TerraGreen

EARTH MATTERS

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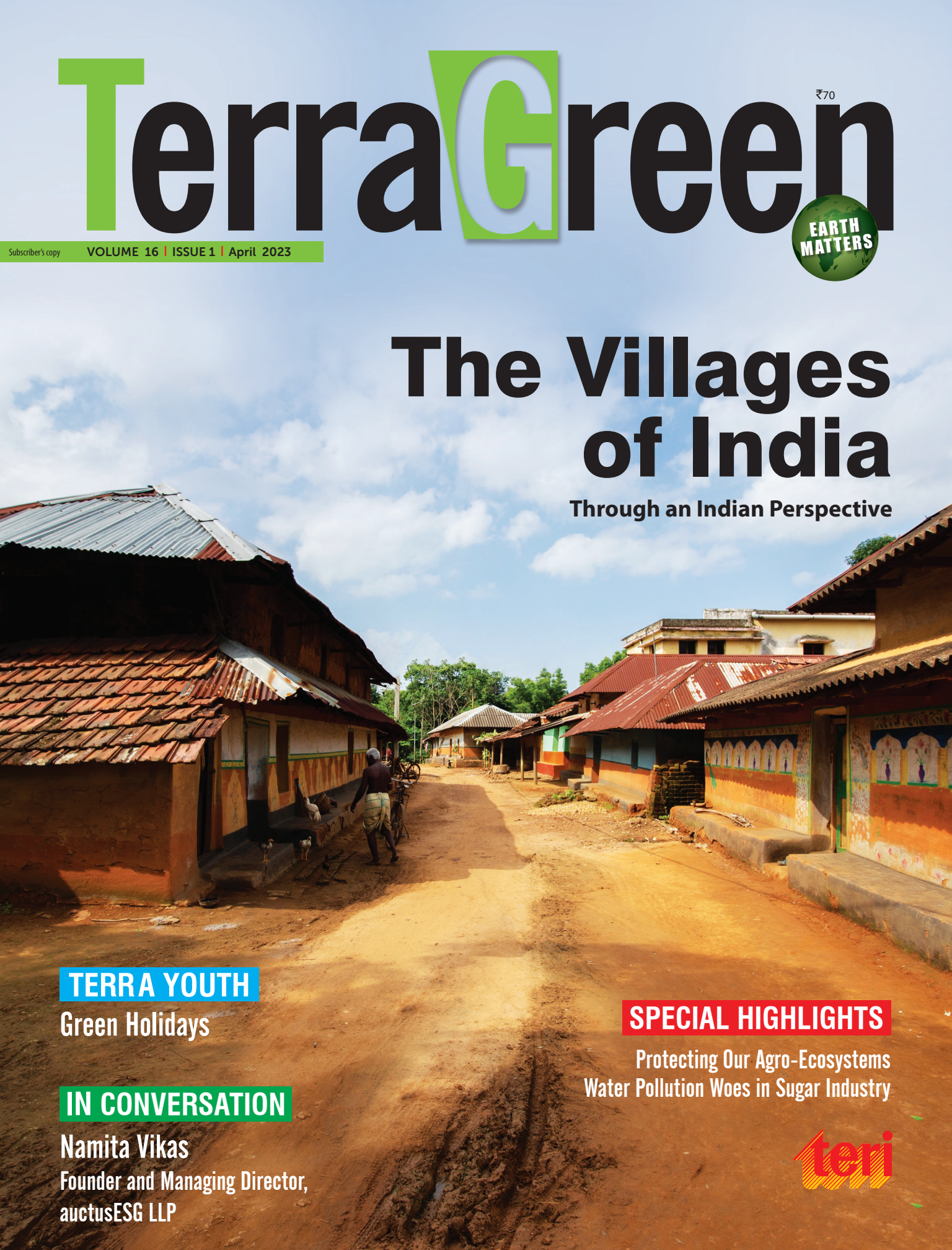
The Villages of India

Through an Indian Perspective



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Editor: Souvik Bhattacharjya, TERI, New Delhi
Frequency: Bi-annual (2 issues per year—March and September) • **Print ISSN:** 0975-7554 • **Online ISSN:** 0975-7562
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Primarily due to high population density, many regions of the continent face severe problems of water pollution on local as well as regional scales and these have to be tackled with a pan-Asian approach. However, the available literature on the subject is generally based on research done in Europe and North America. Therefore, there is an urgent and strong need for an Asian journal with its focus on the region and wherein the region specific problems are addressed in an intelligent manner.

Exclusive distribution

Editor: Dr. V Subramanian, Jawaharlal Nehru University, New Delhi
Frequency: Bi-monthly (6 Issues per year—January, March, May, July, September, November) • **Print ISSN:** 0972-9860
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Mycorrhiza News provides a forum for the dissemination of scientific information on mycorrhiza research and activities; publishes state-of-the-art papers from eminent scientists; notes on important breakthroughs; provides brief accounts of new approaches and techniques; publishes papers compiled from its RIZA database; provides information on forthcoming events on mycorrhiza and related subjects; lists important research references published during the quarter; and highlights the activities of the Centre for Mycorrhizal Culture Collection.

Editor: Dr. Mandira Kochar, TERI, New Delhi.
Frequency: Quarterly (4 Issues per year—April, July, October, and January) • **Print ISSN:** 0970-695X • **Print ISSN:** 0970-695X
Subscription rate: **Print+Online** – ₹500/$119 • **Online** – ₹240/$85

TerraGreen

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

Frequency: Monthly (12 issues per year) **Print ISSN:** 0974-5688
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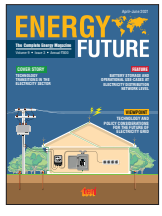

Energy Future

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
Subscription rate: **Print+Online** – ₹800/$80
(Free access to online archives of over 12 years)

TERI Energy & Environment Data Diary and Yearbook

A TERI Publication

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

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

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

The Energy and Resources Institute
Attn: TERI Press
Darbari Seth Block
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EDITORIAL

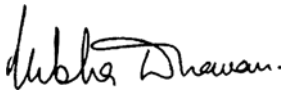
> "Gandhiji's thoughts and understanding of the village were essentially based on the connection he shared with the community, as he found the soul of India in her villages."

The complexity of the village and rural society systems in India has been historically misread and misconstrued. There is a need for a new tradition of scholarship which understands the village systems at the conceptual and theoretical levels. Agriculture, peasantry, land use, social systems and infrastructure, and indigenous technical knowledge systems need a more profound understanding of structural-functional and comparative analysis approaches.

Our cover story this month focuses on the villages of India through an Indian standpoint. It draws attention to Mahatma Gandhi's book *Gram Swaraj,* in which he explains the idea of a self-reliant village. His concept of *Gram Swaraj* is considered one of the most excellent models, focusing primarily on the development of the individual without compromising the integrity of the society and developing a self-sustainable economy. Gandhiji's idea of development focused on the flow of dependency from village to town and not vice-versa; he laid stress on the use of technology, but not compromising on traditional knowledge, skills, and art forms. Gandhiji's thoughts and understanding of the village were essentially based on the connection he shared with the community, as he found the soul of India in her villages. Gandhiji was critical of entrusting the central government with maximum powers and fought for the decentralization of powers.

Rural society has undergone rapid changes in the 21st century. It continues to undergo substantial changes; the agrarian society has transformed from a subsistence-based one to a market economy, with rapid modernization and the use of technology for agrarian and non-agrarian purposes. The abolition of the intermediaries and the emergence of associations and institutions having close linkages with urban and national organizations has led to significant changes in the current rural landscape. Rural and urban landscapes could consequently be a clash of ontologies. This gap needs to be bridged in the most sensitive manner possible, not just through blindly imposing the concept of development upon the villages, but by understanding the perspective of the primary stakeholder.

With this cover story and other articles of current interest, we hope that you enjoy reading this issue of *TerraGreen*. We do look forward to receiving your feedback and letters.



Vibha Dhawan
Director-General, TERI

I liked reading the special WSDS issue of *TerraGreen*. Articles on India's leadership at G20 are very succinct. It is true that India is a prominent member of the Global South and is proactive on expanding clean energy, but is also pragmatic on the balance needed for a Just Transition away from fossil fuels. India understands and is living the principle that even though the climate crisis necessitates a rapid retreat from coal, oil and natural gas, the transition to clean alternatives need not foment economic uncertainty. As developed countries are forced to tackle rising energy costs and buy expensive gas supplies after Russia's invasion of Ukraine, the rest of the developing countries have also been scrambling for expensive gas, leaving some countries with high gas prices, high inflation and domestic turmoil. The shock to the global energy system last year has shown that large-scale energy imports and carbon-intensive systems are not conducive to nimble, future-ready economies.

Rahul Chopra
Kolkata, West Bengal

I liked reading the article on Hariyali Gram and LiFE Movement of India. The authors are correct to say that India's 'Lifestyle for the Environment (LiFE) Movement,' announced at COP26 in Glasgow, aims to propagate sustainable lifestyles based on traditions and values of conservation and moderation. Rural women-led programmes in implementing renewable energy and climate-friendly solutions can support the LiFE movement and India's pledge towards a net zero carbon economy by 2070. Both initiatives are closely interlinked with empowerment of women and communities, focusing on energy security and sustainable consumption and use of resources. As India transitions to fossil-fuel-free sources of energy, distributed renewable energy (DRE)—when energy is generated from renewable energy sources near the point of use, and climate-friendly solutions are vital and can also help support both the LiFE movement and the net zero initiative.

Aakanksha Mohan
New Delhi

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

Regional centres
Southern Regional Centre
TERI, CA Site No. 2, 4th Main, 2nd Stage
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Tel: 0832-2459306, 2459328
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India Records 200 More Tigers Since Last Estimate in 2018

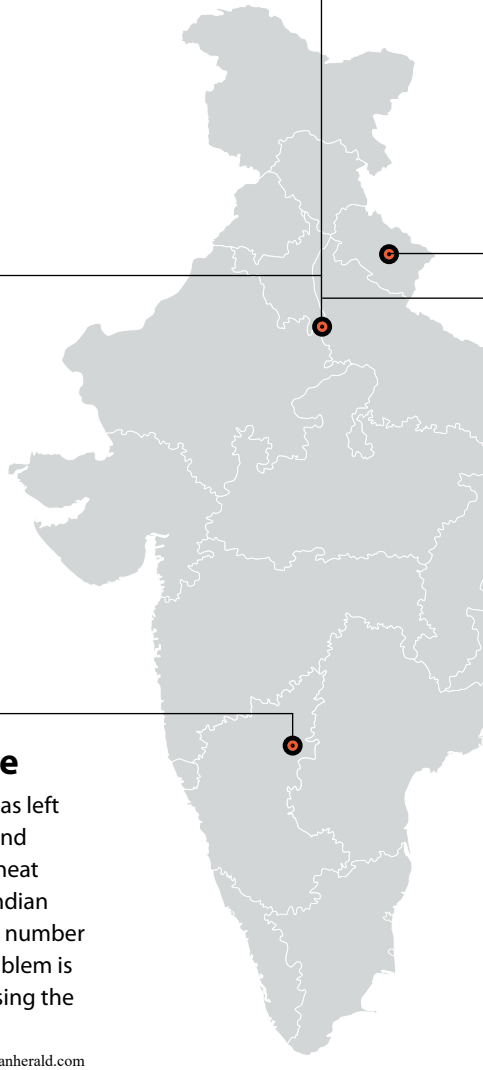
India recently reported a minimum presence of 3167 tigers in the wild—200 more since the 2018 estimate—with Prime Minister Shri Narendra Modi announcing a part of the results of the 2022 all-India tiger estimation, an exercise that provides an update on the status of tigers and the prey base in 53 tiger reserves spread over 75,000 sq. km area. "India is home to 75 per cent of the world's tiger population in the 75th year of Indian independence. The tiger reserves in India cover 75,000 sq. km of land and in the past ten to twelve years, the tiger population in the country has increased by 75 per cent," the Prime Minister said.

Source: https://www.deccanherald.com

Sixty-three Per Cent of Waterbodies in Yamuna Floodplain Dry

A Centre for Science and Environment report has said that 63 per cent of Delhi's wetlands and waterbodies in the Yamuna floodplain are dry. The 'State of India's Environment Report 2023' stated that loss in waterbodies makes the city prone to floods. Three major floods have occurred in the city since 2000. The report added that the climate resilience of cities is hampered by frenetic construction, diminishing green spaces, polluted air and water as well as indiscriminate disposal of solid waste that chokes waterbodies and the stormwater drainage network. "This leaves urban areas vulnerable to the growing heat stress, flooding and deteriorating air and water quality. Cities need to start planning for resilience to minimize the impact of the changing climate and compromised quality of life," the report said.

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



Bengaluru Faces Mosquito Menace due to Climate Change

The alarming spike in the number of mosquitoes over the last few weeks in March-April 2023 has left residents in Bengaluru city and resident welfare associations in a tough spot. The key areas in and around the city and especially on the outskirts along Outer Ring Road are currently facing the heat of the mosquito menace. According to a report in *The Times of India*, entomologists from the Indian Institute of Horticultural Research (IIHR) and other institutes attributed the sudden spurt in the number of mosquitoes to the changing climatic patterns in and around the city. Though mosquito problem is a real hassle around the time of monsoon season, the abnormal increase in their number is posing the threat of a possible outbreak of vector-borne diseases like malaria, dengue, and chikungunya.

Source: https://www.deccanherald.com

India Can Lead the World in Carbon Sequestration

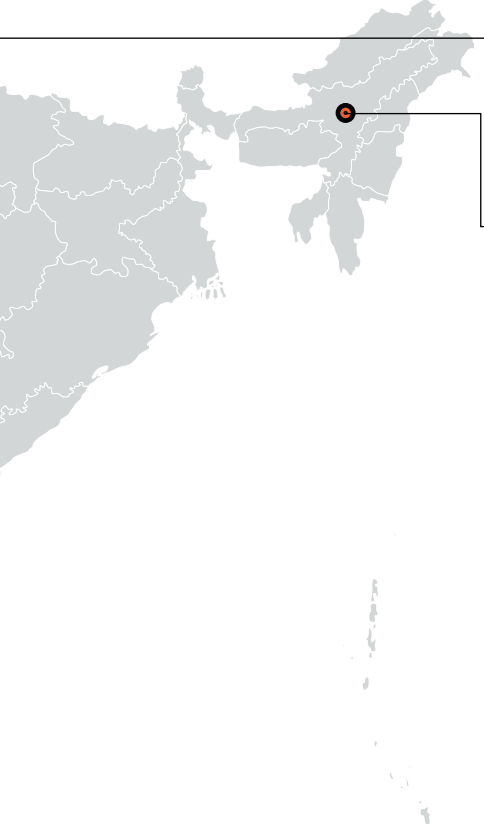
The recently released Intergovernmental Panel on Climate Change report—the *AR6 Synthesis Report: Climate Change 2023*—revealed an uncomfortable truth: The world is not on track to achieve net-zero emissions by 2050 needed to keep the planet from warming beyond a liveable 1.5°C. Since the Paris Agreement in 2015, carbon dioxide (CO_2) emissions from fossil fuels have increased every year except in 2020 (due to the pandemic-induced lockdown), and average about 36 billion tonnes per year. To substantially reduce atmospheric CO_2 requires emulating or speeding up natural processes. India has vast natural resources and can lead in developing and implementing nature-based solutions to remove atmospheric CO_2. Such solutions will help India catch up and exceed its Nationally Determined Contributions pledged in the Paris Accord.

Source: https://epaper.hindustantimes.com/

SUN Mobility to Power 50,000 Electric Two-Wheelers of Zomato's fleet

Electric vehicles energy infrastructure and services provider SUN Mobility recently said it has entered into a partnership with online food delivery platform Zomato to power 50,000 electric two-wheelers of the latter's fleet over the next two years. Under the partnership, SUN Mobility will provide its battery swap solutions for last-mile deliveries with the initial fleet deployment to start in the National Capital. Through this association, the last-mile delivery partners onboarded on Zomato's platform will benefit from convenient and cost-effective battery swapping solutions for their e-2Ws (electric two-wheelers), the company said in a statement.

Source: https://economictimes.indiatimes.com/



Companies Now Count Carbon in Travel, Hotels

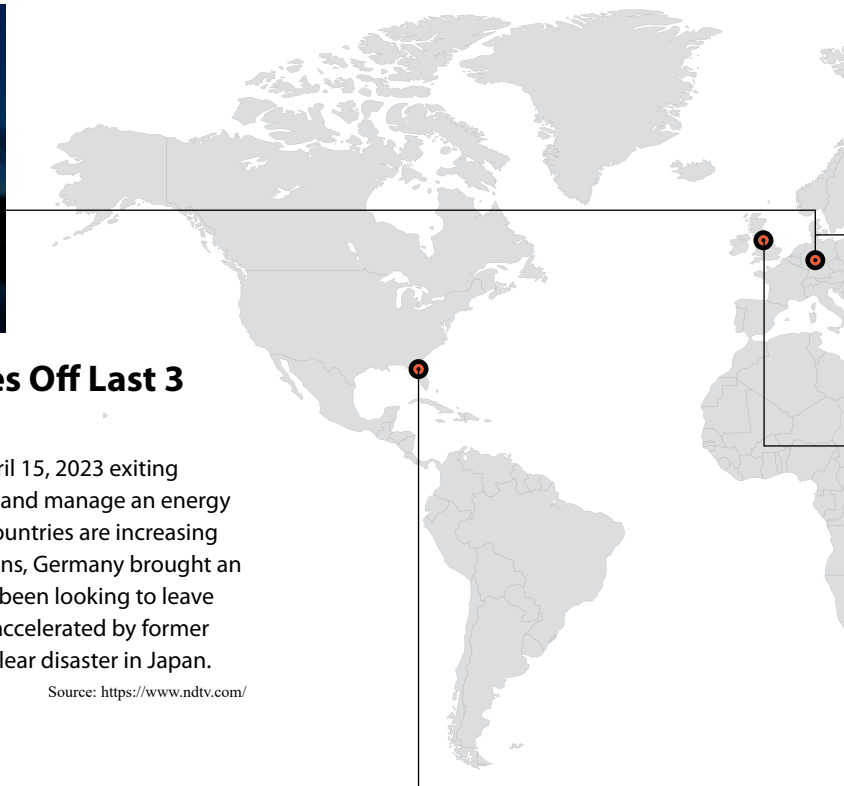
Indian companies are embracing environmentally conscious practices, including choosing lights with low emissions, eco-friendly hotels, and electric vehicles for daily commutes as they pursue sustainable growth and net-zero carbon emissions, industry executives said. "Increasingly, corporates are asking what their carbon footprint on each flight is. We are showing them the carbon footprint that they spend on an IndiGo, a Vistara, SpiceJet or any other airline. There is a surge in queries, especially from sectors such as information technology-enabled services, consultancy firms, manufacturing, banks, and financial institutions," said Sabina Chopra, co-founder and chief operating officer for corporate travel, and head industry relations, Yatra.com.

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

Earth Had Second-Warmest March on Record in 2023

Earth had its second warmest March on record with Antarctic sea ice shrinking to its second-lowest extent, the EU's climate monitoring agency said recently. "The month was jointly the second warmest March globally," said a report from the Copernicus Climate Change Service. The report is based on computer-generated analyses using billions of measurements from satellites, ships, aircraft and weather stations around the world. It said temperatures were above average over southern and central Europe and below average over most of northern Europe. They were far warmer than average over much of North Africa, southwestern Russia, Asia, northeastern North America, South America including drought-stricken Argentina, Australia and coastal Antarctica.

Source: https://economictimes.indiatimes.com/



Germany Ends Nuclear Era, Switches Off Last 3 Power Reactors

Germany switched off its last three nuclear reactors on April 15, 2023 exiting atomic power even as it seeks to wean itself off fossil fuels and manage an energy crisis caused by the war in Ukraine. While many Western countries are increasing their investments in atomic energy to reduce their emissions, Germany brought an early end to its nuclear age. Europe's largest economy has been looking to leave behind nuclear power since 2002, but the phase-out was accelerated by former chancellor Angela Merkel in 2011 after the Fukushima nuclear disaster in Japan.

Source: https://www.ndtv.com/

Droughts, Wet Events Made More Frequent, Intense by Global Warming

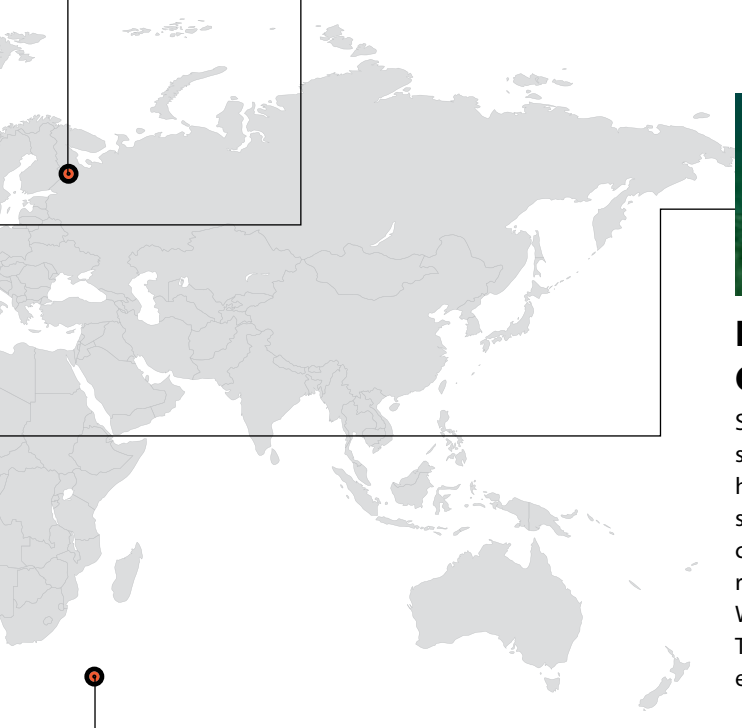
Major droughts and pluvials—periods of excessive precipitation and water storage on land— have indeed been occurring more often, confirmed a new National Aeronautics and Space Administration (NASA)-led study. Droughts and floods will become more frequent and severe as our planet warms and climate changes, scientists have predicted, but detecting this on regional and continental scales has proven difficult, the study said. Two NASA, US, scientists examined 20 years of data from the NASA/German GRACE and GRACE-FO satellites to identify extreme wet and dry events, the study published in the journal *Nature Water* said. Floods and droughts account for more than 20 per cent of the economic losses caused by extreme weather events in the US each year.

Source: https://economictimes.indiatimes.com/

SET Award 2023

The Start Up Energy Transition Award (SET Award) Ceremony has been the climax of the SET Tech Festival in Berlin since 2017. The five winning start-ups each received €10,000 in prize money and were announced live from the WECC at the SET Award Ceremony, held as part of the Berlin Energy Transition Dialogue's (BETD) official Evening Reception on March 28, 2023. Awards were presented across five high-impact and industry relevant categories to the following start-ups: Clean Energy & Storage: **Energy Dome S.p.A., Italy**; Mobility & Transportation: **Navalt Solar & Electric Boats Pvt Ltd., India**; Industry: **Heatrix GmbH, Germany**; Buildings & Construction: **Hyperion Robotics Oy, Finland**; Quality Access & SDG-7: **Oorja Development Solutions India Ltd., India**.

Source: https://www.dena.de/



Large Seagrass Bed Discovered in Cornish Bay

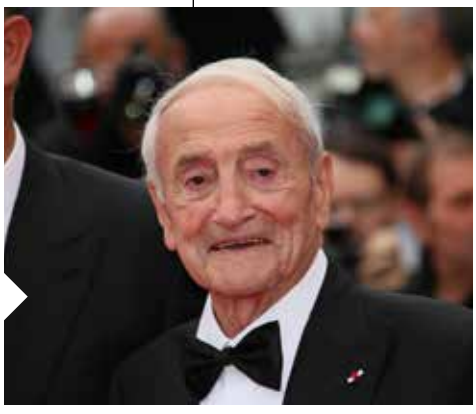
St Austell Bay in Cornwall is home to one of the largest known seagrass beds in the UK, a new report has revealed. The nearly 360 hectare (900 acres) seagrass bed was discovered using acoustic surveys, which identify areas of the sea acting as highly effective carbon stores. The acoustic surveys focused on historically under-recorded habitats of seagrass. The report was published by Cornwall Wildlife Trust and Natural England. Abby Crosby, Cornwall Wildlife Trust marine conservation officer, said the discovery was "a very exciting development".

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

Passing Away of Pioneering French Climate Change Scientist

Claude Lorius, a leading glaciologist whose expeditions helped prove that humans were responsible for global warming, passed away at the age of 91 on March 21, 2023. He led 22 expeditions to Greenland and Antarctica during his lifetime. It was during one trip to Antarctica in 1965 where an evening of drinks with ice cubes led him to prove humankind's role in the heating of the Earth's surface. It was his love of adventure which set him on the path to identifying and predicting an impending catastrophe for the planet. In 1956, just out of university, he joined an expedition to Antarctica. The more polar expeditions he led to the continent, the more he became fascinated with Antarctica's mysteries.

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



The Role of Water Quality in Early Child Nutrition

A Case Study in Uttarakhand

Water is an essential component of healthy growth and development, and ensuring access to clean water, adequate sanitation, and good hygiene is crucial for early childhood nutrition. In this article, **Kanhaiya Lal** and **Vidhu Gupta** highlight that as part of the nutrition security study, their team examined and collected scientific evidence on water quality in Mukteshwar, Uttarakhand, India. This was investigated through on-site testing of drinking water samples and in-person consultations with medical experts. Keep reading to know more…

Undernutrition is a global public health problem especially in children below the age of 5 years. It can affect various aspects of children's development such as physical and mental development. It can be seen in the form of wasting, stunting or underweight. Water is an essential component of healthy growth and development, and ensuring access to clean water, adequate sanitation, and good hygiene is crucial for early childhood nutrition. Proper sanitation & hygiene and safe drinking water can reduce undernutrition and stunting in children by preventing diarrhoeal and parasitic diseases, and damage to intestinal development (environmental enteropathy). Roughly 50 per cent of all malnutrition is associated with repeated diarrhoea or intestinal worm infections as a direct result of inadequate water, sanitation and hygiene (WHO). When children are undernourished, their resistance to infection is lowered and they are more susceptible and more likely to die from diarrhoeal disease and other infections. In fact, diarrhoea is the second-leading cause of death globally in children under five years.[1,2] The condition of malnutrition further exacerbates in hills due to limited availability and accessibility of micro-nutrient rich staple crops around the year. Thus, as part of the Nutrition Security study, the team examined and collected scientific evidence on water quality in Mukteshwar, Nainital, Uttarakhand. This was investigated through on-site testing of drinking water samples and in-person consultations with medical experts.

Storage water

The Importance of Water in Child Nutrition

Adequate hydration is crucial for a child's health and development. It helps regulate body temperature, transport nutrients and oxygen to cells, eliminates waste products, and supports the functioning of vital organs. Dehydration in children can lead to a range of health issues, including fatigue, headaches, constipation, urinary tract infections, and

1 Details available at https://www.wvi.org/nutrition/nutrition-and-wash

2 Details available at 10.1371/journal.pone.0209054

even impaired cognitive function.

In addition to providing hydration, water is also essential for nutrient absorption and digestion. It helps break down food and allows nutrients to be absorbed and transported to cells throughout the body. Without sufficient water intake, children may experience nutrient deficiencies, even if they are consuming a healthy and balanced diet.

It is, therefore, essential to ensure that children have access to clean and safe drinking water at all times. Parents and caregivers should encourage children to drink water throughout the day and offer fluids during meals and snacks. Water should be the primary source of hydration, with sugary drinks and fruit juices limited to occasional treats.

Water Quality and Child Health

Water quality is a critical public health concern. Poor water quality is an ongoing problem in India because the country lacks water treatment facilities that can handle the pollution caused by rapid industrialization and urbanization, and open defaecation in many areas without sanitation infrastructure exacerbates the problem. Access to clean and safe drinking water is essential for preventing water-borne diseases and promoting good health. Inadequate or contaminated water can lead to a range of illnesses in children, including diarrhoea (which is the second leading cause of death in children[3]), cholera, typhoid fever, and other bacterial infections.

Water quality is determined by the presence or absence of harmful substances such as bacteria, viruses, and other contaminants, which can cause gastrointestinal diseases. Water can become contaminated due to various reasons such as natural sources, industrial activities, and poor sanitation

practices. Children are particularly vulnerable to water-borne diseases as their immune systems are not fully developed, and they are more likely to get dehydrated from diarrhoea and vomiting. Moreover, diarrhoea increases malabsorption, in turn increasing the likelihood of malnutrition. Therefore, it can be hypothesized that water quality in the household has a significant impact on children's nutritional status in India.[4] Therefore, diarrhoea and malnutrition have a vicious cycle.[5]

According to UNICEF, around 800 children die every day from diarrhoea caused by poor water and sanitation. Lack of access to safe drinking water and sanitation facilities also affects the nutritional status of children due to the loss of nutrients through diarrhoea and other illnesses. According to the latest National Family Health Survey (NFHS-5), 35.5 per cent of children between the ages of 0 and 59 months are stunted, 19.3 per cent are wasted, and 32.1 per cent are underweight. The situation is slightly better in Uttarakhand, a state in northern India, with 27 per cent stunting, 13.2 per cent wasting, and 21 per cent underweight. Around 7.3 per cent of children under 5 years reported prevalence of diarrhoea 2 weeks prior to the survey at the national level compared to 4.4 per cent in Uttarakhand.[6] However, the region is highly vulnerable to

3 Details available at https://doi.org/10.1016/S2214-109X(18)30005-6

4 Li, W., Liu, E. & BeLue, R. Household water treatment and the nutritional status of primary-aged children in India: findings from the India human development survey. Global Health 14, 37 (2018). https://doi.org/10.1186/s12992-018-0356-7

5 Details available at https://www.defeatdd.org/blog/good-nutrition-and-strong-minds-what%E2%80%99s-connection

6 Details available at http://rchiips.org/nfhs/factsheet_nfhs-5.shtml

the availability and accessibility of micro-nutrient rich staple foods/crops. Under-five diarrhoeal diseases further exacerbate malnutrition by washing out the critical micronutrients.

Water Quality Assessment in Mukteshwar, Nainital

A study was conducted in Mukteshwar, Nainital district, Uttarakhand, to collect scientific evidence on water quality. The study included on-site testing of drinking water samples, and in-person interactions with medical experts deployed in the region.

The water samples were collected and tested from different sources such as spring, *naula* (open well), water supplied in houses, and storage water. Physico-chemical and microbiological tests were conducted on the samples. The samples reported pH values within the acceptable range of Indian drinking water standards (IS 10500) of 6.5–8.5. Additionally, total dissolved solids (TDS) values were below 500 ppm, which is the acceptable limit for drinking water quality. However, 44 per cent of the water samples had TDS values below 50 ppm, which is too low for drinking water. Generally, water with TDS levels between 50 and 150 is considered most suitable for drinking. Only 13 per cent water samples tested had TDS values above 100 ppm. Such low TDS water does not need exhaustive water treatment such as reverse osmosis (RO) treatment.

Total coliforms were also tested as an indicator of the cleanliness of the water source. Total coliforms are a large group of different types of bacteria that share several characteristics. They are commonly found in the soil and intestines of animals, including humans, and their presence indicates that water is likely to contain other more harmful pathogens. About 50 per cent of the water samples were contaminated with total coliforms. Although total coliform bacteria themselves do not necessarily cause harmful illnesses, their presence increases the probability of bacteria that can cause water-borne diseases (such as diarrhoea, typhoid, and jaundice) in the exposed population.

The interaction with local medical experts emphasized that both viral and gastrointestinal diarrhoea exist in the area with the increasing prevalence of the latter type of diarrhoea. Water and personal hygiene-related disorders were widespread in 20–25 villages of Mukteshwar, strangely after the monsoon during July–October. The medical expert also suggested that human/animal open defaecation is the prime cause of gastrointestinal diarrhoea. The treatment methods such as boiling/disinfecting or filtering before drinking should be adopted by the population. Another way


to prevent diarrhoea and other water-borne diseases could be maintenance of personal hygiene.

Water Availability in Hilly Areas

Besides water quality, water availability is another significant issue in most of the hilly areas. As per the Jal Jeevan Mission – Har Ghar Jal Scheme, 64 per cent of households in Uttarakhand have tap water supply as of date. In rural areas, 46 per cent of households have to travel more than 30 minutes to fetch drinking water. Many residents in Mukteshwar rely on storing rainwater from their rooftops during the rainy season for washing and cleaning purposes. However, this water may not be suitable for drinking due to potential contamination. The Uttarakhand Government has announced an ambitious scheme to provide tap water connections to households at a minimal cost of INR 1, which can improve water availability and quality in the future.

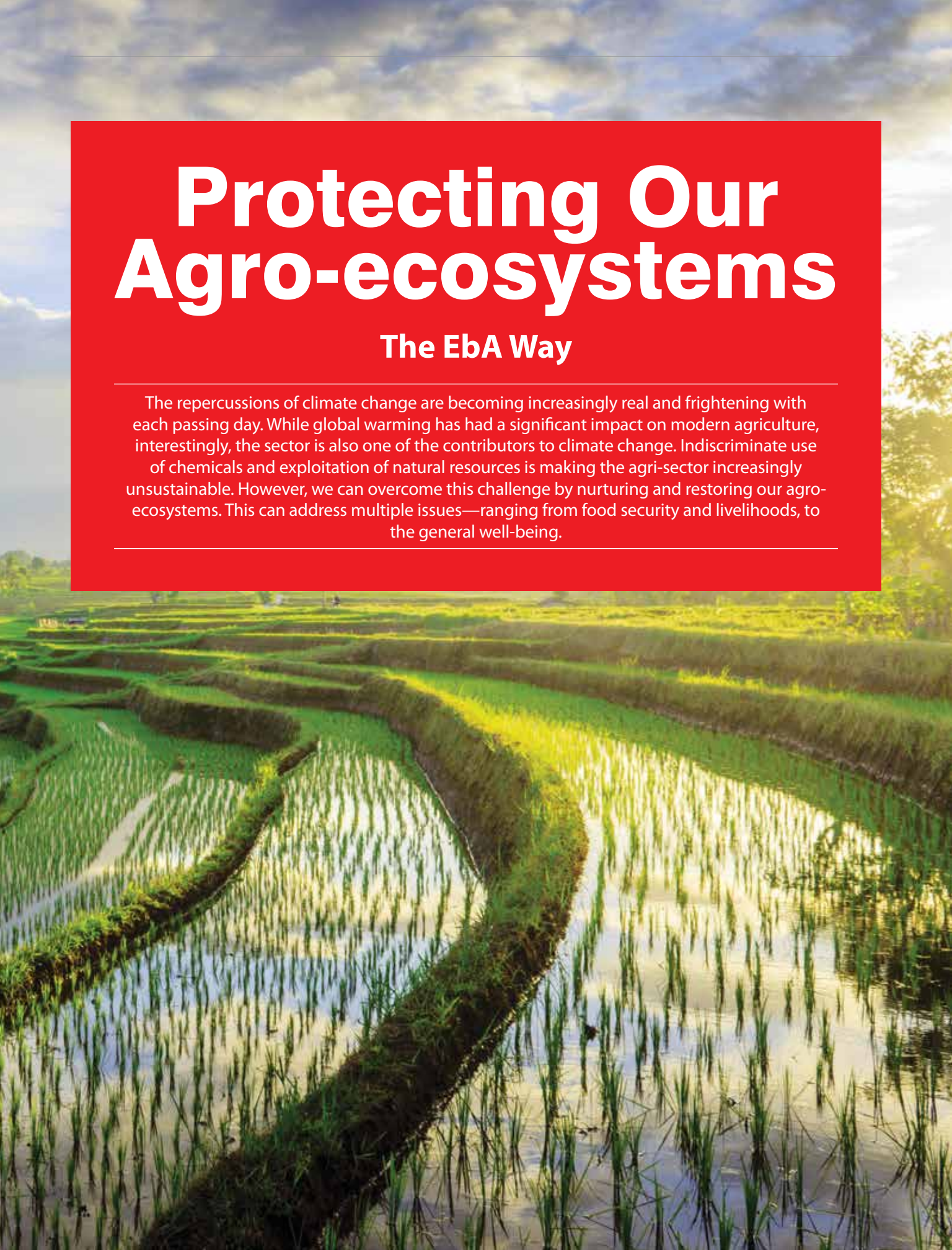
Way Forward

The study's findings highlight the need for proper management of water resources, particularly in the Himalayan region, where water scarcity is an issue. Investing in water quality and sanitation is an essential step towards ensuring child health and development. Governments and communities must prioritize safe drinking water and sanitation facilities, especially in areas where access is limited.

Few ways to reduce the prevalence of water-borne diseases include:

- The open wells are susceptible to microbial contamination, which may cause water-borne diseases (e.g., diarrhoea, typhoid, etc.). So, point-of-use (POU) water treatment can significantly impact the health and nutrition of vulnerable populations (infants, children, and pregnant women). Hence, disinfection of open well water with bleaching powder or chlorine tablets is recommended for safe drinking water.
- The role of the village panchayats is critical for supplying disinfected water to the households.
- The Uttarakhand *Har Ghar Nal Yojana* should ensure adequate water supply and concrete measures to provide good quality water (free from microbes).
- Awareness campaign drives on water quality, quantity, sanitation and hygiene should be conducted to convey the information to villagers.
- Regular monitoring of water quality and testing for contaminants is also critical to ensuring that the water is safe for consumption.■

Kanhaiya Lal and Vidhu Gupta, Environment and Health, The Energy and Resources Institute (TERI), New Delhi.



Protecting Our Agro-ecosystems

The EbA Way

The repercussions of climate change are becoming increasingly real and frightening with each passing day. While global warming has had a significant impact on modern agriculture, interestingly, the sector is also one of the contributors to climate change. Indiscriminate use of chemicals and exploitation of natural resources is making the agri-sector increasingly unsustainable. However, we can overcome this challenge by nurturing and restoring our agro-ecosystems. This can address multiple issues—ranging from food security and livelihoods, to the general well-being.

Communities have been adapting to climate variability for centuries, but today their coping mechanisms are being outpaced by the fast-changing climate. Shifting weather patterns as a result of climate change, affecting rainfall and temperature, are likely to impact the ecosystem goods and services on which people rely. Climate change is also likely to magnify existing risks and vulnerability to disasters. It is therefore critical to develop adaptation capabilities to be able to deal with these challenges.

In response to global climate change impacts, most countries have focussed on 'hard' or 'grey' infrastructure options such as embankments for flood control or new reservoirs to cope with water shortages. These options can be costly to build and maintain, and generally do not take the benefits of ecosystem-based approaches into account.

Ecosystem-based adaptation (EbA), involving the conservation, sustainable management and restoration of ecosystems are cost-effective solutions that can help people adapt to the impacts of climate change. Examples of such nature-based solutions to climate change include sustainable agriculture, integrated water resource management, and sustainable forest management. EbA harnesses biodiversity and ecosystem services to increase resilience and reduce the vulnerability of human communities and natural systems to climate change.

Healthy ecosystems such as intact forests, wetlands and coastal areas provide many benefits to local communities including firewood, clean water, medicines, shelter and food. They can also form physical barriers against extreme weather events such as cyclones and storm surges. Biodiverse forests, for example, can protect roads and other infrastructure from erosion and landslides.[1]

Agro-Ecosystems

Despite being largely considered as agricultural activities, the term 'agro-ecosystem' comprises much more.

Besides the core human activity of agriculture, agro-ecosystems also include the complex interactions between biotic and abiotic factors such as crops, pastures, livestock, flora and fauna, soil, water, etc. Further, the dynamic relationship between commercial agriculture and socio-economic factors makes agro-ecosystems more complex than natural ecosystems.

In today's times, commercial agriculture is viewed as a double-edged sword. On one hand, higher food production is serving the basic needs of rapidly rising population. On the other hand, indiscriminate use of chemicals to enhance agri-productivity is putting severe pressure on our ecosystem—

1 Details available at https://www.iucn.org/

ruining soil health, increasing greenhouse gas emissions, and depleting groundwater resources. In the long-run, these unsustainable practices will threaten the potential of agriculture, forestry and fishery, and impact the benefits and services of these sectors.

How Climate Change is Impacting Agro-Ecosystems?

According to the IPCC Sixth Assessment Report, climate change has already created a significant stress in the agro-ecosystems, thereby declining the capacity to mitigate extreme climate and leading to loss of precious lives and resources. The direct solar radiations (enormous amount of heat/energy) striking on the earth's surface is trapped by greenhouse gases (GHGs) like carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), resulting in atmospheric temperature increase. The concentration of CO_2 is currently at 412 ppm that represents a 47 per cent increase since the beginning of the Industrial Age.

While the entire impact cannot be measured, we know that the effects are irreversible in some cases. Here are some of the specific effects of climate change on our agro-ecosystems:

Field Crops: The human-induced warming has reduced farm yield and also caused increase in pest and pathogen attacks. Also, with increasing mono-cropping the system is gradually reducing land's resilience to climate change stress. Climatic changes driven by

increasing GHGs possibly affects the yield and productivity of agricultural crops from region to region. Studies conducted by the National Innovations in Climate Resilient Agriculture (NICRA) suggest rice yields (both irrigated and unirrigated) are projected to decline between 2050 and 2080. Further, wheat yield is projected to reduce by 6–25 per cent in 2100 and maize yield by 18–23 per cent.

Extreme climatic events have also damaged the nutrient content of food crops. The IPCC report also warned that the protein content of rice, wheat, barley and potatoes could fall by 6 to 14 per cent, putting close to 15 crore more people at risk of protein deficiency.

Horticulture: Climate change has also proved to be detrimental to horticulture production and is potentially causing plant-pollinator and pest mismatches. While temperature extremes could inhibit flower blooming and fruit setting, heavy rainfall can affect bee pollination and also increase crop diseases.

Livestock, Poultry, Fishery: Heat stress, erratic weather and increase in chemical supplements have a major impact on the physiology of livestock and poultry. High temperatures are causing abrupt changes in animals' bodies, leading to disruption in respiration, blood flow and overall resilience. In milch animals, this is leading to a reduced intake of dry matter and consequently, decreased milk production. Climate change is also causing frequent diseases and higher mortality in animals.

Similarly, rise in sea levels due to global warming has decreased sustainable yields of some wild fish populations and has altered the distribution of cultivated, wild terrestrial, marine and freshwater species. Further, uncertain monsoon and frequent cyclones are also reducing the number of fishing days hitting the small-scale fishers across regions.

Forests and Water: Forests and tree-based systems support modern agriculture by increasing crop and livestock productivity. However, in the recent past, the world has witnessed several disturbing incidents of wildfire, causing massive destruction of forest cover and biodiversity. Warmer and drier weather conditions induce fire, drought and insect attacks, while wetter conditions increase disturbances from wind and pathogens.

Livelihoods, Economy and Well-being: Agro-ecosystems have a direct and significant contribution to livelihoods, especially for the rural and marginalized. Seventy per cent of our rural households still depend primarily on agriculture for their livelihoods. India is one of the largest producers of several grains, pulses, milk, fruits, and vegetables. Agriculture alone contributes nearly 20 per cent to the country's GDP.

The impact of climate change is not restricted to loss of livelihoods for farmers and traders, but it also affects food inflation—triggering the vicious cycle of poverty, food insecurity, and malnutrition.

The Government of India's economic survey (2018) estimated that the annual loss of USD 9–10 billion was due to the adverse effects of climate change.

What Can be Done?

Undoubtedly, ecosystem deterioration is the harsh reality of current times. However, with the right strategies and action plan, we can still mitigate the risks to a good extent. As the UN Secretary-General António Guterres said, "the climate emergency is a race we are

losing, but it is a race we can win."

While there is an urgent need to restore the ecosystem by conserving the natural resources and making agricultural processes eco-friendly, we also need to give an equal impetus to building communities' resilience. The long-term sustainability of food production is intrinsically linked to the wise management of agro-ecosystems and biodiversity for food and agriculture. Ecosystem services, such as water flow regulation, nutrient cycling, pollination, pest and disease regulation, and seed dispersal are critical for agriculture and food security.

Fortunately, nature provides us with the biggest support in this endeavour. Nature-based solutions (NbS) can make development and conservation co-exist in harmony and play a huge role in revival of the ecosystems, including agriculture and allied domains. When deployed properly, NbS can deliver a triple benefit, that is, supporting agricultural production, mitigating climate change, and enhancing nature and biodiversity.

EbA—The One-Stop Solution for Ecosystem Restoration

EbA is a nature-based and human-centric approach to adaptation and aims to restore the ecosystem by building the resilience of communities, encouraging participatory governance and ensuring food security. EbA works as a holistic approach as it fulfils the following criteria:

- Reduces social and environmental vulnerabilities
- Generates social benefits by promoting climate change adaptation
- Restores, maintains, and improves ecosystem health
- Encourages stakeholders' active participation
- Supports equitable governance and capacity enhancement

In agriculture sector, EbA conserves and restores the natural resources and strengthens the agro-ecosystem services, thereby empowering farmers, fishermen, and communities dependent on forests and local biodiversity.

Adopting EbA for agro-ecosystems enables climate change adaptation by enhancing agricultural productivity, boosting ecosystem functions, goods and services, and strengthening livelihoods and food security. The approach also enhances water availability, improve nutrient retention in crops, and ensure pollination and pest and disease regulation.

Wrapping it Up

Worldwide, experts and researchers have accepted that if climate change is not tackled with urgency, we are putting the lives and well-being of billions of people and future generations at stake. The impact of climate change on agro-ecosystems has been a cause of ultimate concern to economists, ecologists and agriculturalists as it directly impacts numerous goods and services.

We have already been witnessing the adverse impact of climate change in the last few years, which was further intensified by COVID-19. The pandemic, besides causing a dramatic loss of human life, has also led to a significant loss of livelihoods, especially in the unorganized sectors. Reduced household incomes clubbed with disruption in supply chain led to the adverse impact in food security and nutrition too.

Weather extremes, frequent natural disasters and fast depleting natural resources have become a regular phenomenon in our surroundings. Climate change mitigation is only possible by working in sync with nature—and EbA makes it possible.

There is no universal blueprint for EbA, but there are well-accepted guidelines on how to plan and implement EbA projects. Successful implementation of EbA for ecosystem restoration is only possible through systematic, collective action. For this to happen, stakeholders need to join hands on research, implementation, policymaking and investments, thereby contributing to the global cause.■

Article courtesy: https://wotr.org/2022/08/17/protecting-our-agro-ecosystems-the-eba-way/

"We Need to Shift Focus and Look at the Opportunities Arising from Green Transition"

Namita Vikas is the Founder and Managing Director of auctusESG LLP, a global firm providing strategic advisory on sustainable finance, climate transition, ESG, and climate risk management. Here, she is in a conversation with us for *TerraGreen*.

What to you is 'mainstreaming sustainable development'?
Mainstreaming sustainable development, on the whole, reinforces the idea of resource optimization and efficiency, to avoid serious environmental and socio-economic consequences. While it is difficult to distill a single definition, given the subjective nature of sustainable development, it is definitely no longer a siloed concept; sustainable development is intertwined with economic returns and social and environmental impacts. These issues have also become increasingly important for corporations, financial institutions, capital markets to identify superior risk-adjusted opportunities. In my opinion, all of this is best captured in the IFC's definition, that is, "Sustainability is about ensuring long-term business success while contributing towards economic and social development, a healthy environment, and a stable society."

According to you, what is the role of mainstreaming sustainable development in promoting collective actions?
Historically, collective effort that draws in insights and priorities from different quarters of the economy, has been the backbone of development. This makes sense, given how the scale and simultaneous nature of transition across policy, technology or market preference, is likely to create far-reaching impacts. Thus, we see partnerships and collaboration (SDG 17) as a key tenet in the SDGs framework. This makes a clear case for a systemic approach on the back of collaboration, especially as the solutions for sustainable development are interconnected and interdependent in mutualistic ways, to contribute benefits beyond a single sector. For instance, government and industry announcements and net-zero targets need to be supported by upgrades in technology and skill enhancement, which further requires access to a reliable stream of capital, emphasizing how collective action is central to sustainable development.

Give an example of how you have integrated sustainable development/ climate resilience in your sphere of action/work/decision-making.
auctusESG has been a part of several

projects in sustainability and climate resilience in diverse geographies. For instance, in one of our projects, we developed a gender-responsive climate finance facility in Sub-Saharan Africa, to facilitate investment flows to women and youth entrepreneurs while maintaining risk-return-impact objectives. The facility has been finalized as a private equity fund with the largest fund manager in Sub-Saharan Africa and secured USD 10 million from the UN SDG Fund as risk capital. auctusESG has also conducted a landscape analysis on climate risk and ESG preparedness of 10 large Indian banks, followed by training sessions for over 200 credit and risk officers, and development of a policy options paper for the regulator.

At an organizational level, the firm continues to empower women and fix the broken rung by employing 85 per cent women across senior levels, fostering gender equilibrium in finance and meaningful ESG for sustainable

development. For this, auctusESG was recognized by UN-Women as SME Champion 2021.

What more can be done by policymakers to integrate and mainstream sustainable development across agencies and across levels?

From a financier's lens, the market is inundated with definitions; what is sustainable in one jurisdiction may not be so in another. This lays the groundwork for inadvertent greenwashing. While regulations around taxonomies are evolving, expediting their implementation, to clearly classify green or sustainable would be useful for market standardization. Introduction of climate risk assessments within banks and FIs would also be a step in the right direction. Additionally, carving out a programme similar to the PM-VIKAS initiative announced in the Union Budget 2023, for upskilling and building capacity in sustainable/green sectors, is important. All of this needs to be strengthened by proper data management systems to aid access to comparable, credible, and authentic information. Basis this, policymakers can facilitate better integration, mainstreaming and action on efforts for sustainable development and enhanced transparency.

What more can be done by business and industry in terms of integrating and mainstreaming sustainable development?

There is certainly a need to shift focus and look at the opportunities arising out of the green/sustainable transition. For businesses, a good starting point could be a materiality exercise to highlight and prioritize the sustainability issues/risks in the external ecosystem. The concept of double materiality is also picking up, that is, how the external ecosystem impacts the business. Appropriate quantification of such aspects, their meaningful integration in business risk management, strategy and output, and implementation is critical. For example, big brands are embedding sustainability at the design stage of product development. In the food sector, more sustainable alternatives are emerging. A host of such solutions are bound to maximize both financial and non-financial benefits for sustainable development.

What is your message for the G20, for which presently India is holding the Presidency?

India's presidency of the G20 needs to pave the way for a low-carbon transition in emerging markets. My main message, therefore, would be to mainstream developmental pathways that decouple economic growth from emissions in a glocalized manner. This would need policy and financial incentives, regulations and participatory planning to come together and bridge the top-down and bottom-up priorities for an equitable and just low-emissions economic growth. Towards this, India could launch a just transition energy partnership akin to that of Indonesia and South Africa, given the inevitable transition away from fossil-fuel based industries. Further, facilitating a robust and well-functioning financial infrastructure—capital markets, banking, and fund ecosystems would help mobilize funds towards green and sustainable assets/projects. Strengthening this with capacity-building and skill enhancement is key to a meaningful and comprehensive integration of ESG/climate risks. ■

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The Villages of India

Through an Indian Perspective

In this article, **Himanshu Kumar** and **Vivek Kumar** say that a new tradition of scholarship must evolve to understand the village systems at the conceptual and theoretical levels. The way rural and village has been historically interpreted and understood needs refinement as the colonial imprint 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 approaches.

The Colonial Imprint

India has a vibrant cultural, geographical, linguistic, and ethnic diversity, precisely a hotspot of biological and cultural diversity. At its heart, reside India's people, making this vast country an excellent example of growth, development, coexistence, and harmony. However, the country was subjected to a gruesome 200-odd year of colonialization filled with brutality and exploitation, leading to the breaking up of this beautiful nation and after years of constant struggle, bloodbath, and of course, non-violence spearheaded by none other than Mahatma Gandhi, and finally, we attained Independence in 1947. The colonial years led to a complete transformation of the nation—socially, economically, and environmentally; the British did loot not only the physical treasures of the country but also looted the invaluable intellect and knowledge systems existing in the country, ample evidence of which has been documented by Dharampal.[1]

A lot has changed since then, economics, society, energy, and businesses, but centuries of exploitation have left a scar on us; undoubtedly, with so much exploitation, the dynamics of functioning of a society change and precisely that is what the European colonizers have done to the world, creating impacts not only physical but deeply social and intellectual. Essentially, changing the traditional forms of living, terming them as savage, and forcefully implementing western ideas on India, presuming that the Indian society was uncivilized and lacked knowledge, intellect, and skills. This was false because as per the British archives and the communication of the British collectors—the most noteworthy being *Adams Report*—which established that every Indian village had at least one school in the eighteenth century and there were about one lakh schools already existing in the Bengal and Bihar region giving strong evidence against the notion of Indians lacking skill and knowledge. According to Thomas Macaulay, "India could only be civilized by discarding the Indianness and adopting the utility as the object of every pursuit." The thought process was cleansing the country of what may eventually lead to loot, plunder, and famines. The existing systems and institutions were deprived of revenue and resources, in the absence of which they met an arduous fate, eventually dying out and paving the way for Western ideas to take over.

It is noteworthy to state that the Indian indigenous knowledge systems, cultural practices, and traditional way of life were devastated by the British; the Indian education system in the eighteenth century was more robust, comprehensive, comprised of subjects such as philosophy, theology, and mythology and had vast

1 Dharampal, G. (2017). Essential Writings of Dharampal. Publications Division. Ministry of Information & Broadcasting, Government of India.

expertise in the domains of science & technology, commerce, and medicine. Even more interesting is the fact that it was utterly inclusive and without any bias. As per the records accessed by Dharampal, Brahmins, Vaishyas, Shudras, and students from other castes used to study together in an inclusive system of elementary and higher education. The traditional systems and practices positively influenced the people, and the so-called "Village Republics" functioned in peace and harmony, with a judicious resource-sharing mechanism and revenue disbursement system.[2]

India and its Villages

India has diverse social and geographical diversity and a profound system of knowledge and institutions that have kept its society closely knit and progressive. The village institution is one entity. Much of the country's population still resides in the villages; it has always been a part of a broader economic, political, and religious system. The village has, since time immemorial, formed the fundamental unit in the organization of Indian social polity finding mention in the *Rig Veda* and *Mahabharata*. The term 'gram', still primarily used in India for the village, denoted an aggregate of several families sharing the same habitation.

In their work titled, *Rural Sociology*, S L Doshi and P C Jain have stated that all advanced societies have developed/originated from a village society. They create a hierarchical societal development order, described in the following flowchart:

Rural Society→Town Society→City→Mega City→Metropolitan

Villages in India have been a dynamic entity contrary to the colonial belief that it is a closed and isolated system due to regressive institutions; they have evolved over some time in both structure and function through intellect and perceptions; the aspirations of the village folk have increased manifold but, essentially one central unanswered question is what precisely should be the definition of a village. Some renowned academicians and sociologists from India have attempted to solve this jigsaw puzzle. In his monograph *Indian village*, Dube defines a village as "A territorial unit, the smallest but the most significant among territorial groups in the social organization of communities. Some common values and obligations unify persons belonging to different castes." Thereby, devising a definition based on the geographical scale and social structure. M N Srinivas, in his works, has introduced the concepts of 'Sanskritization', 'Modernization', and 'Westernization', governing the Indian rural society and causing structural and functional changes in them, which have happened in the last 200 years with some of them owing their evolution to colonization. The Census of India defines a village as "The basic unit for rural areas is the revenue village which has definite surveyed boundaries. The revenue village may comprise several hamlets, but the entire village is treated as one unit to present census data. In unsurveyed areas, like villages within forest areas, each habitation area with locally recognized boundaries within each forest range officer's beat was treated as one unit". According to the Census 2011, anything other than a statutory town, Census town, or urban agglomeration is a village.

David Pocock and Louis Dumont have argued that both rural and urban communities are a part of the larger civilization of the subcontinent and that the urban community is nothing but an extension of the rural community.[3] In a way, it is true as we explore the evolution of human society and settlements, from hunter-gatherers to agricultural settlements, which eventually led to the formation of communities and

2 Dharampal, G. (2017). Essential Writings of Dharampal. Publications Division. Ministry of Information & Broadcasting, Government of India.

3 Doshi, S., and Jain, P. (1999). Rural sociology. Jaipur: Rawat Publications.

established relationships between them, leading to villages. Robert Redfield, in *Folk Societies*,[4] stated that folk societies gradually transform themselves into village communities and isolate themselves from the ideal types. The culture contact gives rise to the folk–urban continuum, and the intermediate category between the two polar types presents the peasant societies or the village community.

British administrators turned ethnographers considered village communities as autonomous sociological isolates. In 1830, Charles Metcalfe, the then-acting Governor-General of India, wrote: "The village communities are little republics, having nearly everything they want within themselves and almost independent of any foreign relations." This view has also popularized the concept of village self-sufficiency. This has resulted in falsifying the true nature of the Indian village community and has provided a basis for revivalists and utopian's programmes of political action.[5] This has been challenged by M N Srinivas. Adding practical examples from the village, Srinivas highlights the nexus of socio-political interaction, both inter-village and intra-village, taking a cue from the weekly markets that acted as a medium of exchange between different villages, land ownership, and tenancy; the land included within the boundary of an official or an administrative village may not necessarily be owned by a person residing in it. Furthermore, he also mentions the inter-regional trade which existed in India; various commodities such as agricultural and forest produce were exchanged between multiple regions, Gujarat, for instance, received a considerable quantity of wheat and opium from Malwa, rice and coconuts from the Konkan, sugar from Bengal, and groceries and drugs from the Himalayan regions.[6]

The assumption of the relationship between the village community and the broader political structure is also misinterpreted; this could result from our superficial view of the political system interpreted only from the top and ignoring the more comprehensive system and institutions existing at grassroots level. Therefore, Breman aptly stated "the village does not contest and redefine the state: the state is not only present in the village but also penetrates the state."[7]

Louis Dumont, in *Village Studies*,[8] protested the excessive interest in rural sociology and stated, "India, sociologically speaking, is not made up of villages." It is true that the idea of the village is present in Indian literature and thought and can affect academia and politicians; contesting the idea of the village as a fundamental unit to understand Indian society. He added that "idea of the village in Indian civilization, its reinforcement by Mahatma Gandhi, the pragmatic interest of the early government, officers, and anthropological work had created this fundamental supposition that the clue to an understanding of an Indian society lives in the village."

Gandhiji's thoughts and understanding of the village were essentially based on the connection he shared with the community; he found the soul of India in her villages. Gandhiji was critical of entrusting the central government with maximum powers and fought for the decentralization of powers; this eventually led, after a massive uproar in the Indian Parliament, to the adoption of Article 40.

4 Redfield, R. (1947). The folk society. American Journal of Sociology, 52(4), 293–308.

5 Srinivas, M. N., and Shah, A. M. (1960). The myth of self-sufficiency of the Indian village. Economic weekly, 12(37), 1375–1378.

6 W H Moreland, India at the Death of Akbar, p 244; Gazetteer of the Bombay Presidency, Vol VI, pp 187–98.

7 Breman, Jan. 1997. 'The Village in Focus', in Jan Breman et al. (eds.). The Village in Asia Revisited. Delhi: Oxford University Press, pp. 15–75.

8 Dumont, L., and Pocock, D. F. (1957). Village studies. Contributions to Indian sociology, 1(1), 23–41.

While Gandhiji entrusted the village concept and firmly believed that the future of India belonged to them, he stated that soon, people would be unwilling to live in towns. There will be a considerable shift towards villages; we need to bring out the villages from drudgery and impoverishment and provide adequate physical, social, and psychological nourishment to the people. In his book *Gram Swaraj*, Gandhiji explains the idea of a self-reliant village; his concept of *Gram Swaraj* is considered one of the most excellent models, focusing primarily on the development of the individual without compromising the integrity of the society and developing a self-sustainable economy.

Gandhiji's idea of development was that the flow of dependency should be from village to town and not vice-versa; he laid stress on the use of technology but not compromising the traditional knowledge, skills, and art forms; he firmly believed that technology is a mere tool, and we should not depend exclusively on the *yantras*.

As the world understands it today, development is a complex set of variables and a highly contested and ambiguous nature; different societies, countries, individuals, and groups draw other inferences. Still, a vague definition could bring about social change that allows people to achieve their human potential. Development is a process, not an outcome, and it could have positive and negative dimensions. The School of Oriental and African Studies (SOAS) describes the development as a political process leading to the power tussle.

There was another great leader of India whose views on the Indian villages seemed entirely parallel to those of Gandhiji, Dr B R Ambedkar, in 1948, presented the draft constitution to the Constituent Assembly and made a statement highly critical of the Indian village, that stated, "What is the village but a sink of localism, a den of ignorance, narrow-mindedness, and communalism? I am glad that the Draft Constitution has discarded the village and adopted the individual as its unit". Ambedkar shattered the imaginary construction of the village as an ideal social space and staunchly criticized the village for its ignorance and apathy.[9]

According to S C Dube, it is the need of the hour for a series of studies of village communities from different parts of the country covering the many divergent patterns of organization and ethos, and this is an appropriate method to understand the fabric of rural social systems. Our understanding of rural India will remain incomplete and vague in its absence.

Rethinking and Unpacking the Village of 21st Century India

India has a history of having numerous local-level governance systems and village set-ups, with people co-existing within a defined geographical area with an interdependent economic system. Under the colonial

9 Judge, P. (2021). Ambedkar, Gandhians and the Indian Village. Economic and Political Weekly, 56(12). Retrieved 28 August 2021.

regime, there were 493,444 villages and towns. Of these, 480,437 villages had less than 5000; 1070 towns had between 5000 and 10,000 people, and only 46 had more than 50,000 people. Not more than 5.5 million people, or less than 3 per cent of the total population, lived in towns; in 1901, almost 90 per cent of India's population resided in the rural parts of the country, which shrunk to ~ 68 per cent in 2011.

Even more interesting is the fact that there were around 700,000 villages in India in 1947, and in the present scenario, 664,369 villages exist, a steady decline; an area that comprises such a vast share of the population of the state deserves attention, which has historically lacked since the colonial and the post-colonial period as well. While the British aimed to exploit all forms of available capital, the governments post-independence paid little heed to understand the primary requirements of the rural community. A vast chunk of indigenous knowledge, science, and polity has been left to rot and die.

Even before we start exploring the various branches of the village and unpacking the idea of village or rural, it is essential for us to develop a conceptual understanding of the village. Interestingly, having more than half the population, encompassing a significant chunk of the country's geographical area, there is no prescribed definition of "rural" in the country and as per the census of India reports, "All areas which are not categorized as urban area are classified as rural areas."[10]

India's polity faces problems due to a lack of proper definition and perspective. Therefore, an analysis is required of the primary Indian concepts and institutions like locality and kinship groups, and it could perhaps serve in finding a solution to the country's polity and society.[11]

Rural society has undergone expeditious changes in the 21st century. It continues to undergo substantial changes, and the agrarian society has transformed from a subsistence one to a market economy, with rapid modernization and the use of technology for agrarian and non-agrarian purposes. The abolition of the intermediaries and the emergence of associations and institutions having close linkages with urban and national organizations has led to significant changes in the current rural landscape.

Therefore, it can be understood that rural and urban could consequently be a clash of ontologies. This gap needs to be bridged in the most sensitive possible manner, not just through blindly imposing the concept of development upon the villages, we need to understand the perspective of the primary stakeholder, and as it has been highly debated that a decentralized approach of governance is essential to ensure that the desired targets are achieved. According to Mahatma Gandhi, "Independence must begin at the bottom. Therefore, it is essential to define development from the perspective of the rural areas, the one size fits all approach must be discarded."

To conclude, a new tradition of scholarship must evolve to understand the village systems at the conceptual and theoretical levels. The way 'rural' and 'village' concepts have been historically interpreted and understood needs refinement, and the colonial imprint has distorted the existing fabric of the rural social systems. The credit for constructing the 'immemorial' village community goes to the colonial period. Much later, even for Indian nationalists, the village remained a symbol of 'traditional' India, which the British had sought to sustain for its purposes. Agriculture, peasantry, land use, social systems and infrastructure, and indigenous technical knowledge systems need a more profound understanding of structural-functional and comparative analysis approaches. Furthermore, village and rural society is a complex issue and has been historically misread and misinterpreted, which has caused a significant loss to the country. Therefore, it is the need of the hour to focus on the village and immerse us in the nation's holistic development. ■

Himanshu Kumar and Vivek Kumar, Centre for Rural Development and Technology, IIT Delhi, New Delhi.

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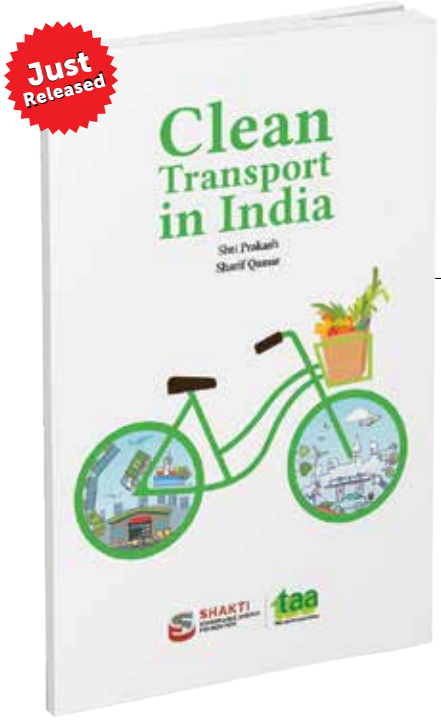

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This book not only presents all the relevant statistics but, more important, explains the implications of those numbers and the interconnections between different facets of transport: for example, the greater number of vehicles on roads may seem to favour mobility but in fact makes roads more congested—and the congestion makes air pollution more severe, thereby aggravating its impact on health. At the same time, the book is not a prophet of doom but also touches upon electric vehicles, hydrogen fuel cells, drones, and even flying cars.

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This book is useful for adults who are concerned about topical issues but lack the understanding to make sense of what they read or watch in the mass media.

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Sweet or Toxic?

Water Pollution Woes in Sugar Industry

The dietary consequences of eating excessive sugar have been discussed and examined thoroughly, to the point where anyone and everyone is aware of controlling their sugar intake. However, an over-looked threat that sugar poses comes from how it is processed. **Anita Khuller**, through this article, throws light on how sugar production may be deadly for the health of our water bodies and ultimately ours, if not properly controlled and monitored.

Sugar plays an important role in most of our diets, which is why its production is spread over 120 countries. Data reports that there are over 60 million acres of land dedicated to the production of sugar globally! In 2022, India emerged as the largest producer of sugar in the world.

The sugar industry has helped farmers and the communities in their areas—both economically and socially. However, sugar production, as in many other industries, if not monitored carefully, can have adverse environmental impacts—related to air/water pollution, soil fertility, and further health risks. In fact, sugar mills and distilleries are one of India's 17 highest polluting industries.

It is the third industry, after the pulp/paper and chemicals sector, to discharge maximum wastewater in India. This is because a huge amount of water is required throughout the production cycle; from the cultivation of sugarcane

till the release of effluent from the mills. One kilogram of sugarcane needs 1500–2000 litres of water to mature in the field. After harvesting, the same quantity of water is required to crush one tonne of sugarcane, releasing around 1000 litres of wastewater! Wastewater from sugar mills is actually not as toxic as that from other chemical-intensive companies. It can, however, pollute water bodies by affecting streams and groundwater ecosystems.

Water pollution takes place when there is an 'induced change in water quality'. In most cases, wastewater contains a high concentration of solids, chlorides, nitrates, magnesium, calcium, and sulphates. The presence of these substances reduces oxygen in water bodies, making them unfit for human use and threatens aquatic life.

Strict Environmental Norms

Various standards and requirements exist to protect the environment from such pollution in India. The Central Pollution Control Board (CPCB) and the state PCBs are mandated to check and monitor the compliance with these standards. The Environmental Protection Act, 1986 requires all industries to treat wastewater before releasing it into the environment. The Ministry of Environment, Forest and Climate Change (MoEFCC) on November 03, 2022, issued a notification to further amend the Environment (Protection) Rules, 1986, expected to come into force on July 01, 2023.

One way in which industrial effluent pollutes healthy water bodies is by increasing the organic matter, which is then decomposed by bacteria and other microorganisms. This process requires oxygen, so the natural presence of oxygen in the water body reduces. Scientists measure this phenomenon using biological oxygen demand or BOD. India's environmental regulations state that, for disposal in freshwater streams, the BOD of industrial wastewater should

be less than 30 mg/l, while 100 mg/l is allowed for disposal on land.

According to the CPCB, the average untreated sugar plant effluent has a BOD of about 1000–1500 mg/l. According to World Health Organization standards, a level of these total dissolved solids (TDS) lower than 300 mg/l is considered acceptable, but anything above 900 mg/l is of poor quality. Five parameters are monitored for all industries: BOD, TDS, pH, COD (chemical oxygen demand), and TSS (total suspended solids) in India.

An interesting article by The Third Pole in July 2021 reflected the author's research in one area of Uttar Pradesh, which has the second largest number of sugar mills in the country. In fact, some of the UP mills are among the largest in Asia, both in terms of production and storage capacity.

However, several complaints had been recorded from the villagers/sugarcane farmers—ranging from overflowing narrow drains with wastewater from the sugar mills in the area, which led to flooding/destruction of their crops, to polluted groundwater. In fact, in 2014, a major sugar mill in UP was fined by the court for polluting the Ganges River.

Industrial effluent is not the only problem in these areas of UP. Some villagers have also complained about the absence of proper sanitation services and clean drinking water by the government. Drains with discharge from kitchens and toilets are not covered, and often hold floating plastic bottles and cans.

Pesticide residue and lead in water are other issues—not connected with sugar mill effluent. Protracted consumption of water with high TDS increases the risk of chronic health conditions, liver and kidney damage as well as weakens the immune system. In one area, the government built a water-purifying facility a few years ago, which has since deteriorated and never been repaired.

All sugar mills/other industries have effluent treatment plants (ETPs) mandated since several years now. Every industry and its ETP outlets are connected to a central monitoring system that regularly reads and sends data to state PCBs and CPCB. If the PCB receives information that the limits have been exceeded, the industry is sent a notice and serious action is taken. However, since the parameters that CPCB monitors are not available to the public, there is a lack of transparency in the system.

Local branches of the UP PCB profess they carry out inspections every three

months, and once a month for industries in the red zone. India colour codes its industrial clusters depending on their environmental impacts. With a pollution index score of 60 and above, sugar industries are categorized as red.

Technology to the Rescue?

With the right technology, ETPs should be able to treat wastewater: involving the decomposition of organic matter using microorganisms, followed by other chemical processes. Though the villagers feel they should be consulted every time an ETP is installed. This is because sometimes, behind the ETPs near the villages, a cluster of dirty ponds develops with the wastewater discharged, which breed mosquitoes and other insects. ZLD (zero liquid discharge) is another mandated regulation for five industries in India, including sugar. Here, wastewater is recovered/recycled/purified and contaminants turned into solid waste, to prevent detrimental environmental impacts. The focus is to produce clean water suitable for reuse. Experts say the ZLD business in India had grown substantially in FY20 to become an INR 450 crore market.

Challenges Ahead

According to wastewater and pollution experts, "avoiding the cost of water treatment by forging data to mislead pollution agencies is a clandestine practice among a wide range of industries across India and elsewhere". Corruption exists and accountability is low. The government claims they don't have enough staff, systems, facilities, or data in place to carry out continuous monitoring.

The UP area faces multiple challenges, including climate change and water depletion. Over the past few years, temperatures have started to increase abnormally around February, affecting the production of crops. Despite the reduced rainfall, farmers are still cultivating sugarcane because they can tap into groundwater reserves to irrigate their fields. But, if a water body does not receive sufficient fresh water to dilute the concentration of waste being dumped in it, the waste can percolate inside and impact the land and groundwater. An alarming fact is that over 27 per cent of industry wastewater in UP is released in the Kali River alone, that eventually joins the Ganges.

A NITI Aayog report found that 70 per cent of water in UP is polluted and cited "unsustainable sugarcane production" as

one of the possible sources. However, an Oxfam study pointed out that the lack of information from monitoring agencies makes the investigation process difficult.

Next Steps

This is not just the case of UP. Farmers are retaliating about groundwater contamination allegedly by sugar mills in other states too, as in Kagwad, Karnataka reported in *The Times of India* in September 2021. A molasses spillage in 2018 from a sugar mill in Punjab polluted the Beas River, and it was fined a huge penalty by the Punjab PCB as reported in *The Tribune*.

Should villagers living near polluting industries continue to bear the brunt of poorly implemented environmental regulations and water scarcity? One solution is to regenerate water bodies, as per government guidelines and initiatives. The aims are several—to make pollution-free water bodies; to preserve excess water during monsoons; to restore and augment storage capacities of water bodies; enhance groundwater recharge; and increase the availability of water for domestic and agricultural purposes. The guidelines for this by the ministries of Water Resources, River Development and Ganga Rejuvenation, Housing and Urban Development, etc., cover both 'stagnated' and 'rolling surface' water bodies.

Other steps include conducting further studies to establish a link between industrial effluents and human health. Even so, experts say individual water samples are not sufficient to determine the extent of environmental damage caused by polluting industries. This should be complemented by soil testing, detailed mapping of the water quality from hand pumps and borewells in the area, and, where possible, blood tests to assess residents' health.

All in all, stakeholders (public, private, and non-profit) will need to work together to improve the operational performance of sugar and other industries through enforcing the wastewater discharge standards, and wastewater conservation and pollution control management protocol. Industrialization is inevitable for economic development, but it is up to us to ensure that all sectors use our natural resources sustainably and responsibly.■

Anita Khuller has over 22 years of experience in technical writing/editing, new business development, communications/training, and capacity building in multi-national non-profit and consultancy sectors in South and Southeast Asia, in the clean energy, waste, environment, infrastructure, rural development and education areas.

Health Hazards Posed by Sanitary Pads

In this article, **Dr Rina Mukherji** discusses revelations made by a recent study on menstrual products. Undertaken by Toxics Link, this study reveals the rampant use of plastics and plasticizers in sanitary pads – the most popular menstrual product used by Indian women.

Considered an indispensable part of female menstrual hygiene today, sanitary pads can, ironically, pose a major health hazard, owing to the extensive use of plastics and plasticizers. This was highlighted in a recent study, "Wrapped in Secrecy: Toxic Chemicals in Menstrual Products", undertaken by Toxics Link, in collaboration with TUV SUD South Asia, with support from the Swedish Society for Nature Conservation (SSNC).

The study, which covered 10 leading organic and inorganic brands in the Indian market, found a host of parabens, phthalates, and volatile organic compounds that are known health hazards being used in female hygiene products due to a lax regulatory regimen.

The study looked into the qualitative and quantitative aspects of inorganic brands. In all, there were 10 major brands that were examined. Surprisingly, although organic pads are considered to

be much safer—since they use organic materials and are biodegradable, the study found both inorganic and organic pads to be equally ridden with parabens, plastics, and plasticizers. This, the study notes, is a major health hazard, especially since a sanitary pad is in direct contact with the vulvar and vaginal tissues, which are more permeable and covered by mucous. This results in direct transfer of harmful chemicals into the circulatory and reproductive systems of a person using the product.

Evolution of the Modern Sanitary Pad

Sanitary pads were found to be in use in Greece sometime around the 10th century. However, they were developed in their present disposable form by nurses sometime in the 1800s, to control excessive bleeding during wartime. The product was then commercialized and became an important part of most women's basic needs in due course.

Initially, sanitary pads were made of wood pulp and cotton, due to their super-absorbent qualities. These were later replaced by cellulose in recent times. Currently, plastics and plasticizers form an important part of a typical sanitary pad, with synthetic plastic being used extensively to improve softness.

The layers of a typical modern sanitary pad are:

- **Top layer**: made of a perforated polyethylene (PE), of polypropylene (PP) plastic sheet
- **Synthetic chemicals**: artificial perfumes, heavy metal dyes
- **Transfer layer**: made of synthetic fibres or cellulose-based pulp
- **Absorbent core**: made of sodium polyacrylate (SAP), which is derived from crude oil
- **Adhesive**: hot melt glue
- **Bottom layer**: made of Polyethylene (PE), which is a petrochemical-based plastic
- **Release paper**: coated with silicone

Although sanitary pads have been around for a long time, a lot of women continued to use traditional absorbent cloth during their periods, due to affordability issues. The growth of the Indian sanitary napkins/tampons market over the last two decades has gone hand-in-hand with rising incomes. While the number of pads sold in 2006 was close to 1.25 billion, sales went up to 5.12 billion pieces by 2016. In terms of value, the Indian sanitary napkin market was worth USD 521.5 million in that year. The market is expected to grow to reach USD 1185 million by 2027. Currently, the market is dominated by Procter & Gamble (P&G), Johnson & Johnson, and Kimberley Clark, with P&G's *Whisper* commanding 50.4 per cent, followed by Johnson & Johnson's *Stayfree* with a 23 per cent share. Kimberley Clark's *Kotex* commands a 2.2 per cent of the market, with the rest being filled up by sundry smaller brands (as per a 2016 report by Euromonitor International).

Problems Posed by Plastics and Plasticizers

The major health hazard is from the use of plastics, plasticizers, and volatile organic compounds (VOCs) used in sanitary pads. The share of plastics and plasticizers has been progressively increasing in recent times. Plastics in sanitary pads disturb the balance of vaginal microflora and may result in uro-genital tract infection, rashes, and the like.

Sodium polyacrylate (SAP), a petrochemical derivative which is used in the absorbent core of almost all commercially available sanitary pads, is believed to have negative effects on the health of its users, with prolonged contact being linked to rashes and toxic shock syndrome (TSS). Other plasticizers of concern include bisphenols, parabens, and triclocarban (TCC). Parabens are antimicrobials used as preservatives in feminine care products, whereas TCC is an antibacterial agent.

Phthalic acid esters, or phthalates are plasticizers used to make the material softer and more flexible, increase plasticity, and reduce viscosity. Phthalates are generally used within the layers of sanitary pads to enhance elasticity and gel-like properties. These are also used in hot-melt adhesives, to join different layers of the pad. Added plasticizers like these are known to be 'endocrine disrupting chemicals' that can negatively impact female reproductive health.

Exposure to parabens is linked to breast cancer, while bisphenol A (BPA) is linked to reducing the viability of germ cells involved in reproduction. VOCs

are added as fragrances, adsorbents, adhesives, moisture barriers, and binders in feminine hygiene products, air fresheners, moth repellents, deodorants, and paints. VOCs have low water solubility and high vapour pressure. Vapours from VOCs are released in the form of gas, and due to their volatile nature, are linked to several negative effects such as: endocrine disruption, infertility, birth defects, and cancer. In sanitary pads, they are used as absorbents, moisture barriers, adhesives, and binders. VOCs such as benzene, styrene, chlorobenzene and acetone are of particular concern, since they can adversely affect humans.

Loopholes in the Regulatory Regime

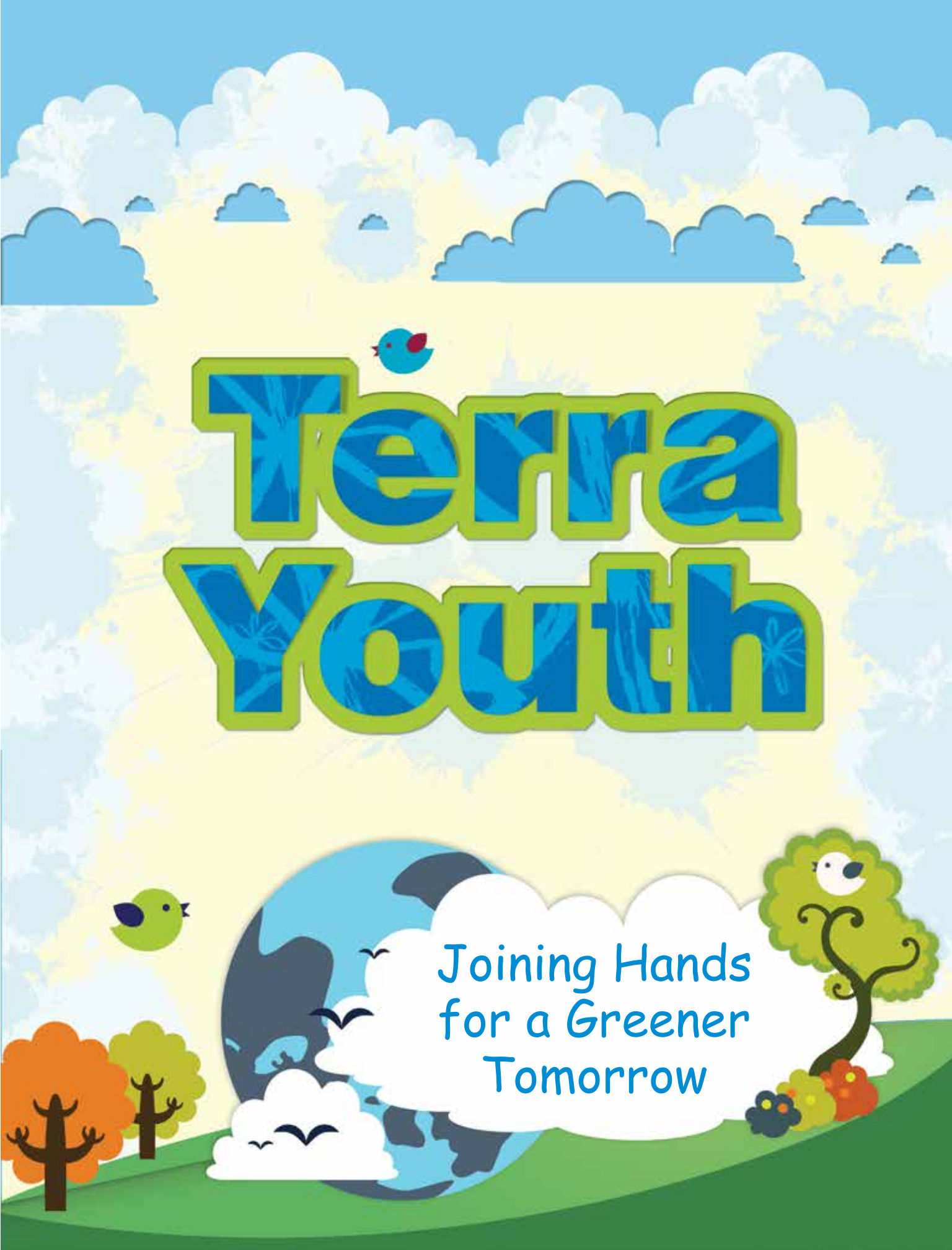
In India, unlike many other countries, there is hardly any regulatory regime overseeing the manufacture of sanitary pads. The Bureau of Indian Standards (BIS) recommends only basic tests to determine the absorbent filters. Since sanitary pads are considered 'medical products', manufacturers are exempt from listing the ingredients in the product.

Furthermore, sanitary waste is classified as 'solid waste' and not 'biomedical waste'. Hence, sanitary napkins and tampons end up in landfills. Although a new set of guidelines were issued in 2018 to prevent sanitary pads from getting dumped in landfills, the recommended local incineration has fallen short of the intended solution. This is because both rural and urban incinerators generally do not meet the required guidelines of high incineration temperatures. Therefore, one is faced with the risk of chemicals finding their way into the environment owing to incomplete burning.

The Solution

Given these facts, the study, while calling for a thorough investigation into the potential impact of VOCs and phthalates in sanitary napkins on the health of women users, demands the framing of standards regarding chemicals in these products. It should be mandatory for manufacturers to disclose the ingredients used through suitable labels on these napkins. At the same time, it notes that regulations and schemes ought to be promoted for the substitution and reduction of harmful chemicals in sanitary pads in the near future.■

Dr Rina Mukherji is an independent journalist with more than 25 years of experience. She holds a doctorate in African Studies and has several media and academic awards to her credit.


Terra Youth
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Evolving Animals of the Pyro Age

Animals have been evolving since a long time in order to fit the challenges posed by climatic conditions. **Jnyanam Bordoloi** is absolutely right when he says species evolve over time, in order to survive and eventually thrive, in some of the most difficult environments created by climate change. When we know which species are leading the race for survival, we can work for the conservation of the ones who are at risk, and the fragile ecosystem they hold.

Animals have always fascinated me. The way the birds dance, the speed at which the falcons dive on their prey, the ferociousness of tigers while protecting their territory and everything else like this. Sometimes, it makes me curious, thinking about how did animals become what they are now? It appears that the answer to my question is evolution.

Evolution is a process in which organisms change their physical and behavioural characteristics in order to fit in the ecosystem they build, along with other organisms, that live in that specific environment. It is this process of evolution which has created the wide variety of organisms we see today. Darwin, the father of evolution, explained that animals evolve according to their selective habitat. He determined that the process is long involving several generations of a species until it finally evolves into a different species. He explained that each generation of offspring representing their parents' characteristics developed the necessary adaptation, physically or behaviourally, for overcoming certain challenges they face in their habitat. An offspring who develops such instincts or physical characteristics, surpasses its siblings and cousins in the race of survival, passing its genes to the next generation. Generation wise such characteristics become more distinct, eventually creating a whole new species. This made me wonder if animals are even evolving in response to climate changes the world is experiencing right now.

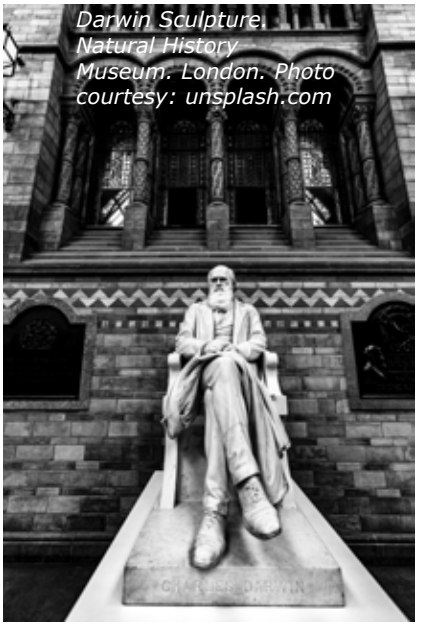
Hawksbill turtle

Animals have been evolving since a long time in order to fit the challenges posed by climatic conditions. One such challenge a great shank of species face was climate change during ice age. Animals evolved into giants and developed insulative mechanisms for keeping themselves warm during the sheer cold in the ice age. However, with the rise of temperature, during the later period of the ice age, some animals failed to evolve in response to that transition of climate at the right time and so they became extinct. Others, that is, the present-day thriving creatures evolved the right way at the right time. That is how evolution works—the ones who change on time, survived and the ones who don't, die. Animals are still undergoing the same phenomena of

adapting according to climate change. Except for this time, they are evolving for the pyro age.

The term pyro age, which is used by scientists to describe this period of climate change caused by a rise in global temperature, has already become a serial killer. This rise in global temperature is initiated by the increasing insolation effect, which is a result of large emission of greenhouse gases due to anthropogenic activities. According to the Living Planet Report 2020, more than 4300 vertebral species faced a severe decline in their population (i.e., an average, of about 68 per cent). About one in every four species is facing extinction.

Apart from this, some species are behaving in an unnatural manner, leading to frequent conflicts between man and animal. In many cases, the conflicts don't settle peacefully. Sometimes humans get injured and sometimes the animals. The rising human–elephant conflict cases in Assam, a north-eastern state in India, is one such example. Roads, railways and farms have been built in elephant corridors. Unable to figure out a safe route, the elephants, in many cases, get hit by trains and sometimes they end up destroying human property. Many elephants, especially the younger members of the herd, get stomped on when crowds of humans create chaos among the herd and sometimes when victims of their unintentional destruction retaliate. However, elephants have been observed changing their itinerant paths in order to prevent such conflicts.



Darwin Sculpture, Natural History Museum, London. Photo courtesy: unsplash.com

Tawny owl

But, how do animals feel the need for adaptation in the first place? Well, it appears that it is an instinct for them. Animals possess a genetic setting of changing either their behaviour, or their appearance whenever they feel it can be beneficial for their survival, and this occurs generation-wise. Similarly, several animals have adapted to catch up with the changing environment. For instance, the tawny owl *(Strix aluco)* found in Europe and Siberia, a species of medium-sized owl, changes colours according to season. To camouflage in winter, they change their feathers to pale grey and white and in summer they turn their feathers into irregular brown, creating a striped pattern. Now, as the climate is becoming warmer as well as snowfall is decreasing and summers are lengthening in their habitat, a population of owls in Finland have changed their routing and are now seen in brown for most of the year. Another example, the great tits *(Parus major)* have been observed to prepone their egg-laying time so as to match with the early spring. Because of the early arrival of spring, their caterpillars also start hatching before the natural due time. Such adaptation and changes in behaviour indicate the species' intelligence. This too is linked to shorter winters and the lengthening of warm-weather seasons. Animals have been observed to evolve as a response to change in their natural environment.

But not all the species are quick to adapt, some don't, and when they do, it's too late. Speaking of adaption in response to change in the environment, a species of sea turtle *(Eretmochelys imbricata)* or hawksbill has failed to do that on time. As a result, the population of hawksbill turtle has fallen more than any other species in the previous decade. About 80 per cent of the hatchlings of hawksbills, which hatch on full moon nights, get disorientated by the lights coming from the towns corresponding to the beach. Hundreds of them get stuck in sewage drains, and thousands get crushed by cars. This species of turtle is among those who are unable

to catch up with the manipulation of their environment by men. What could be more sensitive than a massacre of innocent baby turtles, that too on the first day of their life?

However, there also exists species which adapt, and there are species which change in order to thrive even when their environment is manipulated. Corals are adapting to resist bleaching in warmer waters, salmons are changing their migratory routine, squirrels are preponing their time of giving birth, snails are changing the regulation of temperature in their bodies and so much more. I used to think that only animals are smart enough to adapt in order to cope up in this pyro age. But it appears that I was completely incorrect. Following the paths of evolution, plants too, are adjusting their flowering and fruiting seasons and some have also been observed to manipulate certain processes like transpiration, growth and even photosynthesis so as to match the dynamics created by climate change.

Well, now my fascination towards evolution is rising like the global sea level. Speaking of changes in the marine ecosystem, Humboldt squids have been shrinking in size. From the bills of parrots to the wings of bats, they've increased in size. These are adaptations to encounter the rise in temperature, be it in the air or the water—from Anole lizards *(Dactyloidae anolis)* lengthening their toepads to resist blowing away by frequent hurricanes (which too is a consequence of climate change) to Arctic dovekies *(Alle alle)* changing their feeding habits. From Asian elephants *(Elephas maximus)* changing their migratory routes so as to prevent conflicts with men to deer adopting nocturnal behaviour. From house crows *(Corvus splendens)* increasing the usage of self-made tools to various species of bowerbirds *(Ptilonorhychidae)* using human trash as decorative items for their nests. Animals from all over the world are changing, either adapting to the change of climate or for living alongside the advancements made by human beings, without creating any conflict.

Photo courtesy: unsplash.com

Although climate change is creating an era of mass extinction, some astute animals have learned how to prevent its impacts. Animals are evolving. They were created by evolution and have been evolving ever since. And this is a good indication. Studying such cases also helps in conservation. When we know which species are leading the race for survival, we can work for the conservation of the ones who are at risk, and the fragile ecosystem they hold. Evolution is not an option, it is a must. Species evolve over time, in order to survive and eventually thrive in some of the most difficult environments created by climate change, which the earth is experiencing right now. Species change their behaviour and mutate their physical characteristics to keep up with the constant race for survival, as they say "Survival of the Fittest".■

Jnyanam Bordoloi, Std. IX, Faculty HS School, North Guwahati, Dist-Kamrup, Guwahati, Assam, India.

ISA and Invest India Workshop

Encourages Start-ups and Entrepreneurship in Solar in Mauritius

The International Solar Alliance (ISA) is an international organization with 114 Member and Signatory countries. It works with governments to improve energy access and security worldwide and promote solar power as a sustainable transition to a carbon-neutral future. ISA's mission is to unlock USD 1 trillion of investments in solar by 2030 while reducing the cost of the technology and its financing. It promotes the use of solar energy in the Agriculture, Health, Transport and Power Generation sectors. ISA member countries are driving change by enacting policies and regulations, sharing best practices, agreeing on common standards, and mobilizing investments.

On April 6, 2023 at Port Louis, Mauritius, ISA and Invest India in collaboration with the Economic Development Board (EDB), Mauritius organized a Capacity Building and Knowledge Sharing Workshop for start-ups and small business entrepreneurs at the High Commission of India, Mauritius to encourage entrepreneurship in solar and create awareness about ISA's SolarX Grand Challenge programme. The session highlighted important aspects of the solar energy ecosystem, key information on the criticality of entrepreneurship in solar and climate change, the 'problem statements' that are necessary to solve towards finding a sustainable pathway and useful knowledge that local entrepreneurs may utilize.

Dr Ajay Mathur, Director General, International Solar Alliance, said, "The SolarX Grand Challenge is part of our two-pronged strategy to ease solar deployment in Africa. The first edition of SolarX will focus on the African region to attract investments in the solar energy sector, reduce the gap between energy demand and supply, and promote a robust start-up ecosystem in Africa. "With an estimated potential of 7900 GW of solar in Africa, and only 4 African nations having a start-up ecosystem, there is a yawning gap between what is needed and what is available. African start-ups attracted less than 1 per cent of global venture investments. With SolarX, we aim to change this scenario. This initiative will also help implement the roadmap to mobilize USD1 trillion for solar till 2030." While congratulating Invest India, EDB and ISA for this very timely and pertinent event during his keynote address, Mr Vimarsh Aryan, Deputy High Commissioner of India to Mauritius, also highlighted key aspects of the strength and diversity of the bilateral relationship between India and Mauritius. He also emphasized the enormous opportunities and potential that exist in the renewable energy sector, especially solar and the pivotal role that India, Mauritius and African countries can jointly play in tapping this enormous potential for the benefit of mankind. He urged all participants to actively participate in the workshop and benefit from the SolarX Grand Challenge. He further added that "India remains committed to supporting partner countries, especially from the Global South, by sharing its experiences and expertise in line with the Indian ethos of *Vasudhaiva Kutumbakam*."

Dr Drishtysingh Ramdenee, Director, Economic Development Board (EDB), thanked Invest India, the International Solar Alliance and Waipa for the organization of this unique challenge and for their consideration of Mauritius for the capacity building workshop. Dr Ramdenee provided an overview of Mauritius' conducive ecosystem incepted by Government to achieve the 60 per cent renewable energy in the electricity mix by 2030. ■

More information at https://isolaralliance.org/

Green Holidays

Concepts of Ecotourism and Sustainable Tourism

In this article, **Heemal Handoo Bhat** dwells into the concept of green holidays or ecotourism. Green holiday chiefly involves holidaying in destinations where birds, animals, and cultural legacy are the chief attractions. Ecotourism strives to provide tourists a deeper knowledge about the impression of human beings on their surroundings and to facilitate a genuine acknowledgement of the natural habitats.

"Ecotourism is defined as "responsible travel to natural areas that conserves the environment, sustains the well-being of the local people, and involves interpretation and education."

- The International Ecotourism Society

Green holidays means ecotourism, a kind of tourism aimed at non-native, often endangered, natural environments, to aid in conservation endeavours and observe fauna. It includes visiting sensitive, pure, and comparatively less disturbed natural places. It means accountable travel to natural spaces, protecting the environment, and bettering the sustenance levels of the natives. Its purpose could be to edify the traveller, to offer financial assistance for ecological preservation, to majorly help in the economic progress and political emboldening of local communities, or to create a sense of honour for varied cultures and contribute in human safety. Since the 1980s, ecotourism has been undertaken as a crucial attempt by environmentalists, so that the posterity may enjoy going to destinations relatively unadulterated by man's interference.

Green holiday chiefly involves holidaying in destinations where birds, animals, and cultural legacy are the chief allurements. Ecotourism strives to provide tourists a deeper knowledge about the impression of human beings on their surroundings and to facilitate a genuine acknowledgement of the natural habitats. Responsible ecotourism plans comprise those that lower the negative sides of traditional tourism on the environment and improve the cultural uprightness of the locals. Hence, besides assessing environmental and cultural

elements, a fundamental component of ecotourism is the furtherance of careful protection and preservation of natural resources such as water, wood and generation of employment benefits for the local communities.

Ecotourism, also known as sustainable tourism, shows respect to the gifts of nature and aids in uplifting the status of natural treasures. Moreover, it is an intrinsic part of environmental conservation, and a great help in ameliorating the quality of life of the locals. It also engages the ones practising it to know in greater detail about the historical past of other places and safeguarding the historical milestones.

Ecotourism gives the tourists the privilege to take enriching experiences and learning home. It is much more than merely getting information about facts pertaining to various places of visit. It provides them the platform to lose themselves into the cultures and traditions of the locals and creates an indelible imprint in their mind, never to be erased in the lifetime.

It also creates an attitude of solidarity and oneness with not only nature but also the residents. Apart from that, the visitors develop a feeling of sensitivity with regard to the culture of the land. The curious conversations and light-hearted interactions with the natives leads to mutual understanding. In addition to that, ecotourism also stabilizes the economic condition of the places

travelled to. The local economy gets uplifted and more jobs are created.

Sustainable travel reduces carbon footprints, keep the diverse species safe from exploitation and becoming extinct, thanks to the monetary aid by small firms. It keeps destructive habits endangering the environment at bay. The lesser number of people, the lesser refuse and hence, lesser pollution. Eco-friendly travel options are a hit with both solo travellers as well as a complete family.

Harmonious co-existence among communities is another benefit of travelling sustainably. Besides, it also enables the tourists to have a peek into themselves, their thoughts, their perception of the world and the challenges faced by them, thus making them adaptable, flexible, and open minded. It gives them the treasure of once in a lifetime experiences, to be cherished for years to come. Not to forget, the enhancement of their lexicon representing different places they have visited.

Much more than travelling globally or visiting places of interest and fascination, ecotourism creates positive ripples in the waves of ecology and environment. Reshaping the contours of travel, it is the most righteous way of travelling. It is only in ecotourism that conservation, communities and responsible travel come under one roof. Hence, to keep up with providing a constructive experience to the traveller, increasing their awareness about sustainability concerns and encouraging sustainable tourism operations, green holidays need to be practised globally.

On this illuminating note, let's pledge to actualize the thoughtful words of John McConnell, founder of International Earth Day—"Let every individual and institution now think and act as a responsible trustee of Earth, seeking choices in ecology, economics, and ethics that will provide a sustainable future, eliminate pollution, poverty, and violence, awaken the wonder of life and foster peaceful progress in the human adventure." ■

Heemal Handoo Bhat, Principal, Hansraj Model School, Punjabi Bagh, New Delhi.

African Bird to Inspire a Better Water Bottle

With high resolution microscopes and 3D technology, researchers at Johns Hopkins University and Massachusetts Institute of Technology captured an unprecedented view of feathers from the desert-dwelling sandgrouse, showcasing the singular architecture of their feathers and revealing for the first time how they can hold so much water. "It is super fascinating to see how nature managed to create structures so perfectly efficient to take in and hold water," said co-author Jochen Mueller, an assistant professor in Johns Hopkins' Department of Civil and Systems Engineering, who specializes in smart materials and design. The work was published recently in *The Royal Society Interface.* Sandgrouse found in African deserts typically nest about 20 miles from watering holes to stay safe from predators. To get water home to thirsty chicks, the adult males perform one of nature's best examples of carry out, gathering water and flying home with it, a feat made even more extraordinary considering the sandgrouse is holding about 15 per cent of his body weight in water, and keeping most of it safe during a roughly 40 mph flight home that takes about a half hour.

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

Lightning Strike Creates Phosphorus Material

After lightning struck a tree in a New Port Richey neighbourhood, a University of South Florida professor discovered the strike led to the formation of a new phosphorus material. It was found in a rock—the first time in solid form on Earth—and could represent a member of a new mineral group. In a recent study published in *Communications Earth & Environment,* the professor examined how high-energy events, such as lightning, can cause unique chemical reactions, and in this instance, result in a new material—one that is transitional between space minerals and minerals found on Earth.

Source: https://www.sciencedaily.com

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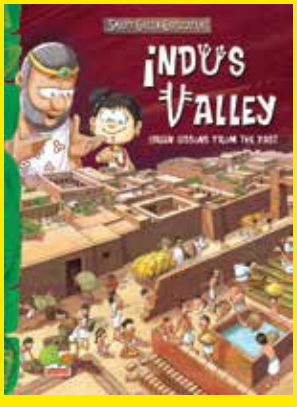

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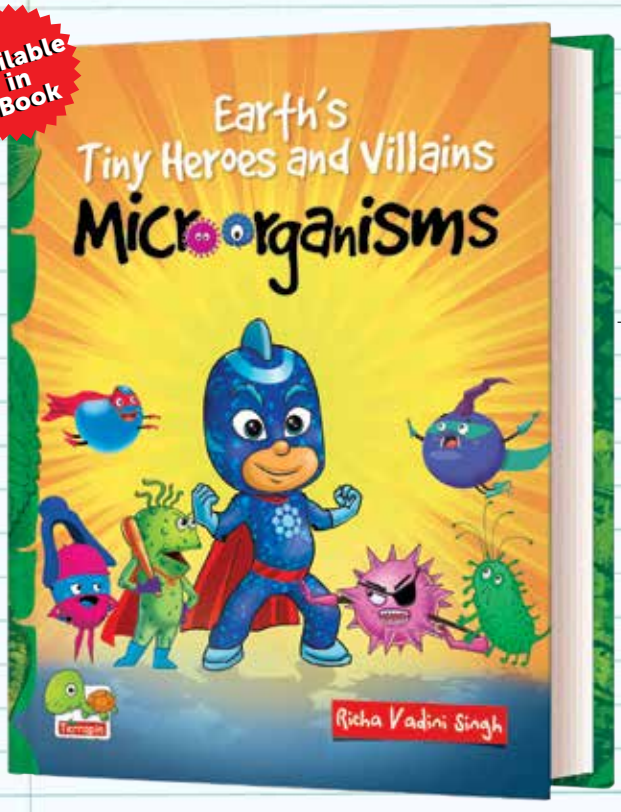

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New Delhi – 110 003/India

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Linde India's CSR Initiatives

In the North Sundarbans

As an organization, Linde is committed to giving back and uplifting the communities in which it works and operates through its various CSR projects. Linde's CSR activities in India include projects to improve road safety, education and healthcare for the underprivileged, disaster relief and rehabilitation assistance, and measures to promote sustainability and environmental protection. The organization has been working across India in various initiatives in the aforesaid areas, partnering with local communities and non-profits.

Linde India Limited is a member of Linde Plc. and one of the leading industrial gases company in India. Linde owns and operates one of India's largest air separation plant and runs several production facilities and filling stations across the country. Linde supplies a wide variety of gases and mixtures and other related services to a wide selection of industries across the nation, both in industrial and healthcare. As an organization, Linde is committed to giving back and uplifting the communities in which it works and operates through its various Corporate Social Responsibility (CSR) projects. Linde's CSR activities in India include projects to improve road safety, education and healthcare for the underprivileged, disaster relief and rehabilitation assistance, and measures to promote sustainability and environmental protection. The organization has been working across India in various initiatives in the aforesaid areas, partnering with local communities and non-profits.

Linde's Initiatives in the North Sundarbans

Sundarbans is a mangrove area in the West Bengal delta formed by the confluence of the Padma, Brahmaputra and Meghna Rivers in the Bay of Bengal, which is prone to natural calamities such as cyclones, thunderstorms, and floods. Sundarbans is home to the world's largest area of mangrove forests, which provides habitat to a wide range of flora, fauna and wildlife, including the famous Royal Bengal Tiger.

Due to the aforesaid vulnerabilities, the Sundarbans are under threat from both natural and human-made causes. Linde's projects in the North Sundarbans attempt to address local community concerns such as access to education, livelihood opportunities, and environmental degradation. Linde aims to bring about change and raise the standard of living of the people in the region through various projects the company undertakes.

Linde also wants to protect the distinctive nature of the North Sundarbans region through these programmes. Linde's initiatives in this region show the company's dedication to sustainable development and corporate social responsibility.

Spreading Digital Literacy through Free Computer Training

Linde and Sandeshkhali Maa Saroda Women & Rural Welfare Society have partnered to increase digital literacy through a free computer training centre at Hingalganj, Taki. The centre, which opened on October 22, 2021, offers basic office programmes and computer lessons to students in this underserved region.

Linde supported the entire centre's construction and continues to offer maintenance and operational assistance. Every quarter, an average of 40 students are trained, and the centre has already trained over 200 students, women, and youth. Hasnabad Hingalganj Block has a population of roughly 4 million people, but due to poverty, the rate of digital literacy is low. Local kids are unable to learn computers as even foundation courses are priced between INR 5000 and 6000 at paid learning centre, which is expensive for many. The training centre at Hingalganj, Taki offers the local people the opportunity to improve their digital literacy and employment possibilities.

The success of this pilot project has prompted Linde to launch similar

programmes across the country.

Restoration of Mangroves in Sundarbans through Afforestation: Team Linde and the Sandeshkhali Maa Saroda Women Rural Welfare Society have launched a cooperative endeavour to restore mangrove forests in West Bengal's North Sundarbans region. The goal is to reconstruct the mangrove wall along the Dasa, Bidhyadhari, Nazat 4 no. Para Bidhyadhari, and Roymongal rivers. So far, about 3 lakh mangrove trees of various varieties such as Jatbaen, Peyarabaen, Kalobaen, Kankra, Garjan, Pasur, Math garan, and Keora have been sponsored by Linde, and are in the process of being planted. Linde will continue to work to restore the region's mangrove cover.

The project will not only protect the environment, but it will also give employment possibilities for local individuals. The loss of mangroves in the Sundarbans as a result of climate change, sea level rise, and sediment depletion has been disturbing, threatening the area's ecological stability. Mangroves protect against natural calamities like cyclones and tsunamis while also supporting marine biodiversity and local livelihoods. This afforestation initiative is a step in the right direction towards restoring mangroves and enhancing the general health of the Sundarbans ecosystem.

Construction of Integrated Child Development Services (ICDS) Centre: Linde has also sponsored the reconstruction of the Integrated Child Development Services (ICDS) Center No. 25, in collaboration with the Sandeshkhali Maa Saroda Women Rural Welfare Society. This centre, which serves children aged 0 to 6, adolescent females, and pregnant and new mothers was in a desolate condition, causing much woe to the benefactors.

Linde and Sandeshkhali Maa Saroda Women Rural Welfare Society, stepped in to renovate the whole facility, completed with solar lights and other necessary facilities. The centre was inaugurated by Abhijit Banerjee, MD – Linde India Limited on February 17, 2023, in the presence of other senior officials and employees of Linde and local authorities.

This centre will serve about 100 children and 50 mothers by providing them with necessary services that will improve their lives. Linde is committed to assisting local communities. Two more ICDS centres are currently being reconstructed in the area.■

Berlin Energy Transition Dialogue

Facilitating Discourses on Global Energy Transitions

India aims to achieve an ambitious target of generating 500 GW renewable energy by 2030. With this target, India aims to meet 50 per cent of its energy needs from renewable sources by 2030. So, we are currently witnessing a significant energy transition in the country. As a media fellow from India for BETD 2023, **Abhas Mukherjee** got a unique opportunity of interviewing and networking with the stakeholders of energy transition in Germany, Europe, and the world. In this article, he gives an overview of the deliberations at BETD 2023 along with some glimpses into Indian participation at the event.

The Berlin Energy Transition Dialogue (BETD) was launched in the year 2015 and since then it has become one of the world's most vital forums on the global energy transition. This year the conference programme was held on March 28–29 at the Federal Foreign Office, Berlin under the motto "Energiewende – Securing a Green Future". The BETD facilitates personal exchange between high-ranking government representatives, global business leaders, scientists, leaders of international organizations, and NGOs. The forum was attended by a large number of foreign ministers, energy ministers, international energy organizations, and experts in the field of clean energy. The two-day conference discussed the challenges in the field of clean energy and how to switch to renewable, more sustainable energy sources, reflecting the international trend towards a green future.

Federal Minister for Foreign Affairs Annalena Baerbock opened the 9th Berlin Energy Transition Dialogue (BETD) on March 28, 2023. She emphasized that "The development of solar and wind capacities in regions where electricity has so far been in short supply offers millions of people around the world the chance to escape the trap of poverty. The BETD conference is the global meeting place for those who want to utilize this opportunity or who are already taking the lead." Dr Robert Habeck, Federal Minister for Economic Affairs and Climate Action, who opened the second day of the conference, felt that the climate crisis requires more, not less cooperation: towards the climate-neutral transformation of the energy systems and the decarbonization of industry, which is now the next challenge we need to tackle.

BETD 2023 also had the august presence of Federal Minister for the Environment Steffi Lemke; Minister for Economic Cooperation and Development Svenja Schulze; and the Director-General of the International Renewable Energy Agency (IRENA), Francesco La Camera besides many other high-profile speakers that included Jennifer Morgan, State Secretary & Special Envoy for International Climate Action, Federal Foreign Office, Germany

Annalena Baerbock, Federal Minister for Foreign Affairs opened the 9th Berlin Energy Transition Dialogue on March 28, 2023

and Dr Simone Peter, President, German Renewable Energy Federation. IRENA's DG Francesco La Camera said, "We must rewrite the way international cooperation works. Achieving the energy transition requires stronger international collaboration, including collective efforts to channel more funds to developing countries. A fundamental shift in the support to developing nations must put more focus on energy access and climate adaptation." La Camera also introduced *World Energy Transitions Outlook 2023 Preview* on Day 1 of BETD 2023 that warns of dramatic lack of progress, calls for strategic shift in the energy transition to sustain 1.5°C climate target.

Kenyan President William Ruto, the first head of state to attend the BETD, delivered the keynote speech on the first day of the conference while the keynote speech on the second day was held by Dr Sultan Al Jaber, United Arab Emirates, President of the United Nations COP28 climate conference this year.

The BETD 2023 also provided young climate activists such as Licypriya Kangujam from Manipur, India, to raise their concern for the planet while delivering their young keynote addresses. Licypriya exuded with confidence when she said that she has a dream that all children living in the world have the access to clean air to breathe, clean water to drink, and a clean planet to live. BETD is a great platform for such young voices from around the world.

International Solar Alliance at BETD 2023

The International Solar Alliance (ISA) with its headquarters in Gurugram, India, is an international organization with 114 Member and Signatory countries. It works with governments to improve energy access and security worldwide and promote solar power as a sustainable transition to a carbon-neutral future. ISA's mission is to unlock USD 1 trillion of investments in solar by 2030 while reducing the cost of the technology

Dr Ajay Mathur speaking at BETD 2023

and its financing. It promotes the use of solar energy in the agriculture, health, transport and power generation sectors.

The ISA also participated in the 9th BETD. Speaking at the panel 'Innovation and Integration as Levers for financing the off-grid sector', Director General of the ISA, Dr Ajay Mathur said, "We've seen a huge increase in the amount of people who are connected through off-grid systems. Today, the off-grid sector is incredibly diverse, however, at the institutional level, the opportunities of off-grid solutions for rural electrification are often rather underestimated, while financial risks tend to be overvalued." Dr Ajay Mathur also highlighted the key opportunities in the off-grid sector saying, "The key problem that occurs is that the regulatory framework of countries often forms a barrier against private sector investment coming in. To advance the off-grid sector, we need an agreement on: regulations, rules and policies that can help scale up the off-grid sector in countries. The second is in order to bring that money in, we need guarantees that pull in private sector investments. I believe that solar and particularly solar mini-grid is the way to provide rural energy access for all today."

Dr Mathur also highlighted the need to substantially ramp up investments up to four times from the current levels to achieve the global clean energy targets. He further highlighted that "The technology solutions to take us to 2030 already exist and continues to improve. The immediate next steps need a holistic policy framework and finance at scale to ensure these technologies are deployed strategically and worldwide. The presence of appropriate governance and regulatory framework provides the basis for realignment of the broader actions under the investment strategy. The existence of supportive regulatory framework also provides private players the confidence to engage and invest."

On the sidelines of the BETD, Dr Ajay Mathur met the President of Germany, Hon'ble Frank-Walter Steinmeier and discussed prioritizing solar towards climate action. The Director General also met H.E. Parvathaneni Harish, Ambassador of India to Germany and discussed areas of cooperation in scaling solar deployment and addressing climate change.

Business-to-Government Dialogue: India

India is the fastest growing economy in the world and has a high demand for increasing energy supply, making it even more important to adapt energy systems to limit greenhouse gas emissions. The business-to-government dialogue offered a forum for exchange between the German energy industry and high-ranking government officials from India. During the two-hour event on March 27, 2023, representatives from India and German business representatives had the opportunity to share and exchange information on the applicable legal and economic conditions in areas of renewable energy and international partnerships. H. E. Parvathaneni Harish, Ambassador, Embassy of the Republic of India, Berlin, talked about Energy Transition Strategy for India. The dialogue was an official part of the supporting programme of the BETD 2023 and the Berlin Energy Week.■

Abhas Mukherjee, Editor, TERI Publications Division, TERI, participated as a Media Fellow at the recently concluded Berlin Energy Transition Dialogue (BETD) 2023 from March 28–29, 2023 in Berlin, Germany.

Feldheim

Hundred Per Cent Energy Self-Sufficient Village in Germany

After his participation in the Berlin Energy Transition Dialogue (BETD) 2023 as a Media Fellow from TERI in March 2023, **Abhas Mukherjee** reminisces his visit to the village of Feldheim, which is one of the most remarkable concepts for supplying enterprises, private households and local government with renewable energies on a decentralized, self-sufficient basis. He learnt how it is possible for communities to be supplied 100 per cent energy with heating and electricity from indigenous, renewable energy sources. The project owes its success to the brilliant partnership between the municipality of Treuenbrietzen, the residents of Feldheim and the project developer, Energiequelle GmbH.

On a pleasant morning on March 30, 2023, I boarded the bus for a guided tour to Feldheim as a side event of BETD 2023. I was quite thrilled that after two days of sublime energy transition discussions under the motto "Energiewende – Securing a Green Future", where ministers and high-ranking delegations from over 60 countries engaged in discussions with representatives from business, science and civil society, I was about to witness a village in Germany which is completely powered by renewable energy. Besides learning about the background of the energy transition, I was looking forward to getting hands-on experience about Feldheim, an energy self-sufficient community, which has plenty of lessons to share in the sustainability sphere. The journey from Berlin to Feldheim

Feldheim wind farm. Picture courtesy: https://nef-feldheim.info/

was quite beautiful as we travelled for about 90 minutes on our bus from the impressive cityscape of Berlin to the spectacular countryside.

Feldheim is located 83 kilometres south-west of Berlin. The Feldheim New Energy Forum is located in Feldheim, a tranquil district within the medieval town of Treuenbrietzen (in Brandenburg). Remarkably, Feldheim produces its own energy from wind, sun and biomass and also feeds it into the grid. Their way of functioning has become a role model for communities around the world. The success of this project is due to the good and cooperative partnership between the town of Treuenbrietzen, the residents of the district, the agricultural cooperative Fläming eG, and the project developer Energiequelle GmbH. Feldheim's hands-on approach to producing its own eco-friendly energy draws thousands of visitors from around the world each year.

The individual households in Feldheim, Treuenbrietzen, are supplied with heat and power from renewable energy power plants on their own doorstep via autarchic local grids or separate distribution networks. The roots of Feldheim's energy prudence date back to 1995, when entrepreneur Michael Raschemann proposed erecting four wind turbines on land owned by the local farming cooperative. The relatively flat and windy landscape proved ideal.

BETD 2023 supporting programme visit to NEF Feldheim

The biogas plant in Feldheim. Picture courtesy: https://nef-feldheim.info/

In partnership with Energiequelle, Feldheim gradually expanded the wind park to its current size, with 55 turbines. Energiequelle GmbH, a renewable energy company that provides project development, planning, and operational management services for wind power, biogas, and photovoltaic plants, designed the various components of this concept. This concept includes cutting-edge, state-of-the-art wind power systems and biogas plants. Energiequelle GmbH installed them as turnkey systems and linked them via the new heat and power distribution system to form a regional energy supply grid.

Wind Energy

As Feldheim is located 150 m above sea level, the wind conditions are really good and, therefore, the nearby wind farm is the backbone of the local power supply grid, while heat is supplied by the local biogas plant. The first wind turbine was commissioned in the year 1995 and today 55 wind turbines stand on the high plateau in Feldheim. These 55 wind turbines with an electrical output of 123 MW supply 55,500 households per year.

Feldheim Biogas Plant

Building on the wind farm's accomplishment, the Feldheim farming cooperative decided to build a biogas plant. Commissioned in December 2008, the village of Feldheim has had its own biogas plant with an installed electric power capacity of 526 kW. The plant is operated by the local agricultural cooperative. The annual biomass input is 8600 m^3/a pig and cattle manure, 8700 tonnes/a of maize silage, and 190 tonnes/a of ground cereals. These raw materials are produced and supplied by the agricultural cooperative. The plant generates 4 million kWh of electricity a year, which is fed into the public grid. The heat produced during power generation is fed into a separately installed district heating grid that supplies the local inhabitants, the livestock farms and commercial enterprises with heating. Each year, around 15,500 m^3/a of livestock manure are produced as a by-product of power generation and supplied back to the agricultural cooperative. Due to their village being self-sufficient in respect of heating energy, the inhabitants of Feldheim save

259,000 litres of heating oil every year. This definitely means they are not only helping to create a cleaner environment, but are also doing financial savings.

Solar Park

The solar farm Selterhof is built on an ex-military centre. The former 45-hectare Selterhof military site served as a communications hub and depot for 40 years until 1994. Construction of the solar farm began in 2008 and was completed in the same year. In the meantime, 284 trackers with 9844 photovoltaic modules generate a total output of 2.25 MWp. The annual yield, therefore, totals to 2748 MWh. This covers the annual electricity requirements of around 600 four-person households.

Wood Chip Heating

The future planning by the New Energy Forum Feldheim is also quite immaculate. In the forthcoming time, the natural fluctuations in the wind power supply will be compensated through a second expansion phase by a battery storage system of the latest generation. A sophisticated heating plant fired with woodchips is available for additional thermal energy requirements on particularly cold days. The wood chip heating in Feldheim has a thermal output of 299 kW. About 460 bulk cubic metres of pine wood chips are used as input annually. The raw materials are obtained from the surrounding forests. Approx. 295,000 kWh are generated annually, thus avoiding 91 tonnes of carbon dioxide emissions. The system is switched on at peak times to produce heat.

Selterhof solar farm. Picture courtesy: https://nef-feldheim.info/

Local Heating Network

The special feature of the Feldheim concept is the separate local heating and power supply network, through which the heat and electricity generated on-site is routed directly to the consumers. In this way, costs and dependencies on the networks of traditional energy suppliers are avoided.

Feldheim District Heating Grid is operational since 2009. Its length is 3000 m and the supplied entities are 35 homes, 1 industrial unit, 2 communal

Feldheim Regional Regulating Power Station. Picture courtesy: https://nef-feldheim.info/

buildings, and 4 agricultural units.

The gas produced in the biogas plant (BGA) is used to operate a block-type thermal power station (CHP), which generates electrical energy and heat at the same time. The heart of the CHP is a motor with an output of 526 kW, which generates electrical energy via a connected generator. The heat generated during the combustion process is largely not released into the environment, but used to operate the biogas plant and to supply households and businesses in Feldheim. This process, known as combined heat and power, enables a very high level of efficiency and is carbon dioxide neutral, since only the exact amount of carbon dioxide that the plants used previously absorbed is released.

Local Benefits

The following are some of the benefits for the local community and environment at Feldheim:

BETD 2023 supporting programme visit to NEF Feldheim

Feldheim woodchip heating plant. Picture courtesy: https://nef-feldheim.info/

- Diversification/commercial use of agricultural products
- Security or creation of new jobs in the local farming cooperative
- Economical and ecological energy
- Increase in value remains in the region, as all input is produced locally
- Eliminates the "import" of 160,000 litres of heating oil
- Generation of business tax revenues from wind farms and biogas plant
- Potential: the arrival of "other" clean industries
- New Energy Forum (NEF) Feldheim: Education and Information Centre
- The town of Treuenbrietzen and the district Potsdam-Mittelmark position themselves as a centre of excellence in the field of renewable energies.

Awards and Accolades

Feldheim is the only renewable energy village in Germany. It is 100 per cent carbon dioxide neutral and also provides cent per cent independent, direct energy supply. It is, therefore, not difficult to guess that Feldheim has won several accolades in the previous years, some of which are as follows:

- Bioenergy Village 2010
- 365 Landmarks in the Land of Ideas 2011
- German Solarpreis 2014
- ELR: Project of the Month, June 2015
- Agenda-21-Prize for the region 2016

While I got this golden opportunity of visiting Feldheim and getting a hands-on experience of the awe-inspiring things going on at this energy self-sufficient village, they also offer schools a four- to five-hour long project day. Pupils learn about the energy self-sufficient village of Feldheim and gain compact knowledge of the production, storage, and transportation of energy. Talking about energy self-sufficiency and energy transition in the world, Feldheim is the place to practice it to perfection!

As I bid adieu to Berlin, Germany after the conclusion of the BETD 2023 and Berlin Energy Week on March 31, 2023, my mind fondly recapitulated the amazing things on energy transition that I had learnt here and resolved to disseminate the messages/ideas gathered from this unique conference.■

Abhas Mukherjee, Editor, TERI Publications Division, TERI, participated as a Media Fellow at the recently concluded Berlin Energy Transition Dialogue (BETD) 2023 from March 28–29, 2023 in Berlin, Germany. He duly acknowledges websites https://nef-feldheim.info/ and https://www.dw.com/ as valuable resources in writing this article along with his own experience during his visit. Pictures courtesy: https://nef-feldheim.info/

Healthy Aging during Global Warming

New Discovery could Hold the Key

Researchers have long known that many animals live longer in colder climates than in warmer climates. New research in *Caenorhabditis elegans (C. elegans)* nematode worms suggests that this phenomenon is tied to a protein found in the nervous system that controls the expression of collagens, the primary building block of skin, bone and connective tissue in many animals.

Since the *C. elegans'* protein is similar to nervous system receptor proteins found in other species including humans, the discovery potentially brings scientists closer to finding ways to harness collagen expression to slow down human aging and increase lifespan in the midst of global warming. Led by scientists at Washington State University, the study was published in the journal *Aging Cell*. "Based on animal studies, scientists anticipate that human lifespan will go down in the future as climate change drives up the ambient temperature," said senior author Yiyong (Ben) Liu, an assistant professor in the WSU Elson S Floyd College of Medicine and director of the university's Genomics Service Centre. "We have found that warm temperatures leading to short lifespan is not a passive, thermodynamic process as previously thought, but a regulated process controlled by the nervous system. Our findings mean that down the road, it may be possible to intervene in that process to extend human lifespan as temperatures rise."

The researchers looked at a nervous system protein known as NPR-8 in the tiny soil-dwelling worm *Caenorhabditis elegans* (*C. elegans*), a commonly used model organism in aging research. During their study, they observed that worms lacking NPR-8 had fewer skin wrinkles as they aged. They also made the unexpected discovery that mutant worms kept at a warm temperature of 25°C (77°F) had increased collagen expression and lived longer than wild-type worms, which did not happen when the worms were kept at 20°C or 15°C (68°F and 59°F, respectively). To determine whether the neural regulation of collagens may play a role in aging and longevity, they conducted a series of additional experiments and analyses.

"What we saw was that the absence of NPR-8 caused an increase in collagen expression, which increased the worms' stress resistance and lifespan and made them look younger than wild-type worms that were the same biological age," said co-first author Durai Sellegounder, a former postdoctoral research associate in the WSU Elson S Floyd College of Medicine who is now a scientist at the Buck Institute for Research on Aging.

In one experiment, the researchers reintroduced NPR-8 in mutant worms kept at 25°C and saw that this reverted the worms' skin from smooth to wrinkled and significantly reduced the animals' extended lifespan. Next, they showed that the extended lifespan of NPR-8 mutant worms also held up under heat stress conditions, with mutant worms surviving significantly longer than wild-type worms when moved into a 35°C (95°F) environment. Additional experiments identified specific neurons responsible for regulating lifespan in response to warm temperatures and pointed to increased expression of collagens as a driver of the improved lifespan at warm temperatures.■

Adult *Caenorhabditis elegans*

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

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

2. **In your opinion, which section(s) need(s) improvement?**
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   ☐ Green Challenges ☐ Terra Youth ☐ Review

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

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

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

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

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

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

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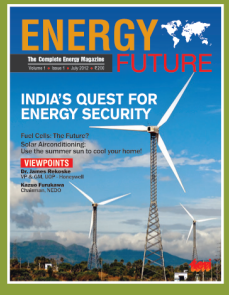

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