity to others, happiness, sharing, caring, and respect for life, besides other human and humane values.

Here, it would be interesting to explore happiness as a value and the value of happiness. Happiness, we are



all agreed upon, is the goal of our life. Every human seeks happiness in life. It is a value we cherish. In fact, every life form seeks happiness. Yet our endeavours and efforts individually and collectively may not be towards enhancing happiness. For instance, increased industrialization and vehicular traffic may translate into better statistics when it comes to economic indicators and development parameters but they adversely affect the health of humans and other life forms and the ecosystems due to the lethal effluents and noxious fumes they generate. So, does it really create happiness? Happiness is also not an economic indicator. When we calculate GDP do we have happiness as one of the parameters? We don't.

Of course, in Bhutan happiness is considered an indicator, in the public domain, of well-being of the people. And so Bhutan comes out with an indicator called gross national happiness, GNH. And in India, in the state of Madhya Pradesh, the government has been

having a happiness department since a few years now. From happiness we also evolve to a state of contentment which is a vital value in moving from a life of greed to one that is need-based which is of prime importance in environment conservation and optimal and judicious resource utilization.

The values we foster and express through our activities at the individual, family, and community levels are significant. Values have their roots in our own beings, in our hearts, and find expression through the myriad activities we engage in each day. This is how we can participate in environment conservation through our day-to-day activities whether it is in terms of conserving automobile fuel, cooking gas, electricity and water or then garbage segregation and disposal or judicious use of kitchen provisions and optimal consumption of food.

We need to integrate education, values, economic development and environment conservation in a holistic

manner for sustainability. The idea of yoga comes in here. Yoga is, no doubt, a set of physical and mental practices for balance, wellness and strength as the parlance is generally understood. However, if we consider the term etymologically, and more generally, yoga or 'yog' refers to the coming together, union, blending, and melding. It is, in fact, in this very sense that yoga is practised with the aim of bringing the body, mind and soul in balance and harmony to achieve excellence. In the context of sustainability, there needs to be an alignment and blending of education, values, economic development and environment conservation with due cognizance of the real world and in real time.

As we go into the arena of yoga we find the Ashtanga Yoga, the eight limbs of yoga—yama, niyama, asana, pranayama, pratyahara, dharana, dhyana, samadhi—as expounded by the renowned and revered Sage Patanjali, (history says he is supposed to have





lived sometime during the period 2nd century BCE and the 4th century CE), who wrote the Yoga Sutras, quite apt here. The eight limbs deal with the physical, mental, emotional and spiritual life and activities of human beings. The first two of the eight limbs deal with the values and morals humans must foster called niyamas, and the traits that must be given up that are termed yamas. While the couple of limbs thereafter deal with the physical well-being of an individual, the limbs after that deal with the mental and spiritual health of a human being.

In this context it is interesting to note that various asanas and pranayamas have names related to nature, and flora and fauna. It is indicative of the traditional Indian respect, appreciation and love of nature in all its forms. For instance, there is the surya namaskar, a set of asanas named to respect the sun that is incidentally highly recommended for all round good health. Then, there are asanas like the vrikshasana, parvatasana, ushtrasana, mayurasana, matsyasana and bhujangasana that are asanas that

involve poses that resemble the tree, mountain, camel, peacock, fish, and cobra, respectively, the terms being those in the Sanskrit language. Then, vajrasana is the thunderbolt pose. In the various pranayamas there is the bhrumari pranayam which is so named as the breathing practice involves the imitation of the buzzing sound of the bee. So, in this we also see the humility in the human psyche and wisdom. As per the ancient system of yoga, there are exercises or poses for our physical and mental health that depend on doing asanas and pranayamas that actually resemble other life forms. In other words, we learn to enhance our well-being from other life forms.

The practice of dhyana, meditation, under the system of Ashtanga yoga, is able to efficiently promote human values in our hearts. By focusing our mind in a natural way, and channelizing our mental, emotional and spiritual energies, and, therefore, our physical energies and activities in an appropriate and conducive manner, meditation

can help us becoming productive and efficient as also creative and joyful. After all, distractions and pollutions affect our mental balance and equilibrium, and thus our activities and our work ethic. In fact, yoga is referred to as a practice that brings excellence to the actions we perform. When individuals are imbued with human and humane values, the synergistic effect at the levels of community and society is significant. It is observed that meditational and spiritual practices are being sought by people of all age groups in present times. This year we celebrate the 10th International Day of Yoga with the theme, given by the UN, "Yoga for Self and Society." We can turn to this ancient Indian practice, and make an attempt at its various elements. It may very well provide a sustainable way to sustainable living. ■

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

Leveraging Sustainable Practices

How Electric Vehicles are Revolutionizing Agriculture

In this article, **Raghav Arora** says electric vehicles (EVs) can play a major role in cutting down carbon emissions in the agri sector and create a safer, cleaner, and climate-conscious industry. Ensuring access to EVs for farmers is a responsibility that falls on both the Indian government and development partners, who must offer support and incentives. Facilitating the availability of these vehicles and equipment is crucial.

Creating a sustainable future demands the collective effort and collaboration of various stakeholders across sectors. While commercial commuter and passenger vehicles always face the eye of the storm from environmentalists who constantly call for cleaner energy, many industries need to align their practices and operations to the clean energy movement for sustainability and better outcomes; one of them is agriculture.

With tractors and payloads, heavy-duty ridgers, and other work and transport vehicles used on farms, agriculture and other food systems is a major contributor to global warming. In fact, agriculture and food systems, including farming practices, land use, crop and livestock production, energy consumption, and food consumption, collectively accounted for 31 per cent of anthropogenic greenhouse gas emissions in 2019, according to the United Nations Food and Agriculture Organisation.

This is enormous and creates a gap for adopting more renewable energy-powered equipment and vehicles on farms. Electric vehicles (EVs), for instance, can play a major role in cutting down carbon emissions in the agri sector and create a safer, cleaner, and climate-conscious industry.

Sustainability in Agriculture: The role of EVs in India

The surge in electric vehicle (EV) registration in India in recent years is

occasioned by a number of factors, including the need to cut down on carbon emissions and the quest for a sustainable future. Within the Indian agricultural space, which 70 per cent of its rural population depends on and makes up 15 per cent of the nation's GDP, there is a growing consciousness about the impact of conventional vehicles and equipment powered by fossil fuels. For example, there are electric tractors available that can perform the same tasks as conventional ones, including crop spraying, mowing, and harvesting, provided the appropriate attachments are used. Electric tractors operate emission-free, thus posing no threat to the environment. However, they often remain inaccessible to smallholder farmers in India and other regions worldwide.

Ensuring access to EVs for farmers is a responsibility that falls on both the Indian government and development partners, who must offer support and incentives. Facilitating the availability of these vehicles and equipment is crucial.

The significance of such initiatives lies in the potential to decrease supply chain costs in agriculture by up to 70 per cent through the adoption of EVs. Moreover, when integrated with the Internet of Things (IoT), these EVs and machines can considerably enhance efficiency and productivity.

Opportunities for EV Adoption in Agriculture and Agri-Logistics

The agricultural sector offers numerous opportunities for the adoption of EVs, spanning from agri-logistics to on-farm activities. EVs have the potential to decrease pollution and transportation costs associated with moving farm produce due to their cleaner and energy-efficient power. What's more, deploying EVs results in significantly less noise pollution compared to diesel and other fossil fuel-powered vehicles.

Added to these are energy independence, multi-purpose use, and improved performance which form other benefits of EV adoption in agriculture. This means that farmers will get more value for their effort, leading to improved livelihoods in communities and overall economic benefits. Furthermore, many governments of the world, including the Indian government, offer subsidies and incentives to promote EV adoption. The fact that this revolution is taking place in the agri sector indicates they will pay even more attention to the efforts of transforming from petrol and diesel vehicles and machines to electric alternatives.

Overall, India's vision to achieve Net Zero Emissions by 2070 is achievable if the right steps are taken. Agriculture can greatly benefit from these undertakings by effectively leveraging the advantages of green energy to enhance food security not only for India but also for the global community.

Raghav Arora is CTO & Co-Founder, Statiq, which is India's largest EV Charging Station Network. It was founded in 2019 by Akshit Bansal and Raghav to promote EV mobility and contribute to environmental sustainability.

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September 17–20, 2024

New Delhi, India

Website: <https://indiawaterweek.in/>

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New Delhi, India

Website: <https://www.ficci.in/>

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