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TERRA YOUTH

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

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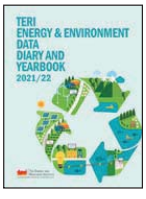

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A TERI Publication

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)

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EDITORIAL

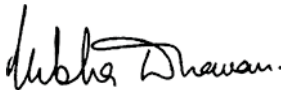
> Bengaluru residents together can make a huge difference by changing their daily habits and issues of water wastage could be significantly addressed through a collective commitment.

Bengaluru, the city known for its high-tech industry, parks and pleasant weather is currently grappling with one of the most severe water shortages in its history. With dwindling rainfall and groundwater levels, the city is on the brink of facing acute water crisis. Despite numerous warnings from climate and water experts, no concerted and timely action was taken which resulted in this misery. The idea of Bengaluru becoming a 'water-deficient' city seemed far-fetched, given its past history of sufficient rainfall. However, the reality on the ground speaks for itself.

This month, our cover story on 'Bengaluru water crisis' highlights that Bengaluru relies primarily on the Cauvery River which is the lifeline for the citizenry and the piped water reaches every home that is supplied by the Bangalore Water Supply and Sewage Board (BWSSB). However, as the city has expanded, certain areas, particularly on the outskirts, have limited access to river water and rely heavily on borewell water and water tankers. The current water shortage may be majorly attributed to a failed monsoon that led to water levels dropping significantly in the Krishna Raja Sagara (KRS) Dam, a key reservoir. Additionally, groundwater levels have depleted or have drastically reduced in many areas. Experts think apart from the challenges of deforestation and climate change, the general systemic and institutional apathy as well as lack of proactive response have led to this chaos. One may not ignore the fact of unbridled planning and conversion of Bengaluru into a concrete jungle which has also contributed significantly to the crisis the city faces today. Experts believe that landscape of the city has been transformed into nonporous paved surface which has restricted the groundwater recharging opportunity. Maintaining groundwater table calls for adequate vegetation cover and rejuvenation of water bodies. It is ironic that the city which once had 1000 lakes and often referred to as 'city of lakes' can no longer take the pride as several lakes dried up over time and it is down to just nearly 200 lakes.

Bengaluru's water shortage has put immense strain especially among the vulnerable sections of the society who can't afford to purchase water from tankers and any other sources. The experts have suggested some immediate and long-term steps to make Bengaluru water sustainable. One of the logical and immediate step to conserve water is enforcement of rainwater harvesting in every home. Another critical step is to rejuvenate lakes by desilting and removing other sediments. Care should be taken to ensure that industrial and sewage effluents are not let in lakes so that clean water can recharge groundwater tables.

Bengaluru residents together can make a huge difference by changing their daily habits and issues of water wastage could be significantly addressed through a collective commitment. The BWSSB has already passed an order banning water usage for car washing, water fountains, gardening, construction and maintenance work, etc., but compliance to such a call would require city-citizenry interface and should be made part of the shared goal.



Vibha Dhawan
Director-General, TERI

I liked reading the cover story of the March 2024 issue of *TerraGreen*. Microplastic (MPs) pollution has become a global environmental concern with significant impacts on ecosystems and human health. Although MPs have been widely detected in aquatic environments, their presence in terrestrial ecosystems remains largely unexplored. I agree with the author that the presence of MPs in agroecosystems underscores the urgent need for comprehensive strategies to mitigate their impacts and safeguard the future of sustainable agriculture. The pollution emerging from plastic-coated agrochemicals is really appalling but is preventable with a comprehensive global approach to plastics regulation in place. As a precautionary measure to protect the human health and cultivation of food that is safe for consumption, it is important to limit the production and use of those agroplastics and agrochemicals that contain persistent contaminants. The entire food supply chain, beginning from the sowing of crops in the field until the plastic packaging on the grocery store shelf must be revamped.

Harish Kumar
Bengaluru, Karnataka

I liked reading the feature story on 'India's quest towards a green future' published in the March 2024 issue of *TerraGreen*, which is a good one indeed. There has been a wide consensus on the need for stronger government agencies, funding and strong willpower to achieve the goal of green growth in India. The sustainable economy is vital for the development of developing nations and it is the need of hour that governments of these countries should take certain steps. These steps may include the policies coming up with the norms that are needed for the eco-friendly economic activities, arrangement and facilitation of investment in green projects, and the acknowledgment and creating resilience towards the market failures. Through its various initiatives Bharat has been successful in taking long strides in its journey towards the target of net zero without compromising its economic development in less than a decade.

Anisha Bali
New Delhi

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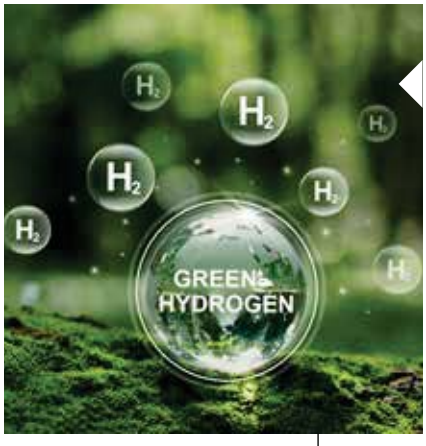


India's First Multipurpose Green Hydrogen Pilot Project at Jhakri

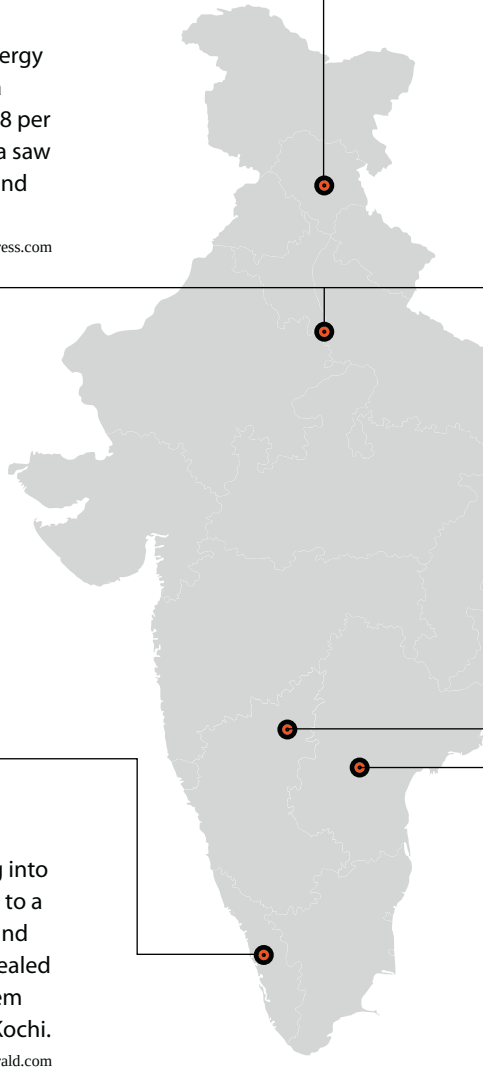
In a significant milestone, the Satluj Jal Vidyut Nigam (SJVN) has inaugurated India's first multi-purpose (combined heat and power) Green Hydrogen Pilot Project at 1500-MW Nathpa Jhakri Hydro Power Station (NJHPS) in Jhakri, Shimla. The state-of-the-art Green Hydrogen Pilot Project was inaugurated by SJVN Chairman and Managing Director Geeta Kapur. The project is the nation's first multi-purpose green hydrogen generation plant with a capability to cater to the High Velocity Oxygen Fuel (HVOF) coating facility of the NJHPS for meeting its combustion fuel requirements in addition to generating electricity through its 25-kW capacity fuel cell. The project is set to produce hydrogen gas by splitting hydrogen and oxygen from water with the help of an alkaline electrolyser of 20 Nm^3/hr capacity.

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

India Becomes World's 3rd Largest Solar Power Generator in 2023

Rapid solar energy deployment in India pushed the country past Japan to become the world's third-largest solar power generator in 2023, according to a new report. The report by global energy think tank Ember said India ranked ninth in solar energy deployment in 2015. Solar produced a record 5.5 per cent of global electricity in 2023. In line with the global trend, India generated 5.8 per cent of its electricity from solar last year, as reported in Ember's "Global Electricity Review". India saw the world's fourth-largest increase in solar generation in 2023 (+18 terawatt hour or TWh), behind China (+156 TWh), the United States (+33 TWh), and Brazil (+22 TWh).

Source: https://indianexpress.com



Heavy Metal Contamination in Fish in Kochi Backwaters

Heavy pollution from industries in Greater Kochi is getting into the water, which is then getting into fish and shellfish, making them dangerous to eat because they have harmful metals, according to a new study. The study by the Department of Marine Technology, Cochin University for Science and Technology (CUSAT), and the National Centre for Coastal Research, NIOT Campus, Chennai, revealed heavy metal contamination in various species of fish and shellfish in the Cochin Estuarine System (CES) in backwaters from Aroor in Ernakulam-Alappuzha border to Eloor, the industrial belt of Kochi.

Source: https://www.deccanherald.com

India Adds Record 18 GW Renewable Energy Capacity in FY24

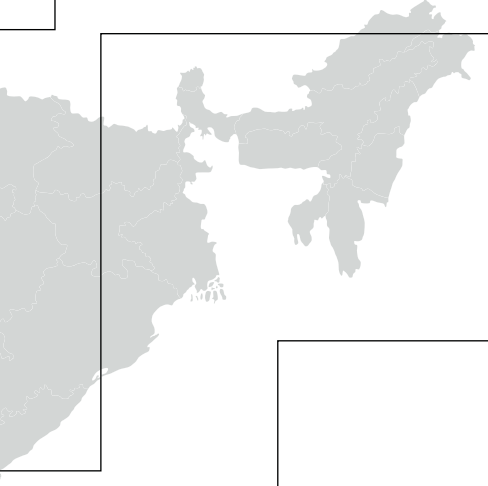
India has added a record renewable energy capacity of 18.48 GW in 2023–24, which is over 21 per cent higher than 15.27 GW a year ago, according to the latest data of the Ministry of New and Renewable Energy. "However, industry experts said there is a need to add at least 50 GW of renewable energy capacity annually for the next six years to meet the ambitious target of 500 GW of renewables by 2030. "According to the data, India's installed renewable energy capacity is 143.64 GW as of March 31, 2024, excluding 47 GW of large hydropower capacity (each plant is more than 25 GW or above). "They pointed out that renewable energy capacity stood at around 190 GW, including large hydro projects, and therefore, India needs to add 310 GW in the next six years or at an average of 50 GW per annum.

Source: https://www.dailypioneer.com/

Hydrogel to Tackle Microplastic Pollution

A team of researchers from the Indian Institute of Science (IISc) may have found a promising solution to the mounting problem: They have designed a sustainable hydrogel to remove tiny plastic particles from water. "The material has a unique intertwined polymer network that can bind the contaminants and degrade them using UV light irradiation," IISc said. Pointing out that scientists have previously attempted to use filtering membranes to remove microplastics, IISc noted that these membranes can become clogged with these tiny particles, making them unsustainable.

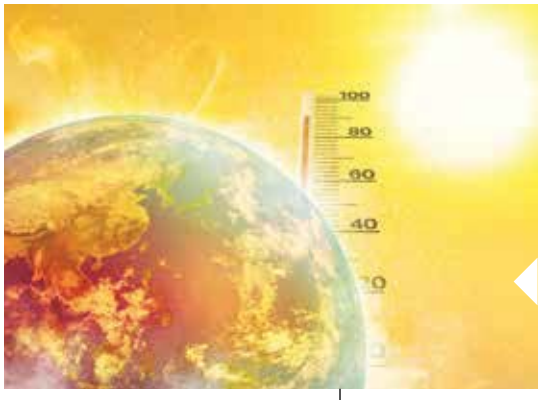
Source: https://timesofindia.indiatimes.com/



Southern India can Lead India's Pursuit of 500 GW RE Target by 2030

India is poised to lead the transition towards a sustainable future with its abundance of renewable resources and a growing interest in e-mobility. Leveraging these resources, Southern India can play an important role in reducing carbon footprint, drive economic growth, and enhance energy security, renewable energy experts and industry players say. A report by the Center for Study of Science, Technology and Policy (CSTEP) highlighted that the southern states, namely Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, and Telangana, boast significant solar and wind energy potentials, collectively totaling 1526 GW of solar energy potential and 1124 GW of wind energy potential.

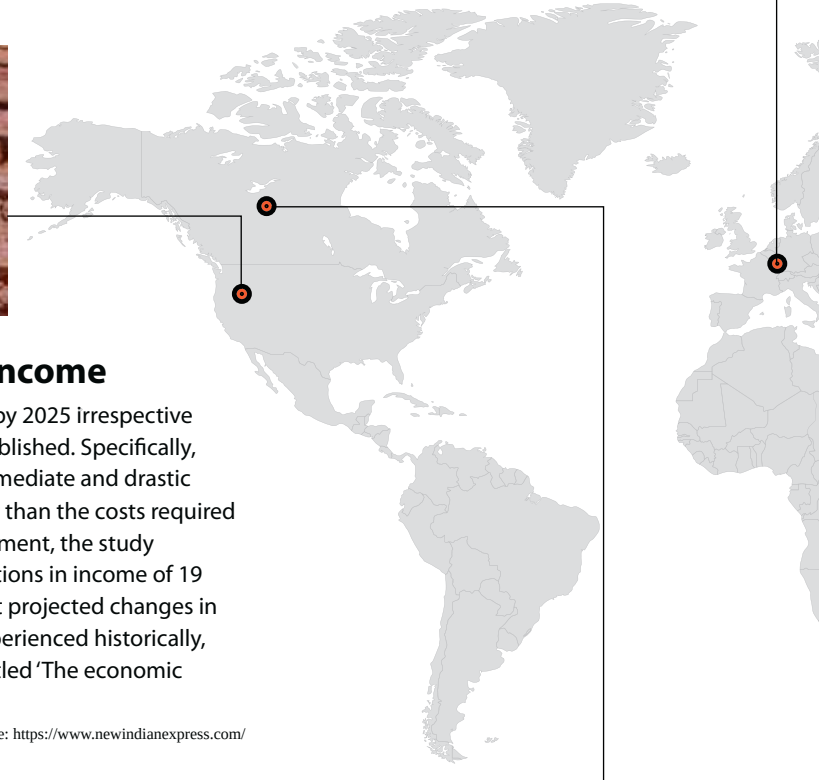
Source: https://economictimes.indiatimes.com/



April 2024 Warmest Since 1940

April 2024 was the warmest April globally since at least 1940, and the 11th month in a row when temperatures records were shattered in a grim reminder of the runaway crisis global warming appears to have become. According to the European Union's Copernicus Climate Change Service, the average surface air temperature in April was 15.03°C, which was 0.67°C above the 1991–2020 average for April and 0.14°C higher than the previous record set in April 2016. The month was 1.58°C warmer than the estimated April average in the 1850–1900, the pre-industrial reference period, surpassing the 1.5-degree threshold that experts had said would be devastating for the world if it becomes the new baseline.

Source: https://www.hindustantimes.com/



Climate Change Could Slash Global Income

The global economy cannot avoid a reduction in its income by 2025 irrespective of how it deals with future emissions, a recent study has established. Specifically, a 19 per cent reduction in income is projected, even with immediate and drastic reductions in CO_2 emissions. This reduction is six times larger than the costs required to limit global warming to 2°C under the Paris Climate Agreement, the study published in the journal *Nature* said. The projection of reductions in income of 19 per cent may appear large. But it arises owing to the fact that projected changes in climatic conditions are much larger than those that were experienced historically, particularly for changes in average temperature, the study titled 'The economic commitment of climate change,' says.

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

Plastic Production Threatens 1.5 Degrees Celsius Limit

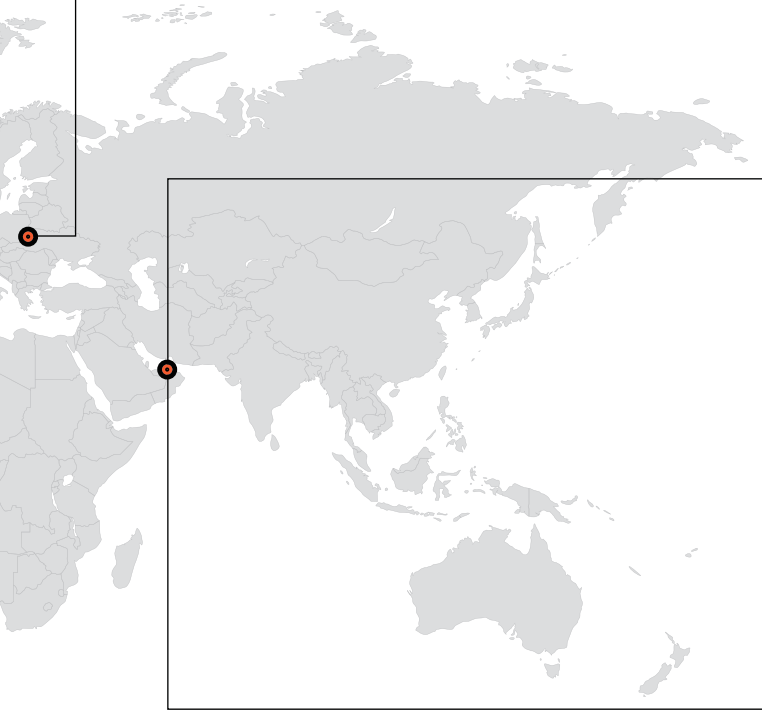
If the current rate of plastic production continues, it could use up the global carbon budget to limit global warming to 1.5 degrees Celsius by as early as 2060 or no later than 2083, according to a new study. The study by the United States' Lawrence Berkeley National Laboratory (LBNL) comes ahead of the fourth round of United Nations negotiations for an international treaty to end plastic pollution in Ottawa, Canada, during April 23–29. It is estimated that global plastic production today accounts for around 12 per cent of total demand for oil and 8.5 per cent of total demand for natural gas.

Source: https://www.hindustantimes.com/

Europe is the Fastest-Warming Continent

Europe is the fastest-warming continent and its temperatures are rising at roughly twice the global average, two top climate monitoring organizations reported recently, warning of the consequences for human health, glacier melt and economic activity. The UN's World Meteorological Organization and the European Union's climate agency, Copernicus, said in a joint report that the continent has the opportunity to develop targeted strategies to speed up the transition to renewable resources such as wind, solar and hydroelectric power in response to the effects of climate change.

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



Deadly Dubai Floods Made Worse by Climate Change

Deadly storms that left Dubai under water and killed more than 20 people in Oman were likely made worse by climate change, scientists say. Heat pumped into the atmosphere by humans made the record rainfall 10–40 per cent heavier, they say. But the natural weather pattern El Niño also drove the intense storms. Scientists warn the link to climate change is not fully certain because the rarity of rainfall in the region gives them little data to work with. The study was carried out by scientists with the World Weather Attribution group. The experts also said the way that cities have been built made the impacts of the storm worse.

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

At Least USD 12 Trillion Needed for Tripling RE Capacity by 2030

At least USD 12 trillion is required to create new infrastructure over the next six years for tripling global renewable energy capacity by 2030, COP28 President Sultan Al Jaber said recently. Addressing the annual Petersberg Climate Dialogue, Al Jaber said the energy transition will not happen without significant investment and a level-up in climate finance. He said the four key priorities to level up climate finance are infrastructure, technology, people and the Global South. "On infrastructure, we need to invest at least USD 6 trillion over the next six years to meet our 2030 target of 11 TW of renewable energy capacity," the COP28 president said. World leaders reached a historic agreement at COP28 in Dubai last year to triple global renewable energy capacity by 2030.

Source: https://www.dailypioneer.com/

East Kolkata Wetlands

Challenges and Solutions

In the article, **Rangeet Mitra** highlights the growing danger on the East Kolkata Wetlands due to anthropogenic activities. He proposes several mitigation plans and recommendations to safeguard the wetlands.

The East Kolkata Wetland (EKW) is situated in the eastern part of the historic Indian city of Kolkata. The Ramsar site spreads between latitude 22° 25′ to 22° 40′ North and longitudes 88° 20′ to 88° 35′ East. It is known as the kidney of the metropolitan city of Kolkata. This wetland ecosystem boasts unique features for treating the city's sewage and serves as a significant food production source for Kolkata and its surrounding areas. It covers approximately 125 sq. km area (45.93 per cent is the water body and 38.92 per cent is the agricultural land) and stretches towards Bidyadhari and Matla River confluence, covering portions of South 24 Parganas and North 24 Parganas. Approximately 750 million litres of sewage of the city passes through this area every day and supports traditional fishing and cultivation process. According to a recent report, approximately 13,000 tonnes of fish and 150 tonnes of vegetables are produced daily in this wetland. Additionally, there are 300 large fish farms in operation, which support the livelihoods of local communities and contribute to the city's food chain. Fish such as silver carp and tilapia are popular species found in these 'bheris', while the wetland also serves as a safe habitat for marsh mongoose and small Indian mongoose. Many significant species of snakes and forty species of birds have been identified by the experts. Also, there are about 100 plant species that have been identified by the experts. Coconut and betel nut trees are the backbone of this ecosystem. This wetland comprises both human-made and natural ponds, playing a crucial role in treating the domestic wastewater generated by the city. The livelihoods of over 50,000 people directly depend on the wetlands.

As per a report published by *The Environmentalist*, people are investing around 5–7 per cent of their monthly income to get access to water. It covers thirty-two *mouzas* or revenue villages spread over two districts—North 24 Parganas and South 24 Parganas. Two municipalities (Kolkata Municipal Corporation, Bidhannagar Municipality) and seven Gram Panchayats (Beonta I, Beonta II, Bamanghata, Tardaha, Kheyadaha I, Kheyadaha II, and Pratapnagar) are under this wetland area. It also cleans city's air and has been working as a carbon sink by storing carbon from wastewater.

Key Challenges Faced at Wetlands

The East Kolkata Wetland experiences tropical weather. The annual mean temperature is 25°C. Usually, it varies from 17–40°C (highest recorded temperature in 30 years is 46°C). Average rainfall is 1600 mm (90 per cent between June and October). Clay soil is available in this area. Majority have opted agricultural and fishery (pisciculture) as their primary occupation. Hydrological structure has linked both natural and man-made drainage and sewerage systems, and it is connected to Sundarbans Mangrove Forest through Bidyadhari River. Due to extensive urbanization and human interventions, there are significant challenges facing Waste Stabilization Pond (WSP) systems, which include natural bioremediation facilities. Below are some of the key challenges:

- It is observed that organic matter in wastewater has been decreasing because of shifting of the livestock outside the city area and quality and quantity of sewage water has been reducing due to silting in the inlet canals. It has impact on fish productions. Experts have reported that operational changes in the lock-

gates on the Bantala sewage canal have led to survival challenges for bheris.

- Nowadays, owners of these bheris have changed their bheri-utilization plan. They are interested to utilize these bheris for picnic, shooting of films, TV serials, etc.
- Maintenance cost is a key issue. Workforce costing, fish feeding materials expenses, etc., have increased the maintenance cost.
- Socio-political issues are also playing crucial roles in these wetland areas.
- Another most prominent issue is urbanization. Because of urbanization, realtors have been illegally encroaching the areas under the EKW and damaging the ecosystem.
- Another most prominent issue is urbanization. Because of urbanization, realtors have been illegally encroaching the areas under the EKW and damaging the ecosystem.
- Calcutta Leather Complex (CLC) is adjacent to the EKW. It has polluted the local environment. Also, sludges from tannery conglomerates have spoiled the local water environment.
- Unscientific solid waste dumping is also causing problems to these bheris.
- Nearby dumping sites (such as Dhapa dumping ground) and small-scale industry (plastic, leather) are also disturbing the ecosystem of this wetland.
- Pollutants have negative impacts on the society and environment.
- Increasing population is another key challenge.

Mitigation Plan and Recommendation

Several strategic steps have been taken by the Government and environmental activists to save the wetland. Migratory and local birds (267), amphibians (10), reptiles (29), mammals (13) and fish (79) have been noticed in this wetland area. Despite the challenges, the EKW is still struggling for survival. To safeguard the

wetlands, the following measures should be adopted:

- Strong action should be taken against the rule violators such as land sharks, local government bodies, etc.
- Robust policy must be prepared to promote the sustainability.
- IEC activities will influence the stakeholders to understand the importance of EKW.
- Restore and promote livelihoods for the stakeholders.
- Nature-based solutions should be adopted to restore the biodiversity and environment.
- Illegal developments should be banned and demolished to safeguard the wetland.
- Plastic usages should be prohibited in this sensitive area.
- Weekly environmental monitoring is desirable.
- Corporate involvement such as CSR investment and knowledge transfer workshops will help stakeholders to establish climate resilient model to sustain the ecosystem.
- Innovative technology will reduce the bottleneck.
- Revenue generation activities such as carbon credits, eco-tourism, etc., will help locals to enhance their quality of life.
- Proper documentation related to East Kolkata Wetlands will transfer key information to the interested people.
- Medicinal plant cultivation will be beneficial for local farmers.
- Providing clean drinking water by encouraging rainwater harvesting and installing renewable energy sources will be the game changer for EKW.
- Natural and artificial drainage systems are to be properly revived to increase the quantity of swage in the wetland.
- Appropriate mechanism should be developed to manage liquid and solid waste.
- Proper demarcation of Ramsar site is required.

Gradually, land sharks are ruining the ecological balance of East Kolkata Wetlands. Due to a lack of knowledge and inertia among stakeholders, there is a failure to grasp the future climate impacts. Signage boards alone serve as the only alarm against exploiting the wetland. Despite Ramsar recognition, there has been no tangible improvement in the ecosystem's condition. The future of this ecosystem appears bleak unless citizens and wetland inhabitants comprehend their roles and responsibilities in protecting this invaluable green treasure. ■

Rangeet Mitra is a development professional who has more than 8 years extensive experience in the fields of sustainability and government policy sector. As a consultant, he has worked with several central and state government organizations as well as non-governmental organizations.

Planet Over Plastic

Brands Leading the Sustainability Charge

Plastic pollution poses a grave threat to our planet, affecting not only our environment but also the well-being of wildlife and human populations. Fortunately, campaigns around the world have raised awareness about plastic pollution and, in some cases, spurred action. However, the challenge lies in translating this awareness and concern into meaningful behavioural change.

Plastic pollution poses a grave threat to our planet, affecting not only our environment but also the well-being of wildlife and human populations. Each year, approximately 10 million tonnes of litter, with 80 per cent of it being plastic, finds its way into our oceans and seas. These plastic products take hundreds of years to decompose, perpetuating their harmful impact.

The Body Shop: Return Recycle Repeat at the store


Xynteo's Waste No More programme

Single-use plastics, such as carrier bags, beverage bottles, coffee cups, and packaging, significantly contribute to this crisis. They are cheap, convenient, and disposable, but their environmental cost is staggering. Fortunately, campaigns around the world have raised awareness about plastic pollution and, in some cases, spurred action. However, the challenge lies in translating this awareness and concern into meaningful behaviour change.

To address this, we must learn from successful campaigns and adopt effective strategies to shift consumer behaviour towards more sustainable choices. Whether initiated by manufacturers, foundations, non-profits, local governments, or international bodies, these campaigns focus on reducing single-use plastics and packaging. By understanding what works and avoiding common pitfalls, we can collectively combat plastic pollution and protect our planet for future generations.

Here's a list of some of the impactful initiatives by different brands to tackle plastic pollution.

Coca-Cola India: "World Without Waste"

Coca-Cola India launched the "World Without Waste" initiative to collect and recycle the equivalent of 100 per cent of its packaging by 2030. They focus on increasing the use of recycled materials in their packaging and promoting responsible disposal of plastic waste.

Recently, Coca-Cola India has introduced bottles made entirely from 100 per cent recycled polyethylene

Coca Cola: World Without Waste

terephthalate (rPET), a first for the Indian beverage industry.[1]

The Body Shop's CFT Partnership with Plastics for Change

With The Body Shop's partnership with Plastics for Change, they are sourcing recycled plastic from marginalized waste pickers in India, providing fair wages and better working conditions. TBS sourced over 400 tonnes of recycled plastic for product packaging in 2021 (doubling this from over 200 tonnes in 2020). They are further scaling up plastic recycling through their Activist Workshop store through the 'RRR' concept and the design where even the store fixtures are made from recycled and sustainable materials.[2]

ITC Limited

ITC's flagship WOW programme is a public–private partnership with municipalities and communities that is turning once unsanitary waste

threatened neighbourhoods into clean and healthy environments. A unique source segregation and collection pathway, WOW works towards a circular economy, one which re-consumes its waste.[3]

WOW's recycling system consists of:

- Waste segregation by households
- Preliminary category-wise segregation by waste collection workers
- Sorting at Dry Resource Collection Centres (DRCCs)
- Super franchisees—large-scale waste aggregators

Xynteo's Waste No More Programme

In collaboration with the partners, Xynteo's Vikaasa developed the Waste No More programme. By building Islands of Excellence at the ward level, Waste No More demonstrates working models on plastic waste circularity. Each Island of Excellence focuses on:

- Strengthening waste management infrastructure
- Integrating the informal sector
- Educating and empowering communities, including children
- Strengthening the ecosystem by informing policy

The programme's first pilot kicked off in Mumbai in March 2020. D Ward, a municipal ward in the heart of Mumbai where a material recovery facility has been set up to collect and sort the incoming dry waste, connections have been established with the informal sector to create one unified supply chain and awareness campaign on responsible waste management has been launched to empower and integrate the communities.

Adidas Primegreen and Primeblue Sustainable Technology

Adidas has developed fabric technologies called Primeblue and Primegreen, which use recycled materials, including plastic waste collected from beaches and coastal areas. These materials are used in their sportswear and footwear collections, promoting sustainability in their products.

This recycled high-performance material, made in part with Parley Ocean Plastic, is just part of their commitment to continue to innovate in the area of sustainability until they reach their goal of being completely off of virgin polyester by 2024.[4]■

1 Details available at https://www.coca-cola.com/gb/en/sustainability/this-is-happening/sprite

2 Details available at https://www.thebodyshop.com/en-gb/packaging/community-trade-recycled-plastic/e00010

3 Details available at https://www.itcportal.com/sustainability/itcs-circular-economy-initiatives.aspx

4 Details available at https://report.adidas-group.com/2020/en/at-a-glance/2020-stories/our-sustainability-initiatives.html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Solid Waste and Marine Litter

Strategizing SWM and Shifting Behavioural Perceptions

Solid waste stands as one of the most pressing environmental concerns worldwide. It reigns as the primary culprit behind marine litter on a global scale, often stemming from indiscriminate waste disposal in public areas. In this article, **Shubham Rai** endeavours to offer targeted frameworks capable of addressing and reshaping behavioural attitudes towards the challenges of marine litter and solid waste management (SWM).

Solid waste is one of the most prominent environmental issues globally. It is the most significant contributor to marine litter worldwide, as it can be attributed to waste dumping in public spaces. Every year, the globe produces 2.01 billion tonnes of municipal solid waste, at least 33 per cent of which is not managed.[1] The impact of solid waste is more prominent in developing and underdeveloped nations. The increment in the usage of plastics has substantially influenced the spread of marine litter as majority of it gets accumulated on coastlines. Plastic accounts for about 80 per cent of total marine litter across the world and is projected to rise with the increment in population.[2] About 40 per cent of total plastic production gets added to waste.[3] Marine litter inadvertently contaminates lakes, rivers, seas, and oceans. Also, it dampens the ecological biodiversity and ecosystem of the marine population. Discarded fishing nets made from plastics are an important contributor to marine litter and damage marine ecosystem by entangling numerous fish, whales, dolphins, sharks and sea turtles, etc. According to the United Nations Environment Programme (UNEP), the abandoned fishing nets threaten 66 per cent of total marine animals. Other primary causes of the marine litter are flood waters, drain discharge, untreated municipal sewage, tourism, ship breaking yards, tributaries of rivers, and industrial wastes. Marine litter goes beyond international territories and becomes very dangerous due to its entry into our food chain after being consumed by marine species. Hence, there is a need to strategize and delve into behavioural and societal changes to highlight and address this major concern on a larger scale. SDG 14 has advocated for the reduction of marine pollution. Thus, this article aims to provide specific frameworks that can tackle and shift behavioural perceptions on the issue of marine litter and solid waste.

First and foremost, the fundamentals of solid waste management (SWM) should be prioritized and implemented effectively to prevent marine litter at source. The waste must be segregated at the source and collected from the doorstep. Adopting a decentralized approach by involving urban local bodies, self-help groups, and non-governmental organizations to organize exhibitions on solid waste disposal, composting, and recycling can augment awareness and shift people's behaviour. Indore, the cleanest city in India, has undertaken this approach by involving municipal corporations and self-help groups in enhancing community participation in managing solid waste.[4] As a result, people's habits improved in segregating and converting kitchen waste into compost, ultimately transforming the city's cleanliness scenario. Also, encouraging public engagement through participatory programmes such as street plays and

1 Trends in Solid Waste Management. (2023). World Bank

2 'Marine plastic pollution'. (2023). IUCN.

3 Chauhan, A. (2023). 'Marine litter menace: Short-term solutions not enough; need robust policy', Down To Earth [Preprint].

4 Mehra, S. and Darbari, T. (2021). 'Behavioural Change: An Efficient Strategy for Waste Management', eGov , December.

social campaigns on waste segregation at source is crucial in combating solid waste challenges.

Secondly, the focus should be on finding sustainable ways to deal with solid waste. Sustainable solutions not only view waste from the sanitation point of view, but it also highlights the economic gains resulting from the waste. For instance, recycling is one of the eco-friendly ways of managing solid waste as it converts waste into usable products and generates income from them. Moreover, recycled waste can be used as cheaper raw materials by industries and businesses for manufacturing and minimize their costs to a larger extent. Thus, recycling could be used as an asset and potentially become a high economic activity. However, solid waste recycling is uneven globally, with developing countries showing lower recycling rates as the activity is done mainly by the informal sector, especially lower-income and poor households. For instance, only 30 per cent of India's municipal solid waste is recycled.[5] Additionally, the uptake of waste-to-energy (WTE) plants has been highly successful, with the potential to generate energy from waste in developing states. Hence, adopting an integrated waste management approach can accentuate revenue generation from waste in the form of energy, recycled products, and raw materials. Consequently, it can play a pivotal role in shifting people's behaviour towards waste management.

Furthermore, deploying market-based instruments might incentivize change in behaviour by raising awareness and encouraging people to reduce solid waste. Also, it can result in increased revenues to manage the resources for mitigation practices and raise awareness on SWM. An example of market-based instruments could be the setting up of environmental taxation. For instance, imposing taxes on plastic bags and setting up a landfill tax to meet the expenses of running a landfill. It will encourage people to recycle rather than dump waste. Strong policy framework is requisite to build a clear narrative for propagating behaviour change across communities on marine litter. Litter laws should be exercised for proper waste disposal, charging penalties for non-compliance. Ships should be charged for disposing of solid waste at ports and seas. Moreover, attempting to reduce, reuse, and recycle by effectively monitoring and managing the waste infrastructure can be compensated through taxation. Besides, taxing coastal tourists to maintain beaches can generate an environmental awareness drive to prevent littering activities at the beach. Fishermen should be incentivized to report, retrieve, and properly dispose of marine litter on coasts and oceans. Also, they should be encouraged to recycle used fishing nets as it has the potential to generate sustainable products.

The usage of social norms can be effective in reducing littering and changing behavioural patterns towards

5 Press Trust of India. (2023). 'India recycles only 30% of 3.4 MT plastic waste generated annually: Report', Business Standard, 11 January.

solid waste. For instance, deploying more dustbins and placing awareness signs, pictures, and mirrors beside waste containers can cause people to reflect on their actions before littering. Hence, it can arouse a sense of self-consciousness towards cleanliness and SWM in the neighbourhood. This was tried in the Netherlands in 2010 and achieved positive results by lowering the frequency of littering in neighbourhoods and immediate surroundings.[6] Besides, campaigning and waste segregation schemes should be launched widely in cities to influence people's behaviour towards waste management. Innovative product packaging is essential for manufacturers to simplify disposal, which can automate source segregation.

6 (2021) Promoting Behaviour Change for Strengthening Waste Segregation at Source. rep. NITI Aayog.

Digital initiatives such as posting positive and compelling messages on social media can augment the level of engagement on the issue.

Education and awareness play imperative roles in knowledge circulation and inculcating behavioural and societal change towards shifting perceptions of SWM. Education through formal and non-formal modes could be a key driver of change as it will encourage people to generate consciousness and become aware of the issue of marine litter. Capacity-building programmes on managing solid waste should be encouraged by international, national, and local agencies. The programmes should focus on providing technical assistance, skill development, and employment generation to captivate people's attention on the matter. Besides, regulatory frameworks, administrative measures, and standardizations are crucial in mitigating marine litter.[7]

7 (2009) Guidelines on the Use of Market-based Instruments to Address the Problem of Marine Litter. rep. UNEP.

Deploying market-based instruments, an integrated solid waste management approach, and social norms can effectively change perceptions. In addition, innovation and persistent efforts towards community participation are key factors in shifting behavioural patterns at the grassroots level. Engagement through communication and outreach events at community levels, such as organizing exhibitions, brief sessions and community initiatives can provide an interactive experience to the general public on the issue of marine litter and help in generating awareness. Furthermore, it will inspire people to make actionable plans to deal with the issue.

In order to tackle the issue of marine litter, several countries have committed to eliminating single-use plastics through stringent laws and regulations. Single-use plastic bags are now completely or partially banned in over 100 countries.[8] In the past decade, the number of policies aimed towards restricting the use of plastic bags have increased significantly across the globe. Kenya has the world's most stringent regulation in terms of banning plastic bags as the production, distribution and use of plastic bags results in four-year prison sentence or fines of $40,000.[9] Also, many states have pledged to support action plans and increase funding for national recycling

facilities in order to reduce marine litter. Clean Seas campaign, launched in 2017 by the United Nations Environment Programme (UNEP) is an effective global coalition aimed at eradicating marine plastic pollution by mobilizing people, businesses, governments, and civil society organizations to modify practices, standards, and policies for significantly reducing marine litter. At present, 63 nations are the signatories of this campaign.[10] Furthermore, the campaign encourages individuals and organizations to join Clean Seas pledge for mapping and reducing their plastic footprint.

The National Mission for Clean Ganga, the Smart Cities Mission, and the Swachh Bharat Abhiyan are notable initiatives launched by the Indian Government to address the issue of marine litter. National level workshops have been held to formulate a national marine litter policy.[11] The Union government has banned the production, distribution and use of 19 single-use plastic products since July 2022. Over INR 3000 crore has been spent on public awareness campaigns and coastal area clean-up initiatives as part of Swachh Bharat Mission (SBM).[12]

Swachh Sagar, Surakshit Sagar, a citizen led campaign was introduced in 2022 by the government to initiate improvement in ocean health by reducing marine litter. However, there is a need for more effective and stringent legislation with a focus on behavioural change to tackle the issue of marine litter in India and globally. The focus on behavioural methods will influence and help generate consciousness of individuals on the matter. Thus, leading to assessing and mapping the consumption footprints and taking steps towards reducing marine litter. Education and awareness, use of social norms, legislation, market-based instruments, and sustainable solutions will play a crucial role in incentivizing behaviour change and addressing the concern of marine litter. ■

Shubham Rai is a young professional who is currently associated with TERI as Project Consultant. His interests include interdisciplinary critical research on contemporary global issues.

8 Charlotte Elton. (2023). '"Really encouraging": Plastic bag bans work, say campaigners. Where is Europe lagging behind?', Euronews.Green, 5 April.

9 The Guardian. (2017). 'Kenya brings in world's toughest plastic bag ban: four years jail or $40,000 fine', 28 August.

10 UNEP. (2022). 'Inside the Clean Seas campaign against microplastics', 17 February.

11 'Status of Marine Litter in the Country' (2022) PIB [Preprint].

12 Chauhan, A. (2023). 'Marine litter menace: Short-term solutions not enough; need robust policy', Down to Earth, 10 February.

Sowing Sustainability

How Urban Farming is Transforming City Spaces into Climate-Resilient Havens

Manindar Singh Nayyar is the Founder & CEO of the CEF Group, a pioneering entity in waste management, renewable energy, biofuels, agriculture, and more, alongside his philanthropic efforts. In recent years, Mr Singh has demonstrated exceptional leadership in managing the company's operations. His initiatives have positioned the company as a trailblazer, introducing innovative technologies tailored to India's social and commercial landscape. In this interaction, he discusses how urban farming is reshaping city environments into resilient hubs amidst climate challenges.

Could you provide details about the work your organization (CEF Group) is doing?

CEF Group, a Delhi-based clean energy provider, is a leading name in the renewable energy field of India specializing in biofuels and MSW/agri-waste management. It aims to deliver a reliable, clean, green and technology-equipped business model for biofuel production, waste management, organic agri-inputs for rural and urban farming across the globe. With a vision of building a green world, CEF Group is creating healthy and sustainable communities and energizing the same with clean and green renewable resources to provide a better life to mankind in future to come.

The Company's mission is to contribute effectively to the advocacy of renewable energy and execute its projects like setting up Bio-CNG plants across the country, urban farmer concept, municipal solid waste and organic manure projects with efficacy by following the highest standards of quality, safety, and environmental sustainability.

Established in 2014, the company drives through three major segments of the industry— biofuels, organic agri-inputs such as organic manure, bio-nutrients, bio-boosters, bio-

pesticides/bio-insecticides along with comprehensive solutions on urban farming.

CEF Group's 'Urban Farming' concept is revolutionizing the way people in urban areas live and alerting them how knowingly or unknowingly they are becoming contributors to environmental deterioration. Urban Farmer is a significant step taken by CEF Group towards converting polluted urban spaces into clean and green. It develops the best green spaces in urban houses by converting balconies, backyards and terraces into live gardens. The highlight of the Urban Farmer concept is that it can modify any space (be it small or large) of your house into an organic food production centre even if it is as small as 200 sq. ft. CEF Group's Urban Farmer team not only converts your urban homes into environmentally friendly

space but also ensures the complete maintenance and sustenance of the space through their dedicated expert Urban Farmer Green Officers (trained and certified gardeners).

Among the biofuels and organic manure segment, the CEF Group is working in alliance with NAFED. This alliance is catering to the setting of 100 Bio-CNG plants in India to reduce the carbon footprint by providing a green alternative to vehicles running in the country. In order to promote organic farming in the country, the CEF group is committed to replacing chemical fertilizers with organic protocols. For this, the CEF group ensures the seamless production and reach of organic fertilizers, organic manure, bio-nutrients/ boosters and bio-pesticides/insecticides to farmers in various parts of the country. In line with the government's Make in India initiative, the CEF group has pledged to provide import substitution in the organic fertilizers and biofuels industry.

Is urban farming a practical response to mitigating the impacts of climate change?

Climate change is no longer a distant concern but a current reality demanding immediate attention. Its effects, from extreme weather to rising sea levels and

resource scarcity, are being felt globally. However, within these challenges lies an opportunity for eco-conscious decisions. Urban farming, once viewed as niche, is now recognized as a practical response to mitigate climate change impacts. By converting urban spaces into sustainable ecosystems, urban farming has the potential to transform our environmental stewardship and build a more resilient future.

The need to address climate change is urgent. The WHO estimates that by the 2030s, there could be an additional 250,000 deaths annually due to climate-related diseases like malaria and coastal flooding. Rising temperatures, melting ice caps, and more frequent extreme weather events are among the outcomes of unsustainable practices. The time to take action is now, and urban farming offers a promising path forward.

How is urban farming a sustainable solution?

Urban farming involves the cultivation of crops within and around cities. This practice not only provides fresh, locally grown produce but also has numerous environmental benefits. By reducing the need for long-distance transportation of food, urban farming helps to lower carbon emissions. In addition, the use of organic farming practices can improve soil health and biodiversity, further contributing to climate resilience.

How does urban farming transform city spaces?

One of the key advantages of urban farming is its ability to convert underutilized city spaces into organic food production centres. Vacant lots, rooftops, balconies, and even vertical surfaces can be repurposed for farming, creating green spaces in the heart of urban areas. This not only enhances the aesthetic appeal of cities but also helps to mitigate the urban heat island effect, which can exacerbate the impacts of climate change.

How does urban farming promote community engagement?

Urban farming also promotes community engagement and social cohesion. By bringing people together to grow and share food, urban farms can strengthen social bonds and create a sense of belonging. This can be particularly important in densely populated urban areas where social isolation is a growing concern. Besides, urban farming can provide economic opportunities for local residents, especially in underserved communities.

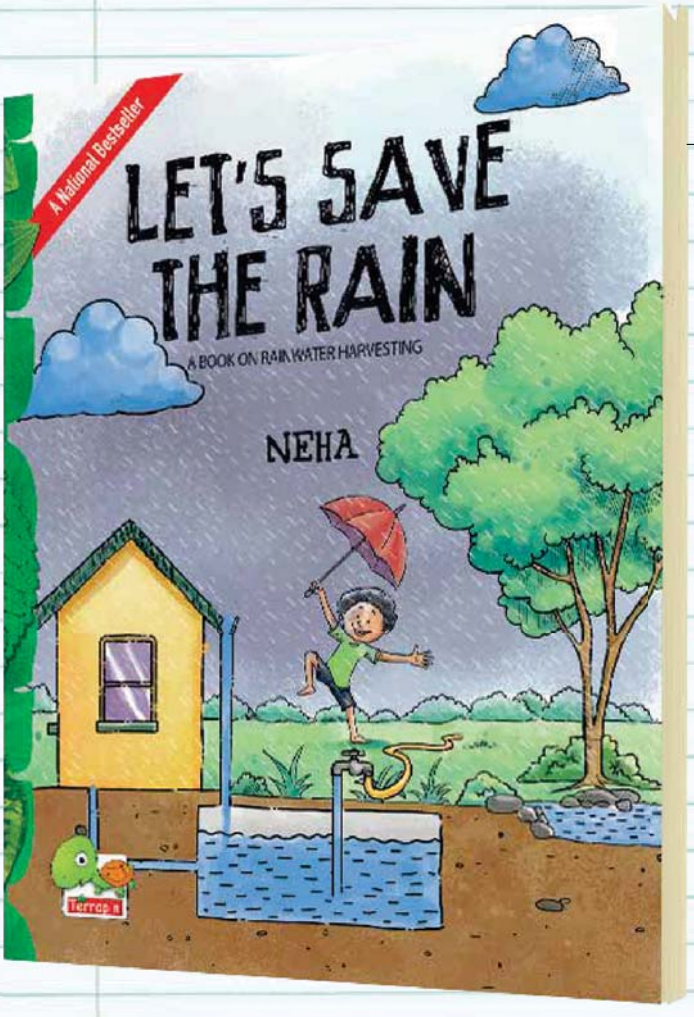
What is the policy support needed to fully realize the potential of urban farming?

To fully realize the potential of urban farming, supportive policies and incentives are needed. While some state governments have extended their support by providing subsidies and thus creating an enabling environment for urban farming, policymakers can help to scale up this sustainable practice and make it accessible to more people.

How could urban farming act as a game-changer in the fight against climate change?

Urban farming has the potential to be a game-changer in the fight against climate change. By transforming city spaces into sustainable havens, urban farming can help reduce carbon emissions, improve food security, and enhance the resilience of urban areas. However, realizing this potential will require concerted efforts from policymakers, communities, and individuals. It is time to embrace urban farming as a solution to climate change and work towards a more sustainable future. ■

Rain Is Gain When We Harvest Rainwater



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Bengaluru Left High and Dry

Water Crisis Hits the Erstwhile Garden City

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

Bangalore, or Bengaluru, popularly known as the land of pleasant weather, is changing rapidly. A city with a climate comparable to that of a hill station seems to be slowly losing its charm, and, most importantly, running out of water. Bengaluru is facing one of the severest water shortages of all times. As the city grapples with less rainfall and depleting groundwater levels, it is only a matter of time before the taps run dry. Although the climate and water experts have repeatedly warned about this predicament, nobody believed that Bengaluru could turn into a waterless city because the city, for the most part, has had a history of adequate rainfall.

Unexpected Water Shortage

A few years ago, a typical day during the rainy season in Bengaluru can be visualized as gloomy sky sporting dark clouds, cool temperature and shower spells which can make it hard for anyone to get out of bed. Sunshine would sprout from time to time. Even Bengaluru's summers are known for rain spells in the evening. But now all we get to experience is scorching heat with sparing rain. It is hard to imagine the current plight, but was this expected? And most importantly how did the garden city aka Silicon Valley turn into a waterless valley?

In an exclusive interview with *TerraGreen,* Vishwanath S, a water expert, and Advisor at Biome Environmental Trust says, "Bengaluru's water crisis is unexpected because it is a groundwater crisis. The pipe water supply from the Cauvery River remains the same at 1470 million litres per day and that will be continued to supply till monsoons in June." He explains that no single authority can be blamed for the water shortage as the Bangalore Water Supply and Sewage Board (BWSSB) continues to do its job of supplying water. He further states that the BWSSB has 1.1 million connections and it gives 1417 million litres per day, and it will give an additional 775 million litres per day. But groundwater needs better management.

Water Status

Bengaluru's water needs are met with Cauvery River which is supplied as piped water by the BWSSB. Along

with river water, the city also depends on borewell water. As Bengaluru has expanded its perimeters, the river water is not available in certain regions especially the outskirts which completely relies on borewell water and water tankers. The present water shortage is the immediate impact of failed monsoon which pushed the water levels well beyond the desirable range in the Krishna Raja Sagara (KRS) Dam. In addition to this, the groundwater has also disappeared or greatly reduced in many regions. Amidst the crisis, the private water tankers have almost doubled the price which greatly affects the common people.

Several news reports claim that migrants in different sectors including tech industry are leaving the city by availing work from home options. At present, the water shortage is experienced disproportionately in the city. The shortage is mostly in the areas which do not have adequate access to piped Cauvery water from BWSSB. But that certainly does not mean that other regions will remain unaffected by water crisis. Whether the entire city will fall into the throes of water crisis will depend on the impending rainfall.

In terms of house types impacted by water shortage, high-rise apartments in the outskirts have also taken a blow. Despite paying high rent and maintenance, apartment residents had to suffer from non-availability of water. Susheela, a senior citizen and a resident of a high-rise apartment, says that she has been living in Bengaluru city all her life, but never had she faced any water shortage. "At first messages began to circulate in our apartment WhatsApp groups that water supply will be stopped from 11 pm in the night to 5 am in the morning to deal with water shortage. But the next morning, there was no water supply. We were shocked and confused. How can we manage without water? We did not even store any water. The RWA of the apartment later told us there was no water in borewells and they were unable to get water tankers. We were so disturbed. It took a toll on my mental health. Later they found tankers, but we were clueless for almost two days. I was thinking that I must shift to my ancestral village if there is no water in Bangalore. Even now I am planning to shift, just in case."

Water shortage has also affected tribal communities in the outskirts of the city. Ravishekhar and Chikkalargamma stay in the Hakki Pikki tribal village which is 36 km from the city near the Bannerghatta National Park. They expressed their challenges of water scarcity especially during the summer. The pots they kept to collect rainwater remain dry as there has been no rainfall for the longest of times. They depend on water tanker that always comes twice a week and is

not regular. Besides, there is a great demand for water due to which they are forced to stand in long queues to fetch water from the tanker. They barely have enough water for basic drinking and domestic work. In such a scenario, they do not get water for their agricultural activities. Bengaluru's water shortage has put immense strain especially among the vulnerable sections of the society who do not have the financial means to purchase water from costly tankers and other sources.

What Drove Water Away?

As evident from the numerous news reports, the water crisis in Bengaluru is mainly due to unplanned urbanization, deforestation, and destruction of lakes. The failed monsoon in 2023 brought the pending doom to the surface. According to Dr T V Ramachandra, Co-ordinator, Energy and Wetlands research group, Indian Institute of Science, Bangalore, the present water crisis is not unexpected. "It was expected which I had told couple of years back. I had predicted in my publication that from 2020 onwards we will face this crisis," says T V Ramachandra. True to his words, Professor Ramachandra had stated in his article published in *Current Science* journal way back in 2016 that Bengaluru

will become unliveable in 2020 by "depriving the city dwellers of clean air, water and environment." The analysis clearly points out that this situation will take place due to loss of green cover, open spaces and increase in urban region (paved surfaces).

"Crisis is because of unplanned, irresponsible urbanization. We are just putting all eggs in one basket without understanding the carrying capacity of a region. For any region to have developmental projects we assess the carrying capacity," he says. He points out that in the last five decades there has been 1055 per cent increase in paved surfaces, and loss of 88 per cent vegetation cover and 79 per cent of the water bodies. "Now if you look at the number of trees in Bangalore, we have 1,478,000 trees for a population of 9.5 million. That means for every 7 persons we have one tree. But what is required for every person is 7 trees." This clearly underlines the problem of imbalance in carbon dioxide output and oxygen requirement,

Dr Ramachandra delineates the connection between groundwater and lakes. He says that 45 per cent of Bangaloreans depend on groundwater which is depleting. "When lakes were present, groundwater was available at 100 to 150 feet. After removal of lakes, within a span of 5–6 years, it went down to 600 feet. Today, in a span of 23 years, the water level has gone down to 1800 feet, and still water is not available in most regions in Bangalore. The groundwater level in the city has declined to such an extent that to replenish it, takes a long time. Coupled with depleting groundwater level, we also have overexploitation of water resources. This aggravates the water crisis."

Dr Ramachandra blames the bureaucrats' irresponsibility for the present crisis. The rainfall problem in Cauvery is due to deforestation and climate change. Conversion of Bengaluru into a concrete jungle is one of the major causes for water shortage. Dr Ramachandra says that we have transformed Bengaluru landscape into nonporous paved surface due to which the groundwater recharge does not happen. "When there is no provision to facilitate the groundwater recharge how can we expect the water situation to improve. Everywhere the region is covered with concrete. For any region to have sufficient groundwater, we need to make the landscape porous. That is possible only when there is vegetation cover and water bodies," he explains.

But Bengaluru's water bodies are in sad situation. According to Bruhat Bengaluru Mahanagara Palike (BBMP), the municipal corporation of Bengaluru, there are 210 lakes in the city. It is ironic that Bangalore which once had 1000 lakes and known as city of lakes is down to just nearly 200 lakes. But even the quality of 200 lakes is questionable. Many of the lakes in the city are encroached upon for construction purposes. Needless to mention they are polluted by industrial and sewage

effluents. And many of these lakes are heavily silted which makes rejuvenation of lakes impossible.

Prof. Ramachandra cites the example of the famous Sarakki Lake in Bengaluru as a success story. "When Sarakki Lake was rejuvenated, within a year the groundwater table improved by 320 feet. Today after three years, when major part of the city faces the groundwater crisis, the Sarakki Lake has enough water and the groundwater table is very good. This model should be replicated in all the lakes. We need to rejuvenate the lake and retain rain water."

According to UNESCO, Bengaluru has a history of famine and drought as early as the 1870s. The city is located far away from rivers and heavily dependent on local lakes and wells. The last famine had caused 100,000 deaths. It is also important to understand the impact of climate change on water situation in Bengaluru. The UN body states that preliminary studies on climate change reveal that annual rains have reduced in the past century. Further, the temperature has increased by 0.6 degree Celsius. It is also projected that rainfall would be heavy during monsoon and less outside of monsoon season. "Drought incidence is expected to rise by up to 10 per cent by 2050. Temperatures are expected to rise by 1.7°C to 2.2°C by the 2030s (Karnataka State Action Plan on Climate Change, 2012, Environmental Management & Policy Research Institute and The Energy and Resources Institute)," states the UNESCO's website.

Prof. T V Ramachandra states that our actions have resulted in climate change. "Climate change has affected rainfall pattern. Instead of rains coming for 4–5 months, it comes in few weeks. We have high density rainfall in short duration. There is no percolation of water. All the water rushes to the ocean. Because of which we have this crisis." He gives the example of the glass mosaic building architecture which is lately used in Indian cities. He says that architecture type is

suitable for European or temperate climate but not for Bengaluru. "Our engineers visit those countries, copy and paste it here in Bangalore environment. Our study shows that the electricity consumption has gone up by 10–12 times which is 10 times higher emission. We have increased the greenhouse gas footprint. This results in global warming and subsequently climate change." He further states that we should have designed a climate resilient city.

Immediate and Long-term Steps

Can Bengaluru be saved from its water crisis? The experts suggested some immediate and long-term steps that can be taken to make Bengaluru water sustainable. Enforcement of rainwater harvesting in all the houses should be an immediate step to conserve water. According to Professor T V Ramachandra, the city receives rain of 700–850 millimetres. It is about 15 TMC and the city requires 18 TMC of water which means 70 per cent of Bengaluru's water requirements is available in the form of rain. This could enable houses to store water for 4–5 months.

Another important measure is to rejuvenate lakes by removing silt and other sediments. Care should be taken to ensure that industrial and sewage effluents are not let in lakes so that clean water can recharge groundwater tables. "If we are able to ensure that the lakes are full, the rainwater harvesting is done during the rains and the aquifers are understood, managed and recharged better then there will be no crisis," says Vishwanath S. Aside from rejuvenation of lakes, treatment of waste water to tertiary level can be done which can be used to fill lakes. Prof. Ramachandra says, "If we are using 18 TMC of water, we are also generating 18 TMC of wastewater. If the same can be treated through nature-based solutions as it is done in Jakkur Lake with algal pond, it would yield 16 TMC of treated water. This along with 15 TMC of rainwater harvesting would totally yield 31 TMC of sustainable water for Bangalore consumption."

Wastage of water in the form of car washing should be stopped. The BWSSB has already passed an order banning water usage for car washing, water fountains, gardening, construction and maintenance work, and other entertainment purposes. A fine of INR 5000 will be levied for breaking this rule. Most importantly, there is a greater need to create awareness on the present water crisis as an immediate effect of exploitation of natural resources and human made large-scale destruction. As Professor T V Ramachandra says, it is important to educate people especially young people about environment. "Environment literacy is only 3.5 per cent. Around 96 per cent people are environmentally illiterate, which results in resources mismanagement, changes in climate and water crisis as seen in Bangalore." We need to understand the environment to save it. ■

Dr Indumathi Somashekar is an Assistant Professor at the Department of Media Studies, CHRIST (Deemed to be University), BGR Campus. She has over a decade of teaching experience at various educational institutions in India. Alongside her academic pursuit, she has extensively written and published science and environment-oriented articles as a freelance journalist. She has published articles in premier magazines such as Down to Earth, Planet Earth and Energy Next.

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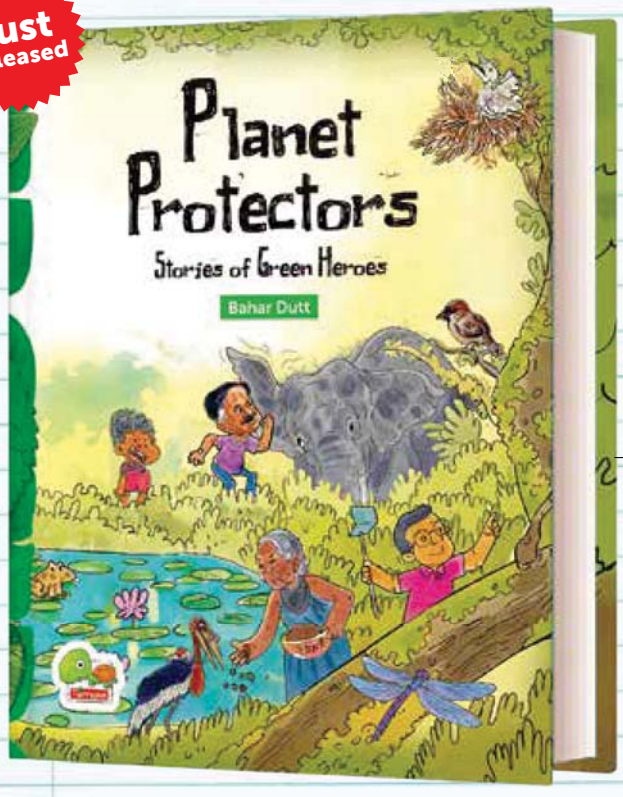

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Preserving Goa's Rich Natural Heritage

Noteworthy Efforts by Groups and Individuals

Discussing the natural riches of Goa, which serves as a sanctuary for a wide array of flora and fauna, **Manu Shrivastava** highlights the efforts of various groups and individuals in the region. They are spearheading initiatives such as nature trails, heritage walks, and educational programmes to raise awareness among locals and curious tourists alike about the region's indigenous plant and animal species. These efforts underscore the ecological abundance and evolutionary legacy embodied by Goa's endemic biodiversity. Keep reading to know more...

Nestled along the pristine coastline of the Arabian Sea in Western India, Goa boasts of a rich and unique natural heritage that has been captivating travellers, visitors, and residents alike. From lush forests to meandering rivers and unique coastal ecosystems, Goa's landscape is a mosaic of biodiversity, sustaining life and balancing the fragile ecosystems of the zone.

Goa's forests, representing a significant component of its natural wealth, are a haven for diverse flora and fauna. The Western Ghats, a 1600-km long mountain chain that spans six Indian states along the western coast and a UNESCO World Heritage Site, cradle these forests, nurturing myriad endemic species. Dense canopies of towering trees provide habitat to elusive wildlife. As per the 'India State of Forest Report (ISFR) 2021', the total forest cover in Goa is 2244 sq. km which is 60.62 per cent of the total geographical area of the state. Forests not only serve as a sanctuary for biodiversity but also play a crucial role in mitigating climate change through carbon sequestration.

India's smallest state Goa is home to many wildlife sanctuaries such as Bondla Wildlife Sanctuary, Bhagwan Mahavir Wildlife Sanctuary, Netravali Wildlife Sanctuary, Molem Wildlife Sanctuary, Cotigao Wildlife Sanctuary, Mhadei Wildlife Sanctuary, etc. Here, diverse terrestrial life ranges from the majestic Indian Gaur and spotted deer to elephants, jungle cats, and a plethora of other species such as Indian giant squirrels, mongoose, slender loris, and sloth bears.

Goa's state animal is the gaur, and the state bird is the ruby-throated yellow bulbul. The forests are home to foxes, wild boars, and migratory birds. Salim Ali Bird Sanctuary on Chorao Island has been preserving its avian treasures, providing a sanctuary for both native and migratory bird species.

The avifauna found in the jungles includes kingfishers, mynas, and parrots. The coastal and riverine areas of Goa are

teeming with a variety of fish species, including crabs, lobsters, shrimps, jellyfish, oysters, and catfish. Goa also has a large snake population, which helps keep the rodent population in control.

With over 450 species of birds reported in the state, Goa's avifauna offers a paradise for birdwatchers. From the slender necked Oriental darter to the colourful Purple swamphen, the state's birdlife captivates with its diversity and beauty.

Katrina Fernandez (left) during a field visit

And then, there are the rivers flowing through the heart of the state. The Mandovi, Zuari, and Chapora rivers, among others, are Goa's lifelines that crisscross the landscape, shaping the terrain and sustaining ecosystems along their banks. These waterways harbour a rich aquatic biodiversity, from fish species to amphibians and reptiles. Additionally, they serve as a source of sustenance and livelihood for local communities, supporting agriculture, fishing, tourism, and transportation.

One of the most interesting features of Goa's natural heritage is the khazan land. An integral part of Goa's coastal ecosystem, khazan lands are coastal wetlands. These reclaimed tidal flats, managed through an intricate network of embankments and sluice gates, have been cultivated for centuries, yielding rice, vegetables, and salt-tolerant crops. Beyond agriculture, khazan lands serve as vital habitats for migratory birds and support fisheries and aquaculture, contributing to the socio-economic fabric of the coastal communities in the state.

The soil in Goa, enriched by centuries of sedimentation and organic matter, supports a variety of crops, including rice, coconut, and cashew. Furthermore, it forms the foundation for Goa's unique agricultural practices, such as khazan farming, which harnesses the nutrient-rich silt deposited by tidal waters to cultivate crops in coastal areas. This harmonious relationship between land and water exemplifies the sustainable utilization of natural resources ingrained in Goan culture.

In recent years, on the one hand there have been calls to protect Goa's natural heritage threatened by the surge in haphazard construction owing to development activities, tourism, etc. On the other, there's been a steady rise in awareness among locals about protecting and preserving the land's rich natural resources.

Several groups and individuals are organizing nature trails, heritage walks and programmes to create awareness among locals and interested tourists about the zone's endemic flora and fauna that symbolize ecological richness and evolutionary heritage. From towering trees, medicinal herbs, and vibrant flowers to elusive reptiles and charismatic amphibians, Goa's endemic species paint a vivid portrait of biodiversity and natural beauty.

Through efforts undertaken in the direction, prioritizing conservation initiatives and fostering a deeper appreciation for its fragile biodiversity, Goans are ensuring that these unique species continue to thrive for generations to come. The works underscore the importance of conservation efforts in safeguarding the ecological treasures. Environmentalists have reignited the call for the declaration of a tiger reserve in Goa, spurred by incidents of tiger deaths in the Mhadei Wildlife Sanctuary and concerns over development activities impacting wildlife habitats. Advocates argue that establishing a tiger reserve would not only enhance monitoring and potentially boost the tiger population but also attract technical and financial support from the National Tiger Conservation Authority. Notwithstanding the debates and political nuances surrounding this demand, one thing remains clear: There is a critical need to safeguard Goa's natural landscapes and protect its iconic wildlife species.

The recently-concluded 'Greener Side Campaign', organized by 'Echoes of Earth', has emerged as a beacon of awareness, shedding light on the often-overlooked facets of Goa's biodiversity. This month-long event has captivated participants with a line-up of activities and workshops focused on exploring Goa's diverse ecosystems. From mangroves to bees, dragonflies, damselflies, butterflies, and birds, the campaign has delved into the ecological significance of these species, emphasizing the importance of conservation and preservation.

The GHAG Walk Fest, which is more than just a series of tours, has been a unique opportunity to deeply explore the essence of Goa. The Goa Heritage Action Group (GHAG), known for its efforts in preserving Goa's heritage, organized a series of insightful excursions, providing participants with first-hand experiences of Goa's rich natural heritage, history, culture, and traditions. The carefully curated walks across various picturesque locations in Goa, offer glimpses of the state's diverse cultural and natural landscapes and the region's unique flora and fauna. From bustling markets to serene lakes and historic sites, each destination showcases a unique aspect of Goa. The guides, referred to as "passoikars," are experts in their respective fields, passionately sharing their knowledge and enthusiasm for Goa's heritage with the participants. In the latest edition, in addition to the guided walks, the festival has also introduced the India Walk Slam, aiming to inspire individuals from across India to organize heritage walks in their own communities, thus fostering a culture of heritage preservation nationwide.

Led by Heta Pandit and her team, these walks have been attracting a diverse group of participants united by their shared passion for Goa's heritage. Participants range from locals and new residents to scholars and tourists, all drawn together by their shared fascination with Goa's rich cultural and natural heritage.

These walks are helping locals and concerned individuals acquire knowledge about indigenous flora and fauna of Goa. The nature walks include trips to interesting and biodiversity-rich zones. The shore walk in Zuari Bay is one of the many nature walks in biodiversity-rich zones. Zuari is the largest river of Goa, a tidal river that originates at Hemad-Barshem in the Western Ghats. The Zuari and Mandovi Rivers in Goa form an important estuarine system that is critical to its economy.

Ucassaim's tour provides an opportunity to explore Goa's khazan, the unique ecosystem and the wildlife including mangroves, otters, crocodiles, etc. The khazans also symbolize Goa's socio-economic heritage. Another interesting activity is a walk through the trees in the Campal neighbourhood of Panjim. A walk through the forests with trees and plants of medicinal value is also a popular one among these nature trails.

Curca village in Tiswadi, North Goa is the venue for spring walk that highlights the rich biodiversity and the ecosystems of the zone. This zone has a rich flora that includes coconut palm, cashew, sal, jackfruit, and mangoes. Also, a tributary of Zuari River flows through the village

GHAG tour in progress

Uday Mandrekar getting ready for a crocodile sighting tour

and forms a spring as well which is a popular site.

"These walks also educate participants about sustainability with a focus on sustainable housing and impact of modern-day construction on the environment," offers architect Tallulah D'Silva. The diverse backgrounds and expertise of the "passoikars," ranging from architects and historians to naturalists and artists, add depth and authenticity to each walk, ensuring participants gain a comprehensive understanding of Goa's multifaceted heritage. As participants traverse through Goa's landscapes and historical sites, they not only absorb knowledge but also foster a sense of connection and stewardship towards preserving Goa's cultural legacy for future generations.

In the heart of Goa's Chorao island, known for avian biodiversity and dense mangrove vegetation, lies a sanctuary for a unique and elusive species—the smooth-coated otter. This area, known as 'otter island,' has become a focal point for groundbreaking research aimed at not only understanding these fascinating creatures but also at conserving them on a global scale. The conservation efforts here are led by Katrina Fernandez of the Wild Otters Research and her team of dedicated individuals.

The smooth-coated otter, a predominantly freshwater species, has adapted to the coastal and estuarine habitats of Goa, particularly in mangrove-covered areas like Chorao. With only a few pockets around the world where otters have thrived in such environments, Goa's otter population presents a unique opportunity for studying their behaviour and interactions with human-modified landscapes. By engaging in projects that aim to enhance otter habitat quality, mitigate human-wildlife conflicts, and raise awareness about the importance of otter conservation, Fernandez is at the forefront of efforts to safeguard Goa's otter population and ensure the coexistence of otters and humans in shared landscapes.

Uday Mandrekar has emerged as a beacon of conservation in Goa. His dedication to preserving Goa's rich biodiversity and his profound knowledge of the local flora and fauna have earned him widespread recognition and admiration among nature enthusiasts and conservationists alike. Mandrekar's influence extends beyond birdwatching, as he is also recognized for his expertise in leading crocodile sighting tours in the Chorao backwaters. Through these excursions, Mandrekar not only showcases the fascinating world of crocodiles to visitors but also educates them about the importance of coexisting with these apex predators in their natural environment. His dedication to promoting responsible ecotourism and fostering a deeper appreciation for Goa's wildlife underscores his role as a steward of Chorao's ecological integrity. ■

Manu Shrivastava is a journalist and lawyer with DraftCraft International. She writes widely on environment, climate change, women laws and policy perception.

Air Pollution Challenge

India's Plan to Tackle it in 2024

India possesses both the capacity and responsibility to take the lead in the global battle against air pollution, thereby improving the air quality for its citizens and the environment. India's goal to tackle air pollution by 2024 represents a proactive step forward. However, to realize the benefits and accomplish the desired results, it is imperative for all stakeholders to collaborate and maintain their efforts consistently. Read this article by **Nikhil Savio** to know more.

One of the biggest threats to India's ecology and health is air pollution. The World Health Organization (WHO) reports that air pollution kills over 2 million people in India annually, and the nation is home to 21 of the 30 most polluted cities in the world. The primary causes of air pollution include automobiles, factories, burning of crops, thermal power plants, and emissions from homes. India ranks among the most polluted nations in the world, with over half of its cities having ambient air quality levels above the national average. Its 1.4 billion people's health and well-being, as well as the country's economic prosperity, are seriously threatened by air pollution.

The WHO states that respiration in tiny particulate matter ($PM_{2.5}$) can lead to heart and lung problems, lung cancer, stroke, and early death. Around 1.67 million deaths in India in 2019 were caused by air pollution, making about

17.8 per cent of all deaths in the nation. An estimate of the financial burden of air pollution placed it at $36.8 billion, or 1.36 per cent of India's GDP.

In response to this challenge, the Indian government initiated the National Clean Air Programme (NCAP) in 2019, with the objective of achieving a 20–30 per cent reduction in $PM_{2.5}$ and PM_{10} levels by 2024 when compared to the baseline of 2017. The NCAP is a multi-sectoral, all-inclusive programme that addresses 132 cities that do not meet air quality criteria. The NCAP comprises a number of metrics, including:

- Adding more than 1000 automatic and manual stations, together with satellite-based data and modelling capabilities, to fortify the nation's air quality monitoring network.

- Putting into practice action plans individualized to each city, based on source apportionment studies, in order to determine the primary sources of pollution and the most effective ways to mitigate their effects. Improving the regulatory and enforcement framework, including the Graded Response Action Plan (GRAP), the National Ambient Air Quality Standards (NAAQS), the emission standards for different industries, and the penalties for non-compliance.
- Encouraging the adoption of greener fuels and technology, such as solar energy, electric cars, compressed natural gas (CNG), liquefied petroleum gas (LPG), and upgraded cookstoves.
- Raising public awareness and engagement through citizen feedback platforms, education programmes, and campaigns to encourage social accountability and behavioural change.

To further advance the clean air agenda at the regional and local levels, the Indian government is working in tandem with a range of stakeholders, including state

and municipal governments, research institutes, civil society organizations, and international agencies, in addition to the NCAP. For example, the World Bank is helping two of the most populous and polluted states in the nation, Uttar Pradesh and Bihar, create their first state-wide Clean Air Action Plans using the airshed management concept. In particular, in the Indo-Gangetic Plain, where pollution from a variety of sources, including crop burning, biomass burning, industry, transportation, and power plants, travels over long distances and affects the air quality of several states and cities, this approach acknowledges that air pollution is a transboundary issue that requires coordination and cooperation across different jurisdictions and sectors.

Although India has a comprehensive and ambitious plan to combat air pollution, there are a number of obstacles and gaps that need to be addressed. These include the lack of timely and reliable data, the lax enforcement of regulations, the high cost and viability of some interventions, the competing interests and priorities of various stakeholders, and the unpredictability and variability of meteorological and climatic factors. India must take a comprehensive and integrated approach that balances the environmental, economic, and social aspects of the issue and entails the active participation and cooperation of all relevant actors, from the national to the local level, in order to overcome these obstacles and achieve the intended results.

India must also take note of the finest methods and lessons from other nations and areas, including China, Europe, and the US, that have effectively improved their air quality. India must take a comprehensive and integrated approach to address these issues, which includes: Obtaining more financial and technical support for the NCAP's implementation and evaluation from both domestic and foreign sources; strengthening the committees and bodies' roles and responsibilities as well as their coordination and communication with one another in order to fortify the institutional and governance procedures; enhancing the monitoring and reporting mechanisms, as well as the fines and rewards meted out to offenders and performers, would all help to improve enforcement and compliance; raising public knowledge and engagement through academia, civic society, media and giving people the power to demand and participate in cleaner air.

India has the ability and obligation to lead the world in the fight against air pollution, making the country's air better for both its citizens and the environment. India's aim to address air pollution by 2024 is a positive move, but in order to reap the advantages and achieve the intended outcomes, all stakeholders must work together and sustain their efforts. By doing this, India can enhance public health, economic growth, environmental sustainability, and air quality. ■

Nikhil Savio is a PhD Scholar in Department of Environmental Science, G B Pant University of Agriculture & Technology, Pantnagar, Uttarakhand. His areas of expertise are air pollution monitoring, mapping, wastewater treatment, phytoremediation, and bioremediation. He can be contacted at nikhilsavio8@gmail.com

Terra Youth

Joining Hands for a Greener Tomorrow

Looking for the Chirpy Chirping Sparrows

To Bring Back Happiness

March 20 is celebrated as the International Day of Happiness and also World Sparrow Day. **N Kalyani** says with the sparrow and happiness being commemorated on the same day it is hoped that efforts to protect the sparrow and raise its population across its home range prove fruitful and meet with success so that the return of the sparrow brings back happiness.

There is a short video for the International Day of Happiness, celebrated on March 20, on the UN website, capturing the opinions of persons, speaking in different languages, on what makes them happy, on what gives them happiness. It is a cheerful video to watch and share. For me it has been a matter of happiness to pen what has become the story here bringing sparrows and happiness together. March 20 commemorates the International Day of Happiness as also the World Sparrow Day. It seems to be a beautiful and magical coincidence of commemorations on March 20.

Like so many bird lovers, and more specifically sparrow lovers, for me the sparrow is (was?!) a symbol of chirpiness, what with their pleasant chirping, chirruping and twittering accompanying their activities of feeding, nesting and raising their young ones right within our living spaces, right within our homes. Habits, traits and characteristics of the male and female house sparrow have always made for interesting watching. These have remained etched in the memory over the years. Whether it was the industrious birds building their precious nest. Or the hungry hatchlings ravenously craving for morsels from their indulgent parents. Or then the birds asserting their right to enter our homes whether by flying in through open doors or by knocking persistently at closed glass window panes. And yet there were times when the boldness of the birds cost them their lives when they struck against rotating electric ceiling fans that were a summer time necessity. Though at times kind souls would even turn off their fans

to prevent sparrows from being hurt.

Ecologically, the upkeep and sustainability of ecosystems and food chains depends on every element and every life form that makes up the ecosystem. And so from a large carnivorous mammal to a little scavenging insect every life form holds the key to the health of the ecosystem and the well-being of every life form. It is, therefore, no surprise that the little house sparrow is an indicator species of the health of the spaces of human habitation being as it is a commensal of man.

Here one finds the interesting coincidence with the general theme of this year's International Day of Happiness which is "happiness for the young, the old, and everyone in between." This gives an idea of inclusiveness. But extending it further one would include not just humans but all life forms. In fact, it is also a spiritual idea and ideal that happiness is the goal of each and every soul.

To quote from the UN website: "Happiness is a fundamental human goal. The United Nations General Assembly recognizes this goal and calls for 'a more inclusive, equitable and balanced approach to economic growth that promotes the happiness and well-being of all peoples.' Governments and international organizations should invest in conditions that support happiness by upholding human rights and incorporating well-being and environmental dimensions into policy frameworks, such as the 17 Sustainable Development Goals." One sees here the coming together of various vital aspects—human life, happiness, environment, economic growth, and policy.

I have been writing and speaking on sparrows and their conservation, an issue close to my heart, and over time I find there has been a quick progression in the lack of sighting the cute, little bird species so that for some time now one has not seen in one's neighbourhood the house sparrow, a bird that has had a long history of inhabiting spaces that man inhabits. A visit to a village perhaps sometimes affords one a sighting of the gregarious sparrows. And then that cheers one up.

Such being the scenario it is heartening that both individuals and organizations are taking initiatives to protect the sparrow and conserve its populations. Whether it is by providing nest boxes and feeders for the sparrows, or sensitizing the people on measures that can protect the sparrow, or promoting such measures as the cultivation of indigenous and native crops and plants and trees or avoiding the use of chemicals and fertilizers in agriculture that can help sparrows feed and raise their young.

Over the years, from watching the house sparrow in the fanlights and ventilators of one's bedroom and living room as also parapets and in verandas and balconies one has had to find other avenues to view, listen to and learn about the sparrow all with the objective to protect the avian species and conserve its populations. From the varied forms of visual arts such as painting and sculpture to the performing arts such as music and puppetry, to literature, in prose and poetry, to folklore as also traditions and customs.

For instance, in the Pongal festival that marks the sun's commencement of travel to the northern hemisphere, the *Uttarayana*, the thanksgiving traditionally includes the offering of rice and other grains to the birds such as sparrows and crows that are invited by singing songs.

One is also reminded of the poem by the poet-statesman Atal Bihari Vajpayee, composed in Hindi, where he writes of mountains that may be lofty alright but are lonely, cold, inhospitable, and uninhabitable. And in such places there is no possibility of sparrows living and building their nests and raising their families. For, as mentioned earlier, man and sparrow share their habitation spaces.

Recently, *Resurgence and Ecologist*, a British magazine, had in its latest issue of March/April 2024, (issue number 343) titled "When we Speak", an article titled, "Now or never…," by James Sainsbury that quotes a story which makes mention of the sparrow. The introductory blurb to the article says that the writer reflects "on the profound yet fleeting nature of human life" and "recounts the story of a sparrow that flies briefly into an Anglo-Saxon feasting hall. Amidst the critical challenges faced by humanity," the writer "emphasizes the importance of using the limited time we have and imbuing it with compassion and kindness so that we can have a positive impact."

The quoted story is taken from the writings of the Venerable Bede. About the sparrow he writes: "The sparrow, flying in at one door and immediately out at another, whilst he is within, is safe from the wintry tempest, but after a short space of fair weather, he immediately vanishes out of your sight, passing from winter to winter again. So this life of man appears for a little while, but of what is to follow or what went before we know nothing at all." A philosophical analogy here.

An interest in philately has also afforded me a collection of sparrow-related postage stamps and philatelic material. Stamps are also pieces of miniature art. India brought out a commemorative postage stamp on the house sparrow in the year 2010. Countries such as Yugoslavia, Denmark, Cuba, Bangladesh, Bahrain, Belgium, Belarus, Cape Verde, Faroe Islands, Serbia, Spain, Estonia, Iraq, the Maldives and the Netherlands have also issued stamps on the sparrow. Such postage stamps also help raise awareness on sparrow conservation among the people. As stamps travel far and wide they can be a great means to sensitize the general public.

Research on the sparrow has also led me to researchers and authors who have studied the sparrows and written on the subject. Dr J D Summers-Smith (1920–2020), a British sparrow researcher, authored many a book on the different sparrow species. While Dr Summers-Smith was a mechanical engineer, not a biologist, his interest in and love of sparrows led him to study sparrows. Back in the 1940s when he began his study of the bird, they were easily seen in the neighbourhoods.

Interestingly, one also came across Kees Moeliker, winner of the 2003 Ig Nobel Prize in biology. He is the director of the Natural History Museum Rotterdam, as also the European bureau chief of the Annals of Improbable Research. An ornithologist, his ornithological interests and findings are remarkable. His interest in the house sparrow brought me in touch with him.

With the sparrow and happiness being commemorated on the same day (March 20) it is hoped that efforts to protect the sparrow and raise its population across its home range prove fruitful and meet with success so that the return of the sparrow brings back happiness. ■

N Kalyani is a freelance writer. She has written and spoken on the issue of sparrow conservation for some years now. One of her sparrow stories is part of the English syllabus at an Indian university. She proposes to bring out a book on sparrows.

'Solve for Tomorrow'

Samsung Launches Season 3 of its Flagship CSR Initiative

First launched in the US in 2010, 'Solve for Tomorrow' is currently operational in 63 countries globally and has seen over 2.3 million young people participate worldwide. Samsung Electronics' global CSR vision of 'Together for Tomorrow! Enabling People' is committed to providing education to young people around the world to empower the leaders of tomorrow.

Samsung has announced the third edition of its flagship CSR initiative – 'Solve for Tomorrow', in strategic collaboration with the Foundation for Innovation & Technology Transfer (FITT), IIT Delhi, Ministry of Electronics & Information Technology, and the United Nations in India. With Solve for Tomorrow, Samsung aims to usher in a culture of innovative thinking and problem solving amongst the country's youth.

Solve for Tomorrow 2024 was inaugurated by Mr J B Park, President & CEO, Samsung Southwest Asia; Dr Sandip Chatterjee, Sr. Director and Scientist 'G', Ministry of Electronics & IT, Government of India; and Mr Shombi Sharp, United Nations Resident Coordinator in India, in the presence of other dignitaries.

Mr J B Park said, "In the first two editions, we have seen this CSR initiative have a positive impact on our next generation, who scaled greater heights, embarking on their social entrepreneurship journey. In its third edition, with the introduction of two separate tracks, we aim to solve simultaneously for India and for the world. More importantly, with this flagship CSR programme, we want to play our part in strengthening the innovation ecosystem in the country."

Dr Sandip Chatterjee said, "Environment and sustainable development are amongst the priority agenda of the Government of India. It is an opportune moment to combine technology with the human capabilities for accelerating economic growth. Indian youth, having innovative mind and skills, cares deeply for the environment. Using radical innovations, various global grassroots issues and challenges could be addressed. Programmes like 'Solve for Tomorrow' are a testament to realize the vision of the Government of India, by harnessing the power of youth."

This year, the 'Solve for Tomorrow' programme introduced two distinct tracks—School Track and Youth Track, each dedicated to championing a specific theme and targeted towards different age groups. Both the tracks will run simultaneously, ensuring equal opportunity and a level playing field for all students. The School Track, is tailored for students aged 14–17, focusing on the theme "community and inclusion". The track underscores the importance of uplifting underprivileged groups, improving accessibility to health and social inclusion for all through social innovations and hence 'Solving for India'. The Youth Track on the other hand, targets individuals aged 18–22, with a focus on the theme "environment and sustainability". The track seeks innovative ideas for reducing carbon footprint, protecting the environment and promoting sustainability and hence 'Solving for the World'.

Who can participate: 14–17 year-olds in School Track – individually or in teams of up to 5 members can submit their ideas in the "Community & Inclusion" theme and 18–22 year-olds in Youth Track – individually or in teams of up to 5 members can submit their ideas in the "Environment & Sustainability" theme.■

To find out more and register for the competition in India, visit www.samsung.com/in/solvefortomorrow. Application entry closes at 5 pm on May 31, 2024.

Read more stories on Samsung Electronics' CSR efforts on our CSR webpage http://csr.samsung.com

Empowering Women in Sundarbans

Inclusive Farming Shows the Path Forward for Climate-Resilient Communities

This opinion piece by **George Richards** outlines the crucial findings of a major climate and sustainability project in India, led by one of the world's most prominent climate-focused NGOs. Specifically, the article outlines the potential benefits of inclusive farming for women in pastoral communities.

While it is now almost universally acknowledged that vulnerable communities are disproportionately affected by the dangers of climate change, the risks faced by women in these regions are less often discussed yet require more urgent action given their outsized impact.

One of the key factors exacerbating women's plight is the lack of land ownership, but new, inclusive farming initiatives provide cause for hope. In patriarchal societies, women are frequently denied access to land, leaving them without a secure foundation to weather the storm of climate-induced adversities.

Empowering Women in Communities

Inclusive farming emerges as a powerful solution to the climate crisis in lower- and middle-income countries hit hard by rising waters, volatile weather, drought, and other challenges. By granting women and families the means to grow their own crops, it not only ensures food security but also serves as a catalyst for economic opportunity.

Empowering women in agriculture also has a ripple effect, positively influencing entire communities. Increased income and improved food security translate into better health and education outcomes, creating a positive cycle of development. Indeed, according to the Food and Agriculture Organization (FAO), if women had the same access to productive resources as men, they could increase yields on their farms by 20–30 per cent, whilst the World Bank reports that closing the gender gap in agriculture could reduce the number of hungry people in the world by 100–150 million.

Inversely, in agricultural and pastoral communities, the destruction of crops and wildlife by extreme weather can lead to malnutrition and, in extreme cases, famine.

Sundarbans Shows the Way

In many coastal areas, women have been bearing the brunt of climate-related hardship. Because of the chronic lack of access to resources, including land ownership, and a lack of sophisticated programmes to show how to use land most effectively to mitigate against

climate threats, women have far less of a safety net and are severely impacted by flooding, food insecurity or extreme weather.

The Sundarbans region of West Bengal, a vast swath of towns and villages centred around the forest and its rivers, is home to more than four and a half million people, as well as an abundance of fauna and flora. It is under severe threat from climate change driven by ecosystem degradation, which is affecting its natural defenses.

In 2007, landfall from Cyclone Sidr damaged some 40 per cent of the entire forest, and Cyclone Alia in 2009 impacted upwards of 100,000 residents and countless wildlife. The residents of Sunderbans continue to grapple with increasing salinity, reduced freshwater supply, and rising sea levels.

The Impact of Inclusive Farming

In Sundarbans, nurturing mangroves has emerged as a cost-effective and environmentally sustainable method of coastal defence. The success of such initiatives relies heavily on the active involvement of local communities, which predominantly include women.

These resilient coastal plants act as natural barriers, mitigating the impact of storm surges and stabilizing shorelines. By involving women in the nurturing and conservation of mangroves, communities not only fortify their defences against rising sea levels but also create a sense of environmental ownership and responsibility.

The Ankur project, a gender and economic justice project established by Community Jameel in partnership with the Rupantaran Foundation of West Bengal, aims to help these communities revive their land, deliver food security and empower women and girls in these communities who are disproportionately negatively impacted by climate disasters that amplify existing gender inequalities.

Specifically, the programme has formed 400 women's collectives with 10,000 women from the supported households, facilitating the transmission of traditional knowledge and community practices, and providing a platform for an inclusive approach to farming. In just two years the programme has helped over 40,000 people in the Sunderbans area to rebuild and look forward.

Building on Experience

By dismantling barriers to land ownership and empowering women to take the lead in agriculture and coastal conservation, the Ankur Project not only ensures immediate climate resilience but also fosters sustainable, long-term development.

It is imperative that policymakers and NGOs alike recognize the transformative potential of inclusive farming and increase funding and resources for programmes that specifically prioritize the empowerment of women in pastoral communities.

Not only will this build a more resilient and equitable future for us all, but it will also provide a tangible return on investment through the increase of crop production and money saved from alternative responses to climate disasters. ■

George Richards, Director of Community Jameel—a global NGO focused on leveraging science, technology and data to support vulnerable communities. In his role, George is the leader of one of the world's largest private scientific funders.

Study Models the Journey of Inhaled Plastic Particle Pollution

With recent studies having established the presence of nano and microplastic particles in the respiratory systems of both human and bird populations, a new University of Technology Sydney (UTS) study has modelled what happens when people breathe in different kinds of plastic particles and where they end up. Led by Senior Lecturer of Mechanical Engineering Dr Suvash Saha, the UTS research team has used computational fluid-particle dynamics (CFPD) to study the transfer and deposition of particles of different sizes and shapes depending on the rate of breathing. The results of the modelling, published in the journal *Environmental Advances,* have pinpointed hotspots in the human respiratory system where plastic particles can accumulate, from the nasal cavity and larynx and into the lungs. Dr Saha said evidence was mounting on the significant impact of nano and microplastics on respiratory health.

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

Wild Orangutan Treats Wound with Pain-Relieving Plant

Even though there is evidence of certain self-medication behaviours in animals, so far it has never been known that animals treat their wounds with healing plants. Now, biologists from the Max Planck Institute of Animal Behavior, Germany and Universitas Nasional, Indonesia have observed this in a male Sumatran orangutan who sustained a facial wound. He ate and repeatedly applied sap from a climbing plant with anti-inflammatory and pain-relieving properties commonly used in traditional medicine. He also covered the entire wound with the green plant mesh. Thus, medical wound treatment may have arisen in a common ancestor shared by humans and orangutans. The closest relatives to humans, the great apes, are known to ingest specific plants to treat parasite infection and to rub plant material on their skin to treat sore muscles.

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

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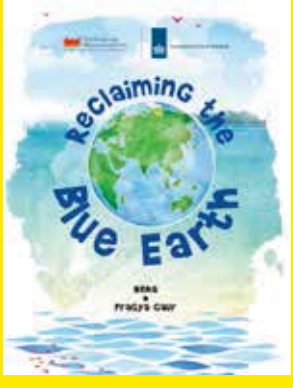

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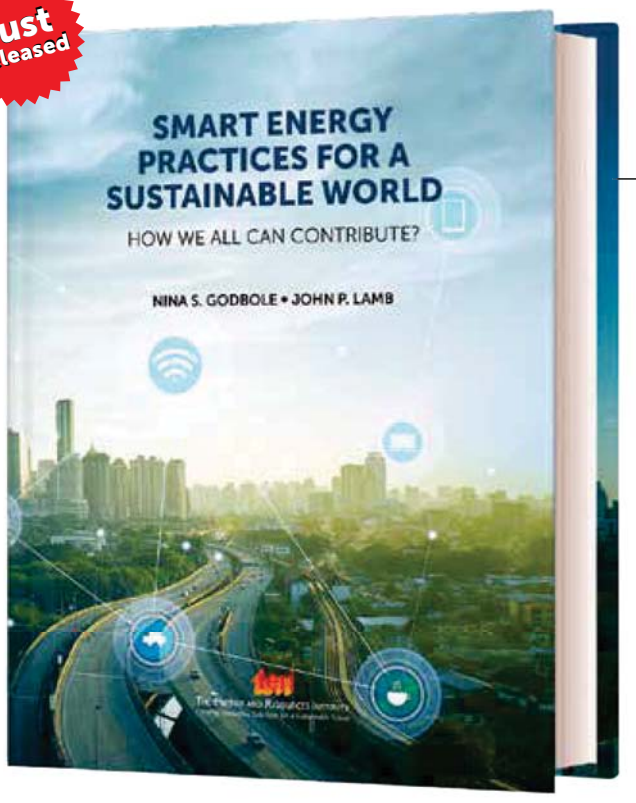

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This book stresses the need for us to judiciously, sustainably, and smartly harness and use energy techniques in order to effectively combat climate change. The book also gives an in-depth discussion on utilization of artificial intelligence and information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

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

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Kaziranga Hit by Poachers Again

Lost Two Rhinos on a Single Day

In this article, **Nava Thakuria** informs us that the poaching of one-horned rhinoceros has resurfaced in the world-famous Kaziranga Forest Reserve in Assam, northeast India, in the first month of 2024, with two rhinos being killed simultaneously in its Agaratoli forest range. However, there is a silver lining as 2024 brought good news to wildlife enthusiasts: two rhinos were sighted in Laokhowa and Burhachapori Wildlife Sanctuary after many decades. The author presents various rhino statistics in this regard.

The poaching of one-horned rhinoceros returned to the world famous Kaziranga Forest Reserve in Assam of northeast India in the first month of 2024, as two rhinos were killed simultaneously in its Agaratoli forest range. The on-duty forest staff recovered the carcass of a single horn rhino near Maklung forest camp of Kaziranga National Park & Tiger Reserve, while making their routine patrolling on January 22, 2024. The precious horn, as it happens usually, went missing. It was apprehended that the adult rhino, often killed for its horn that fetches a few million dollars in the illegal wildlife market, was poached on the previous night.

The second rhino carcass was detected by the elephant patrol party on January 26 within a kilometre distance. The multiple killings of rhinos on a single day have taken everyone by surprise as this was unexpected and clearly the poachers have improvised their poaching tactics, said an officer of the forest reserve. He also added that a number of forest officials and guards along with police personnel were engaged in the investigation process to nab the culprits and recover both the rhino horns. Their prompt efforts resulted in detention of a suspected poacher (identified as Joggu Pegu, a resident of Mohuramukh in Golaghat district) and recovery of a horn with an AK series assault rifle within days. The second horn was yet to be recovered.

The authorities have intensified surveillance and patrolling to counter the criminals' improvised methods using sophisticated weapons to kill wild animals for personal monetary benefits. Meanwhile, an individual from Manipur was also identified as being involved with the crime as a shooter. Assam police chief G P Singh, who also leads the special rhino protection force in Kaziranga, appreciated the ground staff for the 'outstanding investigation'. He expected public support and cooperation to eradicate the poaching of wildlife.

Mentionable is that, the Kaziranga authorities recovered 79 rhino carcasses with horns intact which died due to natural causes such as old age, infightings and flood water entering the forest reserve from the mighty river Brahmaputra on the northern border. Incidentally, it was the first case of rhino poaching this year in Assam, which enjoyed the credit of zero-poaching incident in the year 2022 to draw the international media attention. Last year, Kaziranga and also Manas National Park & Tiger Reserve in western Assam, adjacent to Bhutan, lost two rhinos each to poachers. Kaziranga witnessed last year's poaching in March.

Manas Forest Reserve witnessed the poaching incident in June 2023, even though the authority believed that the rhino was killed a few weeks back and the poachers succeeded in snatching away the horn. The incident sparked a series of protests by local environment and wildlife enthusiasts against the authority for its failure in protecting the wildlife. An umbrella body of 14 local organizations demonstrated their anger against a section of corrupt and irresponsible forest officers. Even a group of youths shaved their heads publicly on July 9 to show solidarity to the cause of wildlife conservation.

A UNESCO world heritage site Manas Forest Reserve (like Kaziranga), gives shelter to around 45 rhinos with a host of other inmates such as water buffalo, tiger, leopard, golden langur, gaur, pygmy hog, Bengal florican, etc. On the other hand, Kaziranga supports over 2613 rhinos (the global population of one-horned rhinos is around 4000 in the wild). It also gives shelter to over 150 Royal Bengal tigers and around 250 leopards, over 5500 Asiatic elephants, a large number of Asiatic wild buffaloes, different species of deer, birds, fish, etc.

Other forest reserves of Assam namely the Pobitora Wildlife Sanctuary (around 107 rhinos) and Orang National Park

(125) support the rhino population to increase up to 2650 individuals. With a drastic reduction in poaching following the deployment of heavily armed ground forces and other modern gadgets, Assam expects to increase the rhino population to 3000 very soon. Till date, a number of poachers have been arrested and many died in encounters with the security forces. The captured poachers and their associates admit that they had taken the risk of killing rhinos inside the restricted forest reserves because of enormous monetary benefits.

Needless to say, the number of poaching incidents in Assam has been reduced in the last five years thanks to the brutal laws against the poachers, strengthening of ground staff inside the protected forest areas, and increasing public awareness in the fringe localities of forest reserves. Once it lost as high as 27 rhinos to poachers in 2013 and 2014 each. Next year the count fell to 17 and 2016 reported 18 cases. The year 2017 witnessed only seven incidents of rhino poaching, followed by another seven in 2018, three in 2019, and two cases each in 2020 and 2021. Assam records the death of 100 rhinos every year in its forest reserves due to natural causes. A mature rhino weighing from 2000 to 3000 kg can live up to 45 years in the wild. Moreover, a female turned sexually mature by five years carries each pregnancy for around 16 months. The calf normally accompanies the mother for two years since the birth.

Native to the Indian subcontinent, the greater one-horned rhino (Scientific name: *Rhinoceros unicornis*) is one of the worst-affected rhino species on Earth. The reason behind the poaching of rhinos is the high demand for the horns in a number of countries (including China) where people term it as black ivory. The heavy mammal with a great sense of hearing and smell (but poor eyesight), enjoys great sexual power, as its mating time may continue for 45 minutes. So, many people unscientifically believe that one can achieve unusual power with the help of rhino horns (using it as an aphrodisiac/traditional Viagra).

The rhino horns, grown by both males and females after attaining six years, are also believed to have other medicinal values supposed to cure typhoid, headache, stomach ailment, food poisoning, snakebites, and even cancer. Taiwan, Thailand, South Korea, Vietnam and the Middle East are also known to be huge markets for rhino horns, where its use for medical purposes and scientific research is legalized. But the veterinarians always argue that rhino horns comprise the same protein (keratin) that constitutes the formation of hair and fingernails and it does not possess any quality for sexual stimulation.

Rhinos are recognized as vulnerable species by the International Union for Conservation of Nature (IUCN) and India's Wildlife Protection Act formulated in 1972 gives enormous power to the forest rangers to protect the grass-eating pachyderm. The global population of rhinos remains around 27,000 individuals. With the decrease of rhino poaching incidents in India and Nepal (its Chitwan National Park, Parsa NP, Bardia NP and Shuklaphanta NP cumulatively support 750 single horn rhinos), the pressure mounts in South Africa, which gives shelter to over 15,000 two-horn rhinos. The country witnesses the killing of over 400 rhinos annually (more than one poaching every day) seemingly to feed the demand in Asian countries.

Nonetheless, 2024 brought good news to wildlife buffs as two rhinos were sighted in Laokhowa and Burhachapori WS after many decades. Assam Chief Minister Shri Himanta Biswa Sarma, who remains proactive in conserving rhinos in various forest reserves, recently shared a photograph on his social media account and expressed his delight for the return of rhinos to the forest reserve after nearly 40 years. The wildlife sanctuary in central Assam used to give shelter to around 50 rhinos till 1983, but the entire population was wiped out by the menace of poaching and grassland habitat loss. Lately, the CM also posted a photograph of a rare golden tiger spotted in Kaziranga few days back. ■

The writer is a northeast India-based journalist.

Revitalizing the Yamuna River

Innovative Strategies to Rejuvenate the Yamuna River

In this article, **Diksha Pandey** delves into a range of approaches and methods aimed at revitalizing the health of the Yamuna River. These could encompass efforts to mitigate pollution, bolster water quality, restore ecosystems, and advocate for sustainable water management practices. Moreover, the piece highlights inventive solutions such as advanced wastewater treatment technologies, community engagement initiatives, and policy adjustments designed to tackle the multifaceted challenges confronting the river. It might also examine the Yamuna River's significance to nearby communities, ecosystems, and cultural heritage, emphasizing the pressing need for and importance of revitalization endeavours.

The Yamuna River, traversing through Delhi, Haryana, Uttar Pradesh and neighbouring states, has endured decades of relentless pollution. Revered as sacred by many Hindus, it has sadly transformed into a receptacle for sewage, industrial waste, and refuse. This deterioration in water quality has profoundly impacted the well-being and livelihoods of millions who rely on it for drinking, agriculture, and religious observances. Once a symbol of pride in North India, the Yamuna now grapples with alarming pollution levels, standing as one of India's most contaminated rivers. Its restoration presents a formidable challenge for both government and society.

Pollution emanating from untreated sewage, industrial discharges, solid waste, religious rituals, and cremation activities exacerbates the river's plight, jeopardizing aquatic ecosystems and human health in communities along its banks. In order to revive its original state, the government needs to embrace a multifaceted strategy. Here are several

innovative tactics that could play a crucial role in curbing pollution in the Yamuna River and attaining standards suitable for bathing and aquatic life. Consider the following potential solutions and actions for the revitalization of the Yamuna River.

Treating all the Domestic Wastewater

Treating all domestic wastewater and industrial effluents prior to its discharge into the river is imperative. This can be achieved through the installation and upgrading of sewage treatment plants (STPs), redirecting drains carrying wastewater, and effectively managing septage from unauthorized colonies and slums. Employing in-situ techniques to further purify treated wastewater and bolster dissolved oxygen levels in the river is vital. This may involve establishing natural wetlands, implementing aeration systems, and employing bioremediation methods along the river. Regulating the floodplain to prevent encroachment and waste dumping onto the riverbed is crucial. Measures such as delineating floodplain zones, enforcing laws and penalties, and raising public and stakeholder awareness are essential. Utilizing treated wastewater for irrigation, industrial, and domestic purposes, as well as generating solar power along drains, can alleviate water demand, reduce reliance on the river, and yield economic and environmental benefits. Implementing advanced sewage treatment technologies beyond conventional methods can significantly diminish the influx of organic pollutants into the river. The government could incentivize the development and integration of such technologies into existing STPs.

Industrial Waste Management

Rigorous enforcement of regulations governing industrial discharge, alongside the encouragement of zero liquid discharge (ZLD) systems, is crucial for preventing industrial effluents from polluting the river. The establishment of eco-industrial parks featuring shared waste treatment facilities has the potential to be a transformative initiative.

Policy Integration

It is imperative to integrate policies concerning urban planning, waste management, and water resources to comprehensively address the issue. A centralized river management authority could supervise the implementation of these integrated policies.

Research and Development

Allocation of resources towards research and development for pollution monitoring and river ecosystem health is pivotal for devising novel solutions. The government could initiate the establishment of specialized research centres dedicated to studying the Yamuna River.

Strengthening Legal Framework

A robust legal framework is indispensable to enforce pollution control norms effectively. The government might consider revising existing laws to incorporate stricter penalties and incentives for adherence.

On-site Wastewater Treatment in Drains

Employing on-site treatment methods involves purifying water directly at its source, minimizing the need for transportation to external facilities. This approach reduces both the cost and time associated with wastewater treatment.

International Cooperation

Drawing insights from global best practices and engaging with international organizations can offer valuable perspectives on river management. The government could pursue technical and financial support from international entities specializing in river restoration.

Restoration and Regulation of Yamuna Floodplains

The government's initiative to revitalize the Yamuna represents a commendable effort aimed at rejuvenating the river and enhancing the well-being of local communities. This endeavour has demonstrated tangible progress in reducing pollution levels, elevating dissolved oxygen concentrations, and fostering biodiversity in the river. Furthermore, it serves as a model for other regions to emulate, encouraging similar measures to safeguard their rivers and water reservoirs.

Public–Private Partnerships

Collaboration through public–private partnerships (PPPs) in managing river pollution can leverage expertise, innovation, and supplementary resources. These partnerships may target activities such as waste management, water treatment, and awareness initiatives.

Community Involvement

Encouraging local communities to actively participate in river maintenance cultivates a sense of ownership and accountability. Programmes such as 'Adopt a River Stretch' could inspire community-driven cleanup efforts and pollution monitoring endeavours.

These remedies necessitate the coordination and collaboration of diverse entities, including the National Mission for Clean Ganga (NMCG), the Central Pollution Control Board (CPCB), the State Pollution Control Boards (SPCBs), municipal corporations, industries, and civil society. Furthermore, active involvement and backing from the public, particularly local communities and religious organizations with deep cultural and emotional ties to the river are essential. Through collective effort, realizing the goal of a pristine and flourishing Yamuna by 2025 is attainable.

Conclusion

So, in this article we have delved into a range of approaches and methods aimed at revitalizing the health of the Yamuna River. These could encompass efforts to mitigate pollution, bolster water quality, restore ecosystems, and advocate for sustainable water management practices. The write-up highlights inventive solutions such as advanced wastewater treatment technologies, community engagement initiatives, and policy adjustments designed to tackle the multifaceted challenges confronting the river. It also examines the Yamuna River's significance to nearby communities, ecosystems, and cultural heritage, emphasizing the pressing need for and importance of revitalization endeavours. ■

Diksha Pandey, Scientist 'B', Haryana State Pollution Control Board.

Upstream or Downstream, Let's Live a Dream

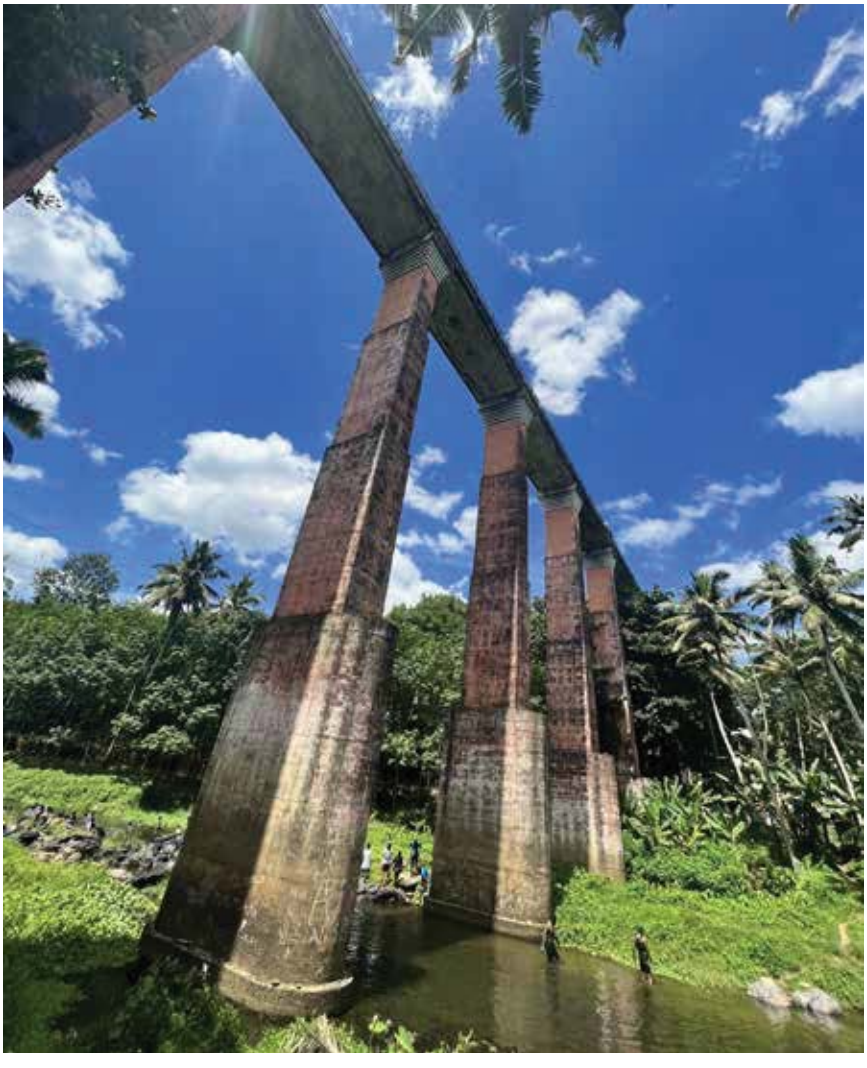
River Walk along the Pahrali River

In this thoughtful article, **Dr Elsa Lycias Joel** says for once, all of us need to escape the hyper-connected modern life, from its rattle and hum, in favour of rare moments of beauty for restorative benefits. Eco-sensitive zones such as rivers ought to be observed and studied to eliminate stressors, if any, to ensure its uninterrupted flow and to help ourselves engage with ecosystems with varying degrees of responsiveness. Our direct experience with river ecosystems plays a crucial role in shaping the knowledge we acquire and pass on. Also, the corresponding meanings and values that we imbue nature with will take better shapes after a tramp along a river.

On a beautiful summer morning, I went for a river walk along the Pahrali River that originates in the Mahendragiri hills in South Tamil Nadu. It was in good shape, thanks to one of the unknown saviours of the environment who happens to be my friend. This life science graduate, researcher, environmentalist cum activist has also committed herself to exposing young minds to this river ecosystem on a regular basis.

Throughout this river walk I was glad and filled with hope because every time I see or think of a river in India, I wonder why they are not revered in spite of being worshipped as goddesses. Is it because they are goddesses and not a masculine pronoun?! Considering a river as sacred but reducing it to gutters, drains and dump yards is equivalent to calling our country 'Bharat Mata' when it is being failed by a powerful handful.

Our political leaders should comprehend that deforestation permeates every other natural resource and triggers significant changes in the hydrosphere. The disappearance or drying up of atmospheric rivers can cripple economies and disrupt seasons, while agricultural lands nearby and afar desiccate, leading to global droughts. In my view, it is imperative to educate



individuals about their entitlement to a healthy environment, empowering them to make informed and responsible decisions as decision-makers. Unless we sow wisdom in young fertile minds, they may not understand that tiny bits and pieces of the environment are essential to every aspect of life and well-being. Crucial ecosystems such as forests, the ocean, rivers, river basins and wetlands must be part of our everyday learning, decisions, and conversations.

In this respect, students of Excel Global School are lucky for two reasons:

1. A 10-minute walk amidst paddy fields, flowery meadows with butterflies and hundreds of mynahs and gigantic trees will take them to this place whenever they need time with God's beautiful creation.
2. This environmentalist is overly sensitive about nurturing the environment and she adopts the best teaching practices towards greening minds.

Environmental science is not about learning concepts and scoring marks. It should be more about how we interact with the environment every day, judicious utilization or sustainable consumption of natural resources, learn from mistakes and adopt lifestyles, social behaviours that will eliminate environmental degradation.

According to the Founder Chairman of Excel Global School Dr Sreekumar Chandrasekharan, "River walks are organized frequently to educate the students about the symbiotic relationships in that ecosystem and to help them be aware that a river is connected to everything else. Until we see rivers for the complete ecosystem that it is, we cannot be the voice of the people, the farmers or the threatened lot".

As I walked along with enthusiastic and curious students who collected specimens in Eppendorf tubes, I noticed that they were so much in tune with nature. If collecting a specimen would mean harming it, then they called out to their teacher to explain the role of that particular flora or fauna in its 'as is where is' state. I saw young minds being cultivated for a sustainable tomorrow.

The manner in which she explained the pros and cons of Eichornia crassipes reminded of R L Stevenson's novel, *The Strange Case of Dr. Jekyll and Mr. Hyde.* The problems it can cause as they spread uncontrollably and the promise it holds when their multiplication is controlled was explained conscientiously.

Large numbers of trumpet snails were found below the waterline which was indeed a good indicator of clean water and we were told that they are playing their roles of filtering water and removing contaminants quite effectively. The roles played by every small organism and plant the students spotted and collected were explained in detail. Nothing existed there without an important function. So, the next time I spot an apple snail or a freshwater mussel I will be sure they are busy decomposing dead plant material and algae. Wings of mayflies, damselflies, dragonflies and butterflies that glided above the water glittered in the sun. Is there anyone who wouldn't be fascinated by the fluttery, skipping flight of a damselfly? Acrobats of the odonates were fun to watch. The fauna along and inside the river seemed like they detected no disaster with us around because a few river birds flew so skimmed low over the water's surface even as the students were frolicking in the waters. Water striders and water boatmen were collected in wide-mouth bottles to be observed, studied and later released into the river. Conversations revolved around Greek mythology and Charon, the ferryman or boatman who carries the dead souls across the river Styx. Students and teachers walked tirelessly in small groups until noon. Together, we walked the talk. The shadow of the trees on one side of the shore, the chattering and giggling of students who pretended to vlog, instructions and information from the eco-warrior who led us, smiles and posing for pictures gave me some special river moments. When we turned around, I suspected my connection with rivers goes beyond the fact that I grew up beside one in my dad's village Neyyoor.

On our walk back to the school, few of us were surprised to know the mosquito ferns found in the paddy field are known as Azolla microphylla or fairy moss or duckweed fern. Knowing these are super plants that destroy mosquito larvae, I collected some for my mother's small fish pond. Duckweed has also been introduced into the paddy field as a non-chemical weed control strategy. It took some time for some of them to understand that duckweed fern and duckweed are two different aquatic plants. Since duckweeds can be used as a tool for phytoremediation of polluted water, I collected some for a pond that is close to my mom's house, in a village called Meycode.

In the words of Sudhamathy, the green warrior, "Today these students might perceive rivers as a thing of beauty but tomorrow they would be sure clean rivers are a necessity, they are the veins of the Earth." Given her commitment, she is sure that the urge to nurture rivers will be buried deep within the subconscious of all who experience a river walk.

I'm glad I walked the long walk along one of the earth's lifelines to reflect upon my ideas of protecting ecosystems and grow stronger with people who think the same. Throughout, I revelled in the sounds and stillness that surrounded Pahrali River.

Someday I wish to join Siddharth Agarwal in his epic walks, encourage many more to join the movement and together see and know what on earth we have put our rivers through. ■

Dr Elsa Lycias Joel regularly contributes articles in TerraGreen.

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